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제27차 대한산부인과초음파학회

추계학술대회

KOREAN SOCIETY OF ULTRASOUND IN OBSTETRICS AND GYNECOLOGY

Daegu

Date : 2024. **10. 18** Fri - **19** Sat

Venue : Hotel Inter-Burgo, Daegu

대한산부인과초음파학회

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모시는 글

존경하는 대한산부인과초음파학회 회원 여러분,

힘든 시기를 잘보내시고 계신지요?

기록적 무더위 또한 우리를 힘들게 하고 있습니다. 여러분을 제 27차 추계학술대회에 모시고자 합니다. 주변 환경이 우리를 힘들게 하고 있으나 언제나처럼 우리는 이 또한 이겨내리란 희망을 가져봅니다.

이번 학술 대회는 예전과 같이 expert meeting 과 같이 열리게 됩니다. 과거 expert meeting 에서는 논란의 여지가 있는 주제에 대한 전문가들의 토론을 주로 했다면 이번 모임에서는 초음파 영역에서 큰 변혁을 가져온 인공지능에 대하여 고찰해 보려합니다. 과거 전단계 인공지능은 machine learning 이라 불리며 자가 학습 기능은 없었으나 최근 개발된 인공지능은 스스로 학습하여 발전하는 개념입니다. 이러한 새로운 기술이 초음파 진단과 어떻게 접목되고 임상에서 이를 어떻게 응용하는지 알아보고자 합니다. 본 학술대회에서는 어려운 상황임에도 보내주신 많은 구연 및 포스터 연제들 중에 엄선된 주제들이 발표를 기다리고 있습니다.

오전에 진행되는 산과 keynote lecture는 최근 업데이트되고 이슈가 되는 주제들로 선정하였습니다. 태아의 성장을 평가하는 새로운 관점을 다루고, 임신 3삼분기 초음파검사의 업데이트된 가이드라인 및 짧은 자궁경부 길이를 가진 산모 처치의 최신 경향에 대해서 강의할 예정입니다.

오후 부인과 keynote lecture에서는 부인과적 임상에서 주로 활용될 수 있는 주제들로 준비하였습니다. 부인과 수술 중에 초음파를 적극적으로 활용하는 방법, 자궁에 생기는 양성 근종과 악성 종괴의 초음파적 구분 팁, 그리고 불임영역에서의 초음파 활용에 대해서 강의가 준비되어 있습니다. 또한, 재미있고 유익한 초음파 이미지들을 만나 보실 수 있도록 소중한 증례들로 꽉 채운 image contest를 기대하셔도 좋습니다.

많은 분들의 참여과 협력으로 우리 추계학술대회가 풍성하고 알차게 발전하고 있습니다. 다만 현재의 사회적 상황으로 직접 참여하시는 분들이 제한 될 것으로 판단되지만 한분 한분의 소중한 참여와 관심을 기대해 봅니다.

대한산부인과초음파학회 회장 **박 인 양**

제27차 대한산부인과초음파학회
추계학술대회
KOREAN SOCIETY OF ULTRASOUND IN OBSTETRICS AND GYNECOLOGY

대한산부인과초음파학회

제2차 Expert Meeting

| 일시 | **2024년 10월 18일 (금)**

| 장소 | **호텔인터불고대구 본관 1층 즐거운홀**

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| 장소 | **호텔인터불고대구 본관 2층 컨벤션홀**

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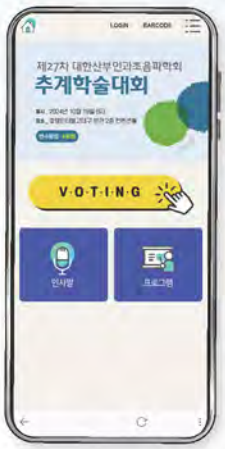


QR코드를 스캔해 주세요.

Voting 참여안내

안녕하세요. 대한산부인과초음파학회입니다.
2024년 10월 19일 진행되는 제27차 대한산부인과초음파학회
추계학술대회에 등록해주셔서 감사합니다.
위 보팅 웹에 접속하시어 당일 보팅에 활발한 참여를 부탁드립니다.
감사합니다.

스마트폰에서 https://www.jebook.kr/ksuog2024f.php에 접속하셔서 보팅에 참여해 주세요.

스마트폰에서 https://www.jebook.kr/ksuog2024f.php에 접속하셔서 보팅에 참여해 주세요.

Voting Web 이렇게 사용하세요!

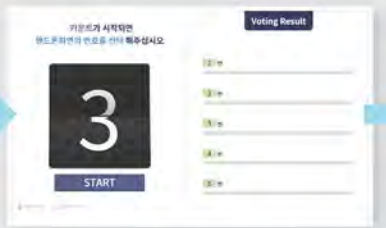
QR코드를 스캔 또는
Voting Web 주소에 접속합니다.

상단 Login 버튼을 눌러 로그인 합니다.
성함과 면허번호를 넣으시면 됩니다.
면허번호가 없는 분은 핸드폰 뒷자리
4자리를 넣어주세요

Voting이 진행되면
해당되는 번호를 클릭하면 됩니다.

Voting 참여방법

스크린에 START 화면이 보여집니다.



START 하면 숫자가 넘어가며
5초 이내에 Voting을 완료해야 합니다.

Voting이 완료되면 결과를
보실 수 있습니다.

강의 중 Voting이 시작되면 스마트폰에서
https://www.jebook.kr/ksuog2024f.php
에 접속하시고 참여해 주세요.

QR코드를
스캔해 주세요.

제27차 대한산부인과초음파학회
추계학술대회

제2차 Expert Meeting

Session I.

좌장 : 홍성연 (행복한병원)
이경아 (이화의대)

Korean Society of Ultrasound
in Obstetrics and Gynecology

CURRICULUM VITAE

조 금 준

1) 현직

고려대학교 구로병원 산부인과 교수

2) 학력

1995.3-2001.2	고려대학교 의학과 학사
2003.3-2005.2	고려대학교 산부인과학 석사
2009.9-2012.2	고려대학교 산부인과학 박사

3) 경력

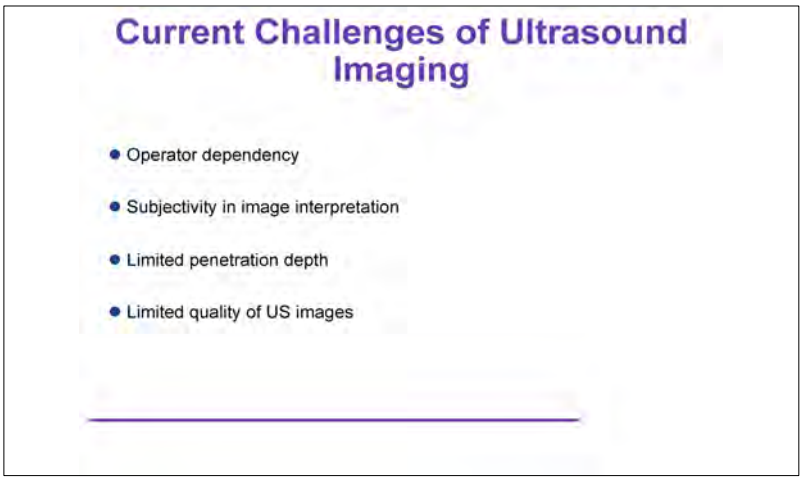
2002.3-2006.2	고려대학교 산부인과학교실 전공의
2006.4-2009.4	국군서울지구병원 군의관
2009.5-2011.2	고려대학교 구로병원 산부인과학교실 임상강사
2011.3-2012.2	고려대학교 구로병원 산부인과학교실 임상조교수
2012.3-2015.2	고려대학교 구로병원 산부인과학교실 조교수
2015.3-2020.2	고려대학교 구로병원 산부인과학교실 부교수
2020.3-현재	고려대학교 구로병원 산부인과학교실 교수
2017.9-2018.10	Northwestern university Visiting scholar

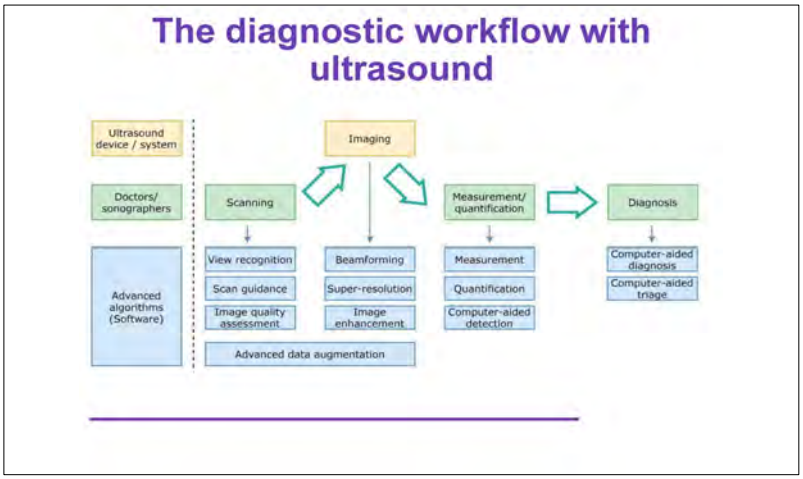
4) 학회 활동

대한산부인과학회 정회원
대한산부인과학회 학술 TFT 위원
대한산부인과초음파학회 정회원
대한산부인과초음파학회 서울지회 지회장
대한모체태아의학회 정회원
대한모체태아의학회 교육위원회 위원장
주산의학회 정회원
주산의학회 재정위원회 위원장

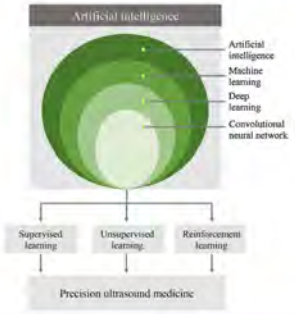
Understanding the development of AI in ultrasound

조 금 준
고려의대

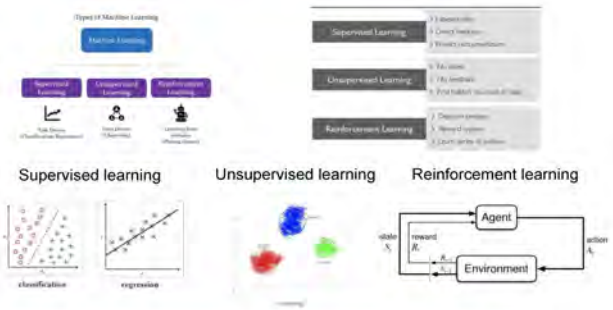




The hierarchical relationships

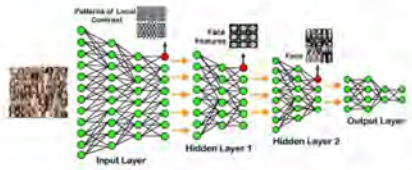


Machine Learning



Deep Learning

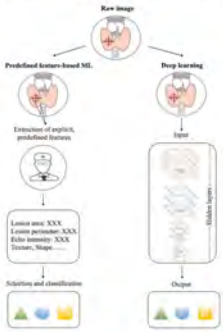
- Based on artificial neural network architecture
- Layers of interconnected nodes called neurons that work together to process and learn from the input data



Deep Learning

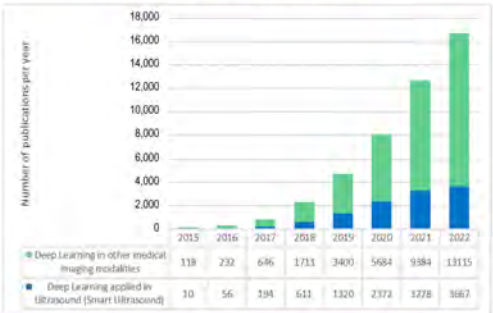
- Feedforward neural networks (FNNs): the simplest type of ANN, with a linear flow of information through the network (image classification speech recognition, and natural language processing)
- Convolutional Neural Networks (CNNs): specifically, for image and video recognition tasks and able to automatically learn features from the images (image classification, object detection and image segmentation)
- Recurrent Neural Networks (RNNs): able to process sequential data, such as time series and natural language (speech recognition, natural language processing and language translation)

Machine Learning vs Deep Learning

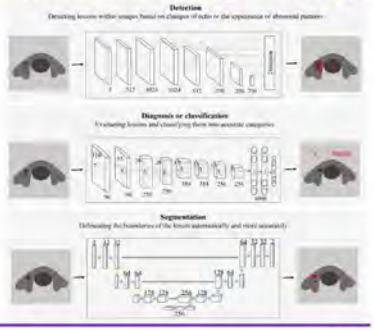


Machine learning	Deep learning
A subset of AI	A subset of machine learning
Can train on smaller data sets	Requires large amounts of data
Requires more human intervention to correct and learn	Learns on its own from environment and past mistakes
Shorter training and lower accuracy	Longer training and higher accuracy
Makes simple, linear correlations	Makes non-linear, complex correlations
Can train on a CPU (central processing unit)	Needs a specialized GPU (graphics processing unit) to train

PubMed with "deep learning" and "ultrasound"



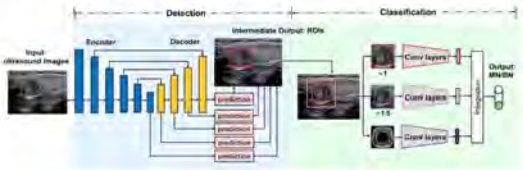
The three main applications of AI in ultrasonic image analysis



Eur J Radiol. 2021 Jun;139:109717.

Thyroid

- 7690 thyroid nodule images from 4279 patients, of which 5139 cases are malignant and 2551 cases are benign

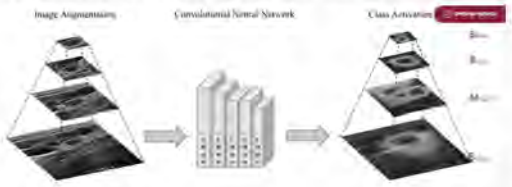


- the accuracy, sensitivity, and specificity of our model for predicting lymph node malignancy were 83.0%, 79.5%, and 87.5%, respectively

Med Image Anal. 2019 Dec;58:101555

Thyroid

- 804 consecutive patients with 812 lymph nodes.

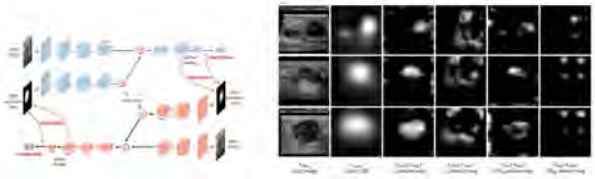


- the accuracy, sensitivity, and specificity of our model for predicting lymph node malignancy were 83.0%, 79.5%, and 87.5%, respectively.

Thyroid. 2018 Oct;28(10):1332-1338

Breast

- 8000 images from 2047 patients

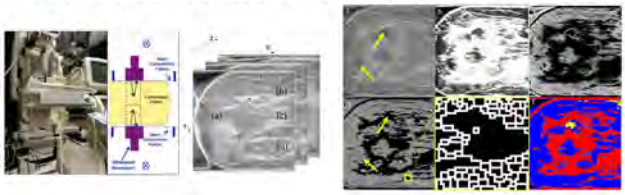


- the accuracy, sensitivity, and specificity of our model for predicting lymph node malignancy were 90.13%, 93.54%, and 83.18%, respectively.

Med Image Anal. 2019 Feb;52:185-198.

Breast

- A database of 21 cases of whole breast ultrasound



- an accuracy of 85.7%, an average similarity of 74.54%, consistent with values seen in MRI brain segmentations

Ultrasonics. 2016 Feb;65:51-8.

Breast

Advanced early lesion detection featuring with Live BreastAssist™

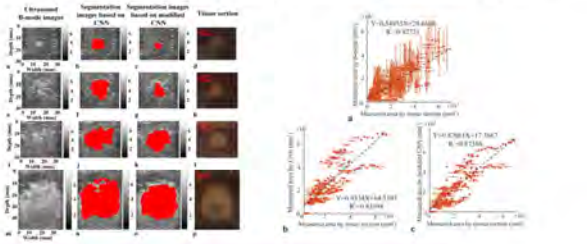
Abdomen and pelvis

- The machine learning applications in abdomen and pelvis and obstetrics ultrasonic image analysis in the papers surveyed

Organ system and body location	Disease classification	Object detection	Image segmentation	Prognosis evaluation
Abdomen and pelvis	Classification of liver fibrosis [84,85]	Detection of fatty liver disease [101]	Segmentation of US prostate [92,142,143]	Monitoring of thermal lesions induced by microwave ablation [91].
	Classification of benign and malignant focal liver lesions [87,144]	Detection of thermal lesions induced by microwave ablation [91]	Segmentation of US kidney [145]	Prediction of responses to TACE for hepatocellular carcinoma patients [146]
	Risk stratification of fatty liver disease [141]	Detection of image registration for prostate radiotherapy [147]		
	Classification and Prediction of kidney function or disease [140,149]	Detection of prostate image registration [150]		
	Classification of three classes of kidney ultrasound images [126]	Detection of prostate cancer [151]		

Abdomen and pelvis

- US imaging based on a CNN architecture for the detection and monitoring of thermal lesions induced by microwave thermal ablation



IEEE J Biomed Health Inform. 2020 Apr;24(4):965-973

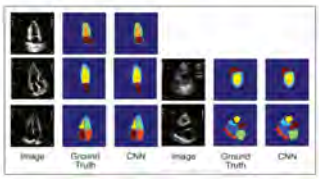
Heart and blood vessels and musculoskeletal system

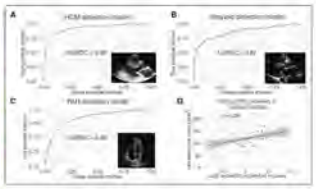
- The machine learning applications in heart and blood vessels and musculoskeletal system as well as other organ systems ultrasonic image analysis in the papers surveyed

Organ system and body location	Disease classification	Object detection	Image segmentation	Prognosis evaluation
Heart	View classification of echocardiograms [98,108]	Detection of heart disease [98,103, 104]	Segmentation of the ventricle of the heart [106]	
	Classification of myocardial wall motion [100,102]		Segmentation of left ventricle and left atrium [109]	
	Diagnosis of ventricular volume [101]			
Blood vessels	Classification of carotid artery intima-media thickness [132]	Detection of vascular lumen [109]	Segmentation of lumen-intima and media-adventitia [110,111,112]	
	Characterization of plaque composition in vascular [108]		Segmentation of vascular structure [113]	
Musculoskeletal system	Diagnosis of myositis from muscle US [114]	US-assisted vertebral body positioning [116]	Segmentation of rectus femoris muscle [118]	
	Estimation of skeletal muscle status [115]	Detection and identification of spine level [117]	Segmentation of pubocerctalis muscle and urogenital hiatus [119]	
	Classification of pediatric pneumonia [120]	Improve US imaging contrast and detection rate [124]	Segmentation of subpleural pulmonary lesions [121]	
Other organ systems or body location	Assessment and diagnosis of lung US [122,123]			

Heart

- A database of 14035 echo studies



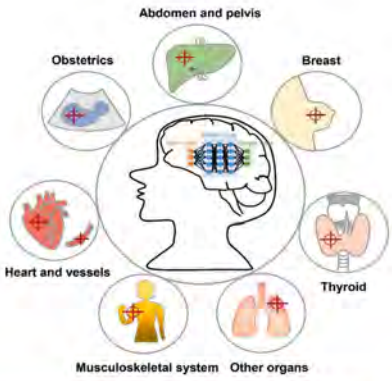


- The groundwork for using automated interpretation to support serial patient tracking and scalable analysis of millions of echocardiograms archived within healthcare systems

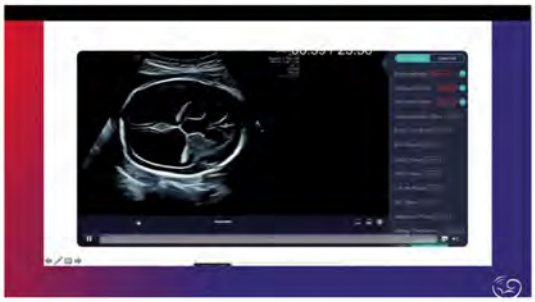
Circulation. 2018;138:1623–1635.

Musculoskeletal system

Deep learning based nerve Segmentation algorithm in real-time that supports treatment procedures



AI & Ultrasound

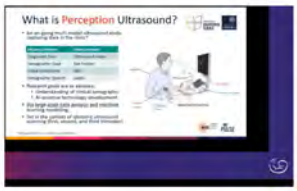


ISUOG 2020

AI & Ultrasound

ISUOG 2020

AI & Ultrasound



ISUOG 2020

Image Enhancement

- One of the primary applications of AI in ultrasound is image enhancement.
- Traditionally, the quality of ultrasound images was heavily reliant on the skill of the operator.
- However, AI algorithms can now process raw ultrasound data to produce clearer, more detailed images.

Image Enhancement

- For example, GE Healthcare's LOGIQ E10 employs AI algorithms to reduce noise and improve the contrast in images, which can be particularly helpful in visualizing small structures or assessing blood flow.

Automated Measurements

- Taking measurements from ultrasound images can be a time-consuming and often error-prone process.
- AI is being used to automate this process, thus increasing efficiency and reducing the likelihood of errors.
- AI algorithms can detect the edges of organs, measure their dimensions, and calculate volumes with a high degree of accuracy.

Decision Support and Diagnostic Aids

- One of the most exciting applications of AI in ultrasound is its ability to assist in making diagnoses.
- By learning from large datasets of ultrasound images, AI algorithms can identify patterns associated with various conditions.
- This allows them to provide real-time decision support to clinicians.

Decision Support and Diagnostic Aids

- Koios DS Breast 2.0 utilizes AI to analyze and classify breast ultrasound images, helping radiologists make more accurate diagnoses of breast cancer.

Portability and Accessibility

- The integration of AI with portable ultrasound devices is helping to bring high-quality imaging to locations where traditional ultrasound machines are not practical.
- Devices like Mindray M9 are compact and very portable.
- The embedded AI helps ensure that even though the hardware might be smaller and less sophisticated, the images produced are still of high quality.
- This is particularly important in remote areas with limited access to healthcare.

Am J Obstet Gynecol 2009; 200:156.e1–4.

Workflow Optimization

- AI is also being used to streamline the ultrasound imaging process. It can automate several tasks such as patient data entry, image labeling, and report generation.
- This not only reduces the burden on the sonographers but also minimizes the chances of manual errors.

The Future Ahead

- As AI algorithms continue to evolve, we can expect them to play an even more significant role in ultrasound imaging.
- While AI is unlikely to replace human expertise entirely, it will serve as a valuable tool in aiding clinicians in making faster, more accurate, and more informed decisions.

Conclusion

- AI's integration into ultrasound systems represents a paradigm shift in the way healthcare professionals approach diagnostic imaging.
- Through image enhancement, automated measurements, decision support, increased accessibility, and workflow optimization, AI not only augments the capabilities of clinicians but also has the potential to greatly improve patient outcomes.
- The harmony between AI and ultrasound is poised to unlock new frontiers in medical imaging and patient care.

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AI in the first trimester

홍 수 빈
가톨릭의대

The primary purposes of a first-trimester ultrasound scan are confirming viability and plurality, accurate pregnancy dating, screening for aneuploidies, identification of major anomalies, and screening for preterm pre-eclampsia.[1] According to the 2023 International Society of Ultrasound in Obstetrics and Gynecology (ISUOG) practice guidelines, minimum scanning standards for the head, neck, heart, abdomen, extremities, placenta, and biometry are outlined (Table). The most critical goal of a first-trimester fetal anatomy scan is the early detection of fetal anomalies, enabling earlier genetic diagnosis and allowing more time for parental counseling and decision-making.

The first trimester is a period when the fetus undergoes rapid organogenesis, and most structures can be visualized via ultrasound between 11 and 14 weeks, especially when assessing nuchal translucency. However, optimal visualization of many anatomical details by ultrasound is typically achieved around 13 weeks of gestation. The sensitivity of anomaly detection during first-trimester scans is reported to be 61% in high-risk populations and 32% in low-risk populations.[2] Larger anomalies, such as acrania and anencephaly, are typically detected in the first-trimester ultrasound, whereas conditions like agenesis of the corpus callosum, cerebellar hypoplasia, and renal agenesis have lower detection rates.[3]

With recent advancements in artificial intelligence (AI) technology, these innovations are also being applied in fetal ultrasound imaging. Among AI techniques, deep learning (DL) is widely used for image analysis.[4] DL technology is being developed to automatically measure anatomical structures, identify the correct scanning planes, and detect fetal

Table. ISUOG minimum requirements for scan at 11 + 0 to 14 + 0 weeks' gestation

Anatomical Region	Minimum Requirements for Scan
General	Confirm singleton pregnancy
Head and Brain	Axial view of head:
	- Calcification of cranium
	- Contour/shape of cranium (with no bony defects)
	- Two brain halves separated by interhemispheric falx
	- Choroid plexuses almost filling lateral ventricles in their posterior two-thirds (butterfly sign)
Neck	Sagittal view of head and neck:
	- Confirm whether nuchal translucency thickness 〈 95th percentile
Heart	Axial view of heart at level of four-chamber view:
	- Heart inside chest with regular rhythm
Abdomen	Axial view:
	- Stomach visible
	- Intact abdominal wall
	Axial or sagittal view:
	- Bladder visible and not dilated
Extremities	Visualize four limbs, each with three segments
Placenta	Ascertain normal appearance without cystic structures
Biometry	Sagittal view:
	- Crown-rump length and nuchal translucency thickness
	Axial view:
	- Biparietal diameter

structures.[5] The use of DL for identifying fetal structures offers significant advantages, including reducing observer variability and shortening observation time.

Several studies have recently explored the use of AI in first-trimester fetal ultrasound imaging. Lin et al. developed a novel model for identifying fetal head structures during the 11-14 week gestational period.[6] Their model accurately detected key structures such as the thalami, midbrain, palate, fourth ventricle, cisterna magna, nuchal translucency, nasal tip, nasal skin, and nasal bone, with an AUC of 0.9774, performing at a level comparable to senior radiologists. Other significant advancements include Liu et al.'s Attention Fusing and Guided filtering (AFG)-net model, which successfully segmented the gestational sac, yolk sac, and embryo regions during the embryonic stage, achieving a measurement error of only 0.66 mm.[7] Yang et al. employed 3D Fully Convolutional Networks (FCN) and

Recurrent Neural Networks (RNN) to improve the segmentation of complex fetal anatomy, such as the fetus, gestational sac, and placenta.[8] Ryou et al. also developed a Fully Convolutional Network algorithm that achieved high accuracy in segmenting the brain, abdomen, and limbs from 3D fetal volumes, with automated measurements closely matching manual ones.[9] Additionally, Tsai et al. developed a deep learning-based system using a Generative Adversarial Network (GAN) to automatically detect the fetal middle sagittal plane (MSP) in 3D ultrasound images, achieving 98.6% accuracy and significantly reducing the time required for analysis.[10]

Recently, at the 2023 ISUOG Congress, a South Korean study reported on a technology that automatically recognizes and segments fetal structures during the first trimester (Figure). For this research, ultrasound images of over 10,000 first-trimester fetuses were prospectively collected from Seoul St. Mary's Hospital, Eunpyeong St. Mary's Hospital, Uijeongbu St. Mary's Hospital, and Bucheon St. Mary's Hospital. Using You Only Look At Coefficients (YOLACT), a model was developed and validated to classify and segment first-trimester structures. The model achieved a classification accuracy of 96.8% and a Mean Average Precision (mAP) of 0.699 at an Intersection over Union (IoU) threshold of 0.5.

These recent efforts hold significant value in promoting the use of first-trimester screen-

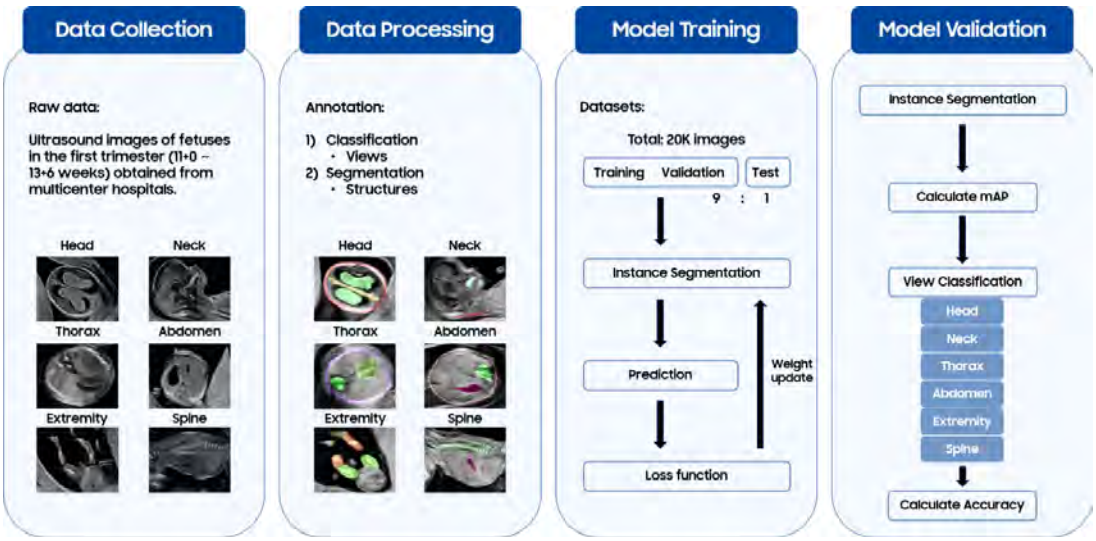

Figure. Overview of first-trimester fetal structural classification and segmentation using the YOLACT model

ing, enabling quicker and more accessible diagnoses. Despite these advantages, there are important considerations and limitations in using ultrasound during the first trimester. Since fetal structures are continuously developing, anomalies detected in the first trimester may resolve and appear normal by the second trimester, warranting careful interpretation. Additionally, it is crucial to remember that excessive concern from both healthcare providers and parents over first-trimester findings could potentially lead to fetal termination, highlighting the need for balanced and informed decision-making.

In conclusion, AI technology, particularly through DL techniques, has the potential to enhance the interpretation of fetal ultrasound images. Current research focuses on using DL for standard view detection, biometry estimation, and structural analysis of the fetus. These advancements allow for rapid and accurate measurements of fetal size and early detection of anomalies. While fetal imaging in the second trimester has been extensively studied and is being applied in clinical practice, further research is needed to optimize the use of this technology for first-trimester fetal imaging.

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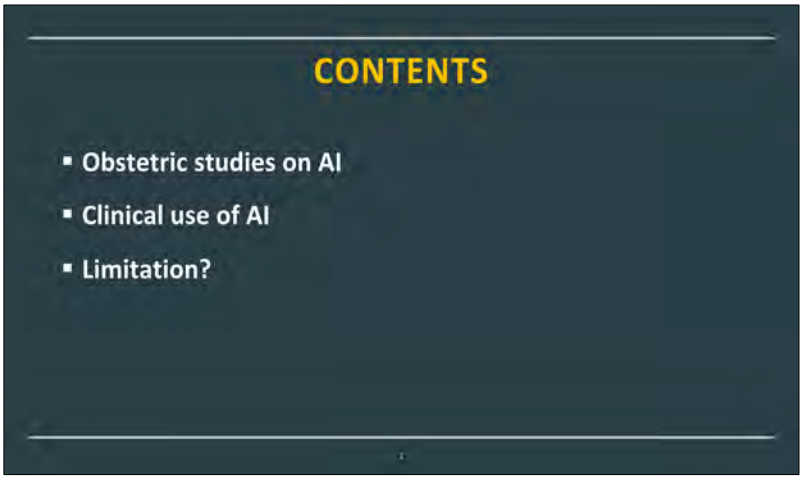
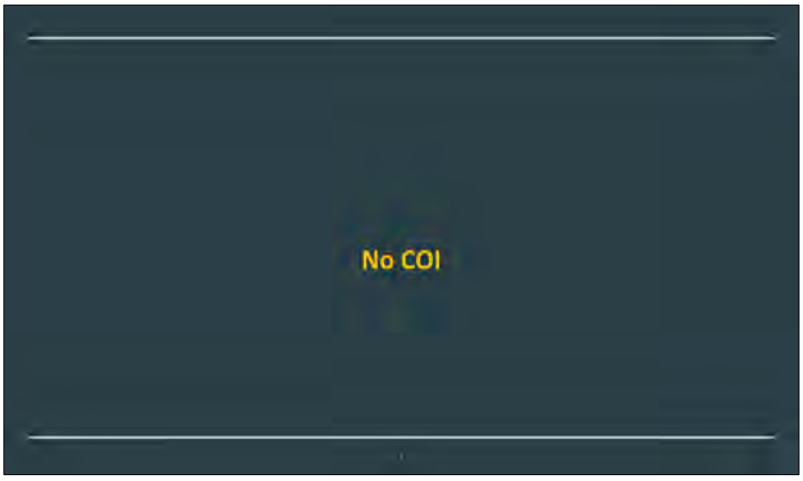
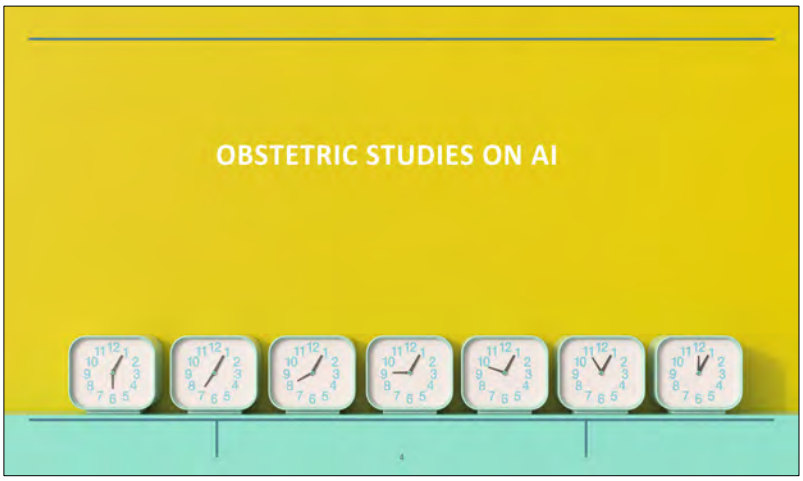
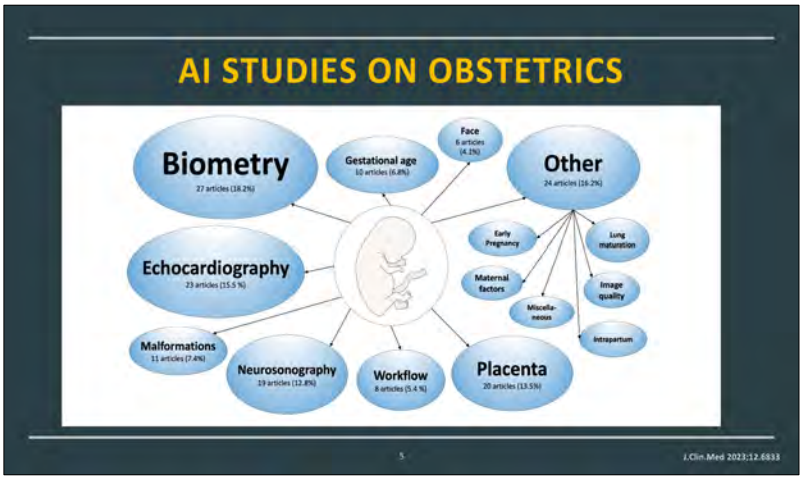
AI in the second & third trimester

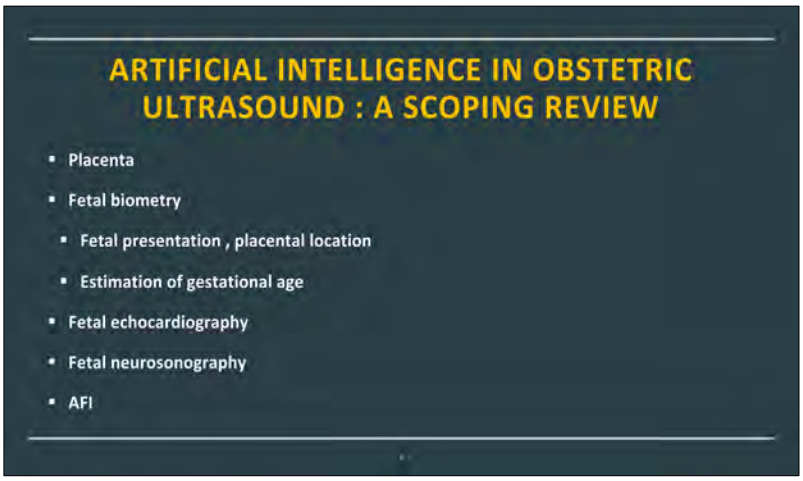
차 현 화
경북의대






OBSTETRIC STUDIES ON AI


AI STUDIES ON OBSTETRICS
Biometry
27 articles (18.2%)
Gestational age
10 articles (6.8%)
Face
6 articles (4.1%)
Other
24 articles (16.2%)
Early Pregnancy
Lung maturation
Maternal factors
Image quality
Miscella-neous
Intrapartum
Echocardiography
23 articles (15.5 %)
Malformations
11 articles (7.4%)
Neurosonography
19 articles (12.8%)
Workflow
8 articles (5.4 %)
Placenta
20 articles (13.5%)
i.Clin.Med 2023;12.6833


ARTIFICIAL INTELLIGENCE IN OBSTETRIC ULTRASOUND : A SCOPING REVIEW
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Estimation of gestational age
Fetal echocardiography
Fetal neurosonography
AFI

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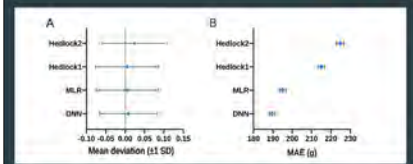

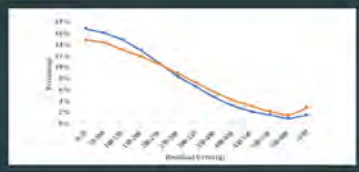

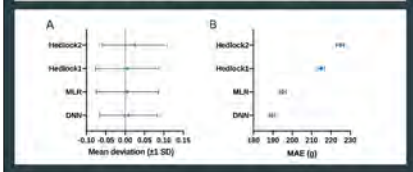

- 189.64 g vs 240.36 g
- 5.79% vs 6.46%

BMC pregnancy and Childbirth 2023;23:560

GA PREDICTION

Technol Health Care. 1998 Aug;4(2):223-31.

An intelligent diagnostic system for the assessment of gestational age based on ultrasonic fetal head measurements

M S Beksaç [1], Z Odçiçin, A Egemen, U Karakaş

Abstract

The object of this study is the assessment of gestational age by using fetal biparietal diameter and head circumference based on automated image analysis and artificial neural networks. Standard ultrasonic measurements were made in 143 normal fetuses between 14 and 40 weeks' gestation. Six hundred and thirteen fetal head images were transferred to a microcomputer environment by means of a frame grabber and spatial software. Biparietal diameter and head circumference measurements were made by automated image processing and analysis techniques. In the next stage, these two fetal parameters were used to determine the gestational age by using an unsupervised artificial neural network. Back propagation learning algorithm was trained by 552 fetal head images and the system was tested with the remaining 61 images. It has been demonstrated that 98% of gestational weeks were estimated correctly by our system.

- PA 14 – 40 weeks
- N=143 , 613 images
- 98% accuracy

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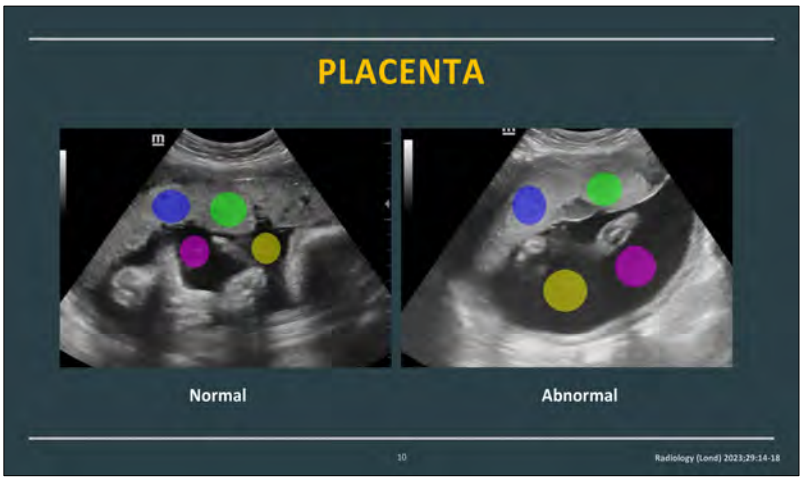
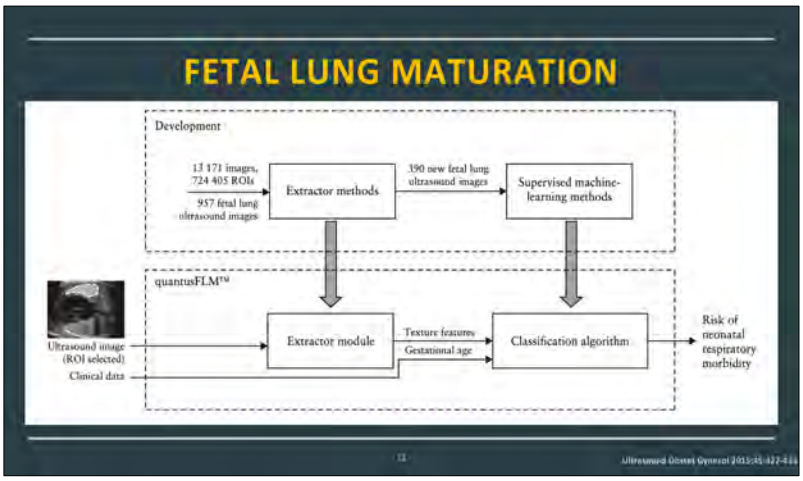
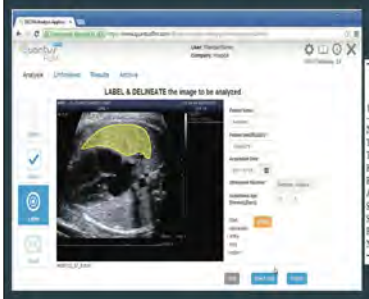


PLACENTA

Texture descriptors	Sensitivity (%)	Specificity (%)	AREA UNDER the curve (AUC)
ANN			
Co-occurrence matrix	83.10	82.90	0.866
Absolute gradient	80.79	79.10	0.793
Histogram	90.04	80.10	0.936
Run length matrix	96.41	92.60	0.961
K-NN			
Co-occurrence matrix	99.84	99.58	0.998
Absolute gradient	97.78	96.49	0.998
Histogram	99.96	99.89	0.999
Run length matrix	99.28	98.49	0.999



FETAL LUNG MATURATION

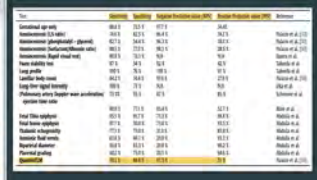


Variable	Gestational age at US (weeks) 28+0 to 39+0 (n = 144)	28+0 to 33+6 (n = 38)	34+0 to 39+0 (n = 106)
Neonatal respiratory morbidity (n (%))	29 (20.1)	21 (55.3)	8 (7.5)
True positive (n)	25	19	6
True negative (n)	100	16	84
False positive (n)	15	1	14
False negative (n)	4	2	2
Accuracy (%)	86.8	92.1	84.9
Sensitivity (%)	86.2	90.5	75.0
Specificity (%)	87.0	94.1	85.7
Positive predictive value (%)	62.5	95.0	30.0
Negative predictive value (%)	96.2	88.9	97.7

13

Ultrasound Obstet Gynecol 2015;45:427-433

FETAL LUNG MATURATION



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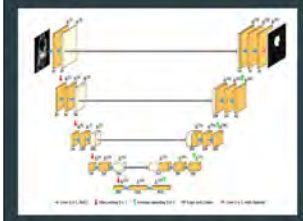
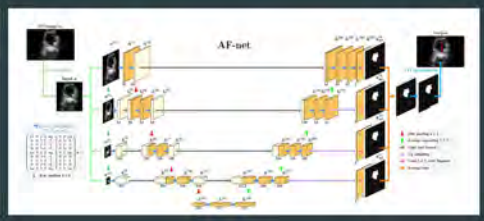
Eur J Obstet Gynecol Reprod Biol 2021;258:343-347

AUTOMATED ASSESSMENT OF AFI



U-net



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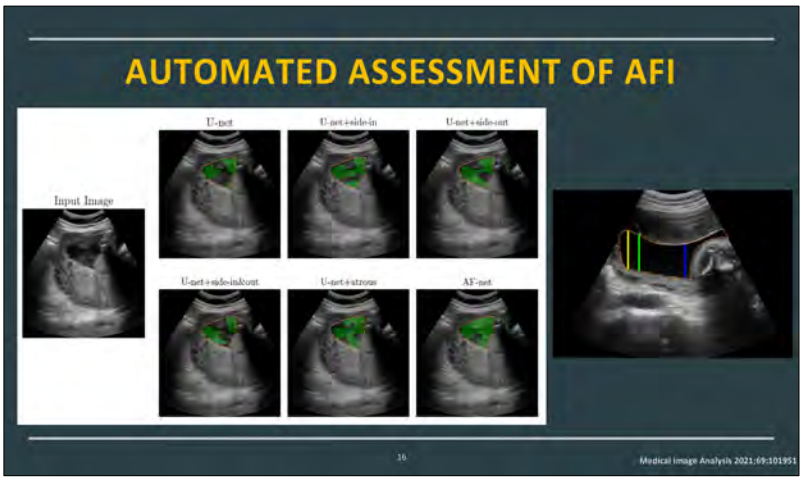
Medical Image Analysis 2021;69:101951


AUTOMATED ASSESSMENT OF AFI
Input Image
U-net
U-net+side-in
U-net+side-out
U-net+side-inout
U-net+atrous
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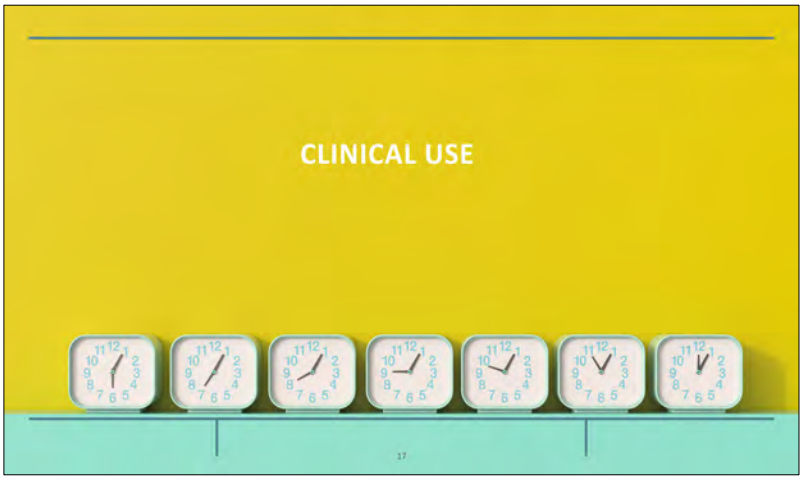
16
Medical image Analysis 2021;69:101951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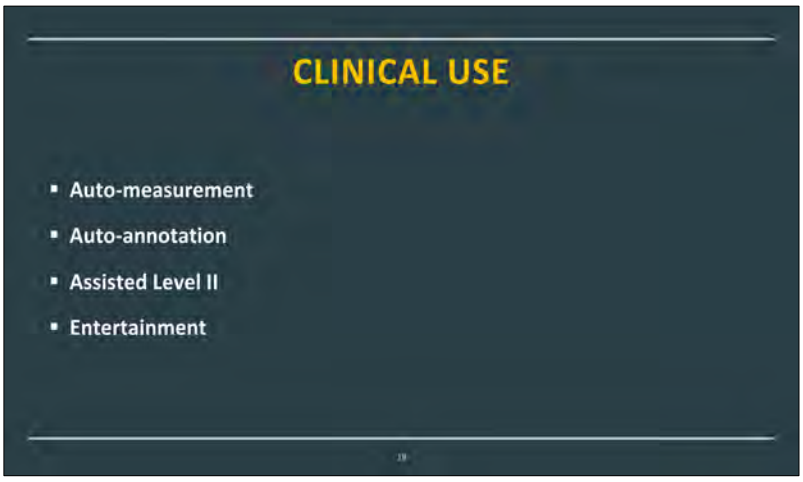
CLINICAL USE
Auto-measurement
Auto-annotation
Assisted Level II
Entertainment
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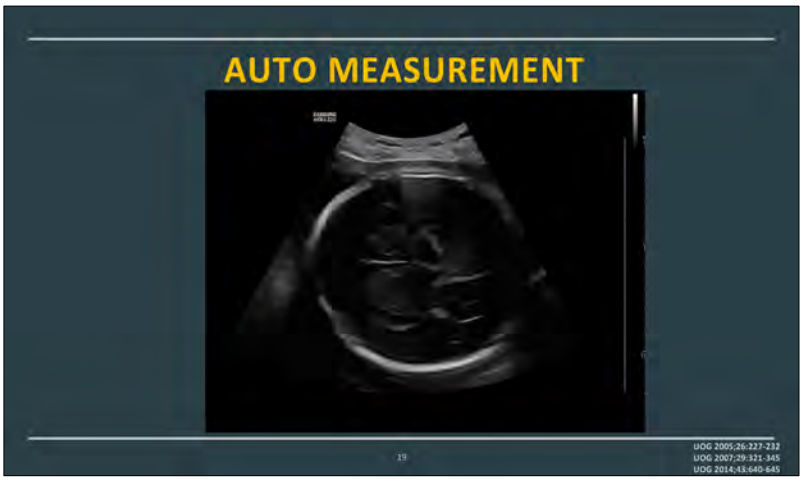
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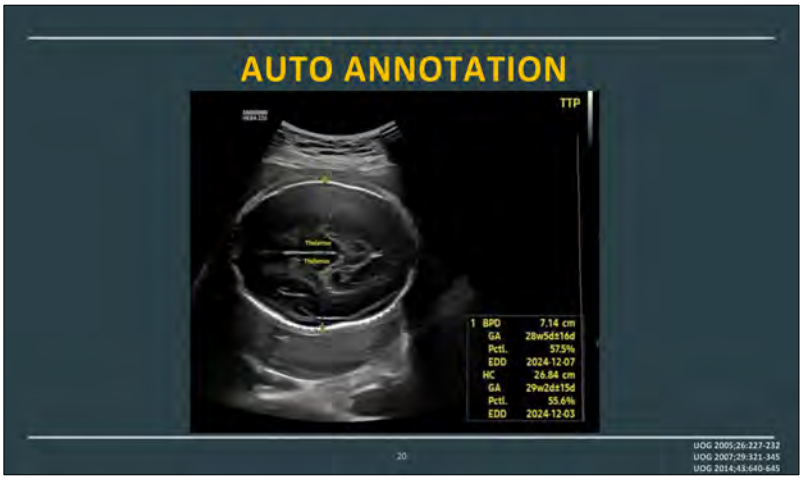
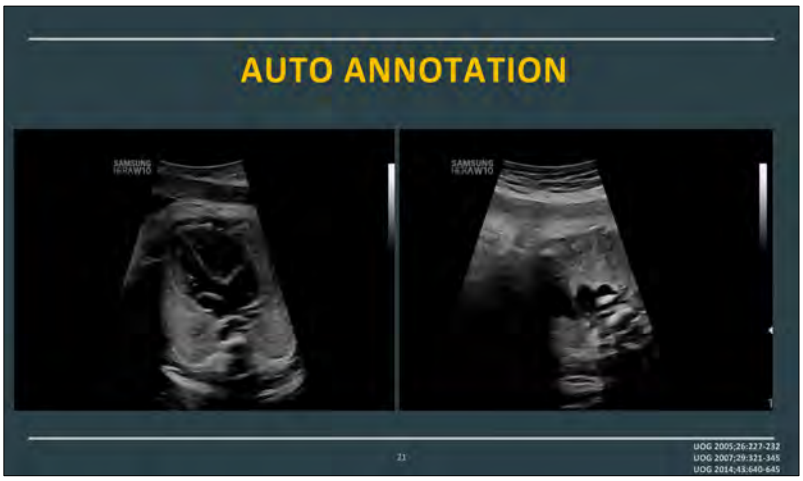
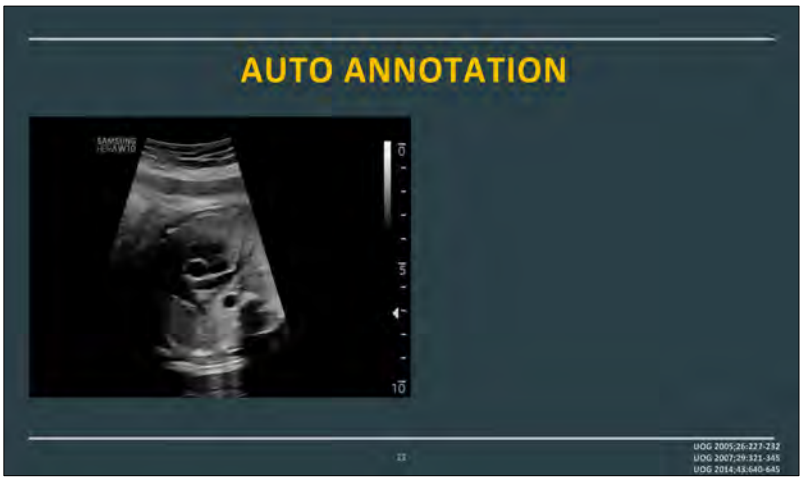
19
UOG 2005;26:227-232
UOG 2007;29:321-345
UOG 2014;43:640-645


AUTO ANNOTATION
TTP
1 BPD 7.14 cm
GA 28w5d±16d
Pctl. 97.5%
EDD 2024-12-07
HC 26.84 cm
GA 29w2d±15d
Pctl. 55.6%
EDD 2024-12-03
20
UOG 2005;26:227-232
UOG 2007;29:321-345
UOG 2014;43:640-645


AUTO ANNOTATION
21
UOG 2005;26:227-232
UOG 2007;29:321-345
UOG 2014;43:640-645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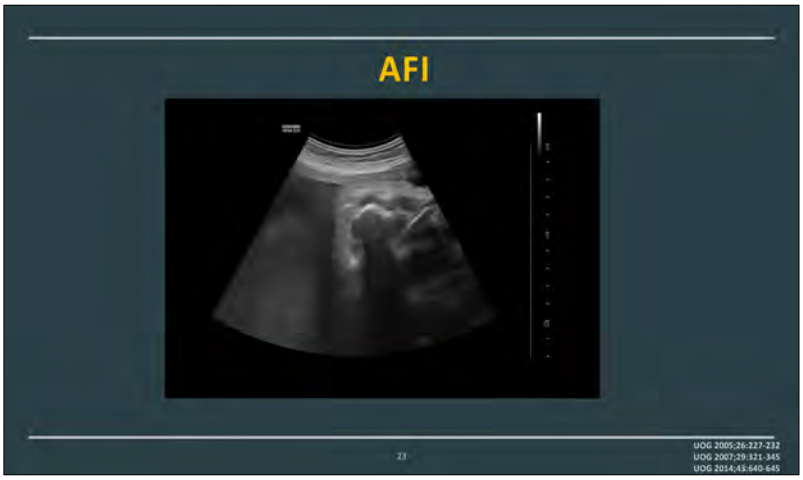
UOG 2007;29:321-345
UOG 2014;43:640-645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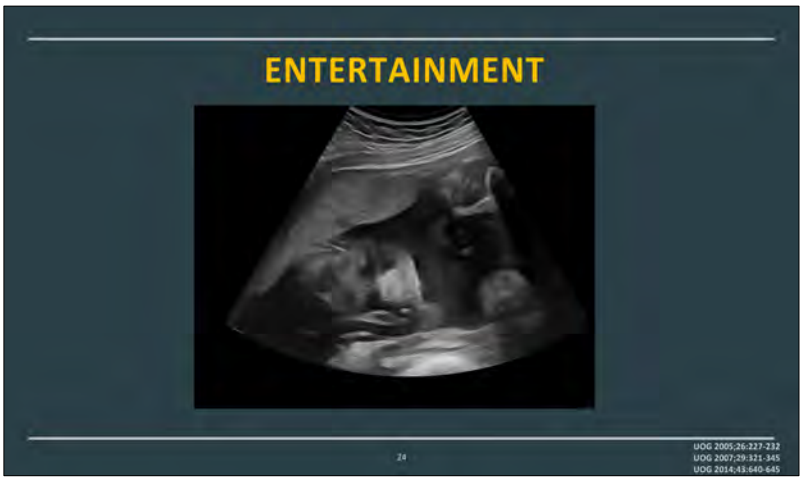
UOG 2005;26:227-232
UOG 2007;29:321-345
UOG 2014;43:640-645


ENTERTAINMENT
UOG 2005;26:227-232
UOG 2007;29:321-345
UOG 2014;43:640-645

ENTERTAINMENT

UOG 2005;26:227-232
UOG 2007;29:321-345
UOG 2014;43:640-645

LIMITATION

- Anomaly
- Laterality

결론

- AI application _ fetal biometry, echocardiography, neurosonography
- Estimation of GA

CURRICULUM VITAE

이 미 영

1) 현직

울산대학교 의과대학 서울아산병원 산부인과 부교수

2) 학력

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2009.3-2011.2	울산대학교 산부인과학 석사
2011.3-2017.2	울산대학교 산부인과학 박사

3) 경력

2006.3-2007.2	인하대학교병원 인턴
2007.3-2011.2	서울아산병원 산부인과 전공의
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2013.3-2016.2	서울아산병원 산부인과 임상전임강사
2016.3-2021.2	서울아산병원 산부인과 임상조교수
2021.3-	서울아산병원 산부인과 부교수
2022.9-2023.8	Rady Children's Hospital of San Diego 연수 (pediatric cardiology)

4) 학회 활동

대한산부인과초음파학회 학술위원회 & 산과초음파연구회 위원
대한모체태아의학회 태아치료연구회 간사, 윤리위원회 위원
대한주산의학회 학술위원회 & 발전위원회 위원

AI enhanced detection of CHD in second trimester ultrasound

이 미 영

울산의대

Congenital heart disease (CHD) is one of the most critical conditions affecting newborns, and early detection during pregnancy is essential for improving survival rates and outcomes. While fetal echocardiography is a reliable tool for detecting up to 85% of fetal cardiac abnormalities, its accuracy can be limited by factors such as fetal position, maternal conditions, and operator expertise. Recent advances in artificial intelligence (AI) offer a transformative solution by automating and standardizing fetal heart assessments, improving diagnostic accuracy, and bridging regional skill gaps among examiners. AI-enhanced echocardiography not only accelerates diagnosis but also paves the way for earlier intervention, potentially revolutionizing prenatal care for CHD. This presentation will explore the latest applications of AI in fetal echocardiography and its future potential to enhance prenatal diagnostic practices.

제27차 대한산부인과초음파학회
추계학술대회

제2차 Expert Meeting

Session II.

좌장 : 조시현 (연세의대)
배진곤 (계명의대)

Korean Society of Ultrasound
in Obstetrics and Gynecology

CURRICULUM VITAE

권 자 영

1) 현직

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연세대의료원 디지털헬스실 디지털헬스케어혁신연구소 스마트헬스케어 사업단장

2) 학력

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2001.9-2003.8	연세대학교 산부인과학 석사
2003.9-2008.2	연세대학교 산부인과학 박사

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2004.3-2006.2	연세대학교 세브란스병원 임상강사
2008.3-2009.2	연세대학교 의과대학 산부인과 전임강사
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2015.3-2018.2	연세대학교 의과대학 산부인과 부교수
2014.10-2016.10	Yale University Medical School, Department of Obstetrics, Gynecology, and Reproductive sciences, USA 연수

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4) 학회활동

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대한산부인과학회 학술TF 위원

대한산부인과학회 윤리위원회 간사

대한생식면역학회 학술위원

세계산부인과초음파학회(ISUOG) Accreditation & Certification Subcommittee 위원

Fetal Brain: All you need to know about AI-assisted fetal brain screening

권 자 영

연세의대

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조 현 진

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1994.3-2000.2	부산대학교 의학과 학사
2005.3-2007.2	울산대학교 산부인과학 석사
2010.3-2014.2	부산대학교 산부인과학 박사

3) 경력

2000.3-2001.2	울산대학교 서울아산병원 인턴
2001.3-2005.2	울산대학교 서울아산병원 산부인과 전공의
2005.3-2006.2	울산대학교 서울아산병원 산부인과 모체태아의학 임상강사
2010.3-2012.2	인제대학교 해운대백병원 산부인과 전임강사
2012.3-2017.2	인제대학교 해운대백병원 산부인과 조교수
2015.8-2016.7	UC Irvine, perinatal research lab 연수
2017.3-2022.3	인제대학교 해운대백병원 산부인과 부교수
2017.3-현재	인제대학교 해운대백병원 태아치료센터 센터장
2022.4-현재	인제대학교 해운대백병원 산부인과 교수
2024.2-현재	인제대학교 해운대백병원 고위험산모신생아통합치료센터 센터장

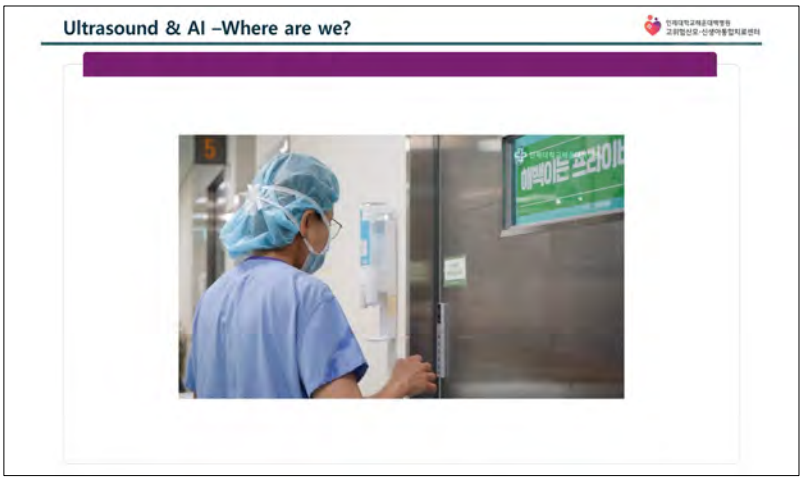
4) 학회 활동

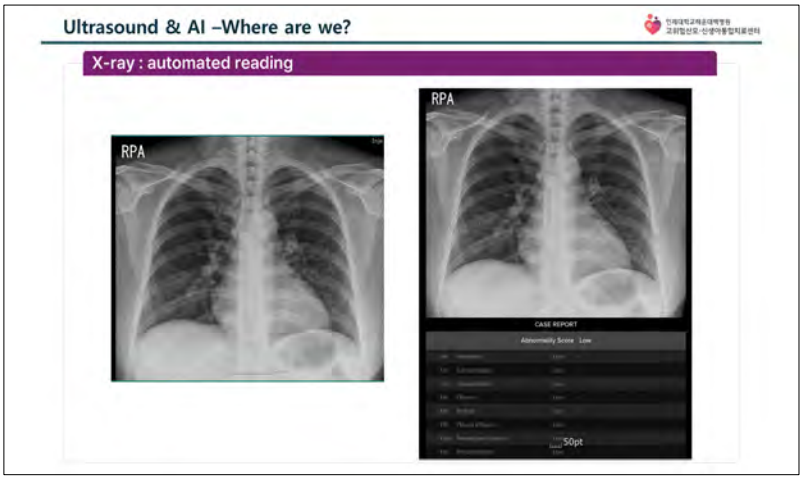
대한산부인과초음파학회 부산경남 지회장

Ultrasound and AI – Where are We ?

조 현 진

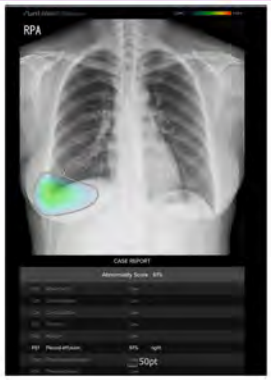
인제의대





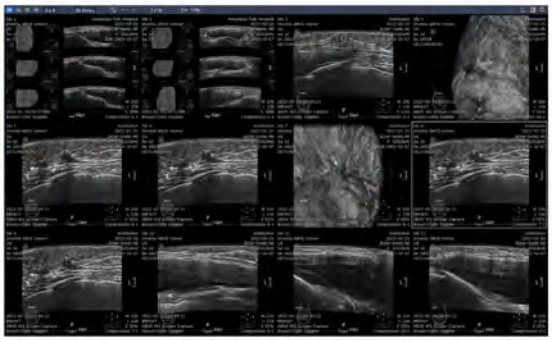
Ultrasound & AI –Where are we?

X-ray : automated reading



Ultrasound & AI –Where are we?

Breast Ultrasound : automated reading



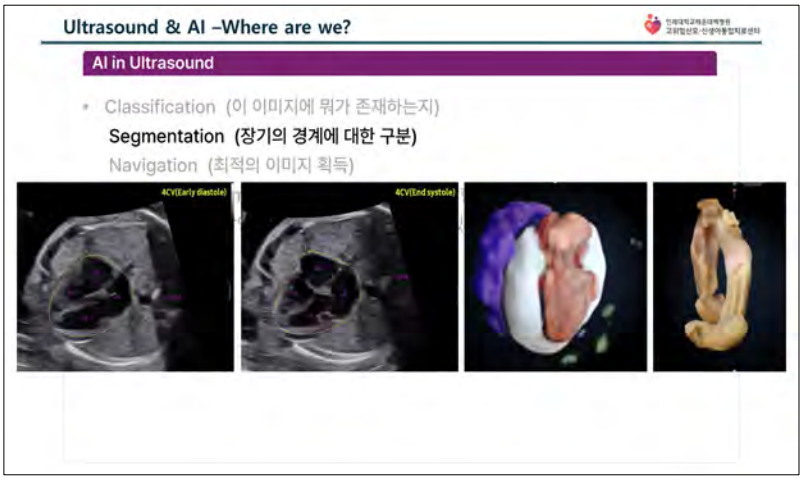
Ultrasound & AI –Where are we?

Ultrasound

- CT, X-ray :
  Automated reading

- USG:
  Classification (이 이미지에 뭐가 존재하는지)
  Segmentation (장기의 경계에 대한 구분)
  Navigation (최적의 이미지 획득)
  Quality Assessment (이 이미지가 진단에 적합한가)
  Diagnosis (정상인가 비정상인가, 어떤 문제가 있는가)


Ultrasound & AI –Where are we?
AI in Ultrasound
• Classification (이 이미지에 뭐가 존재하는지)
Segmentation (장기의 경계에 대한 구분)
Navigation (최적의 이미지 획득)
Placenta
Foot
W 256


Ultrasound & AI –Where are we?
AI in Ultrasound
• Classification (이 이미지에 뭐가 존재하는지)
Segmentation (장기의 경계에 대한 구분)
Navigation (최적의 이미지 획득)
4CV(Early diastole)
4CV(End systole)


Ultrasound & AI –Where are we?
AI in Ultrasound
• Classification (이 이미지
Segmentation (장기의 경
Navigation (최적의 이미지
Quality Assessment (이
Diagnosis (정상인가 비정
Foot
Foot

Ultrasound & AI –Where are we?

AI in Ultrasound

- Classification (이 이미지에 뭐가 존재하는지)
  Segmentation (장기의 경계에 대한 구분)
  Navigation (최적의 이미지 획득)
  Quality Assessment (이 이미지가 진단에 적합한가)
  Diagnosis (정상인가 비정상인가, 어떤 문제가 있는가)

Ultrasound & AI –Where are we?

AI in Ultrasound

- 정지 화면에서 장기의 구분이 되는가?
- 정지 화면에서 측정이 되는가?
- 실시간 영상에서 장기의 구분이 되는가?
- 실시간 영상에서 가장 좋은 view를 선택할 수 있는가?
- 실시간 화면에서 측정이 가능한가?
- 그 외 기능은?
- 비정상을 진단할 수 있는가?

Ultrasound & AI –Where are we?

기존의 EFW 측정

Ultrasound & AI –Where are we?

Automated measurement

- 정지 화면에서 장
- 정지 화면에서 측
- 실시간 영상에서
- 실시간 영상에서
- 실시간 화면에서
- 실시간 화면에서
- 비정상을 진단할
- 그 외 기능은?

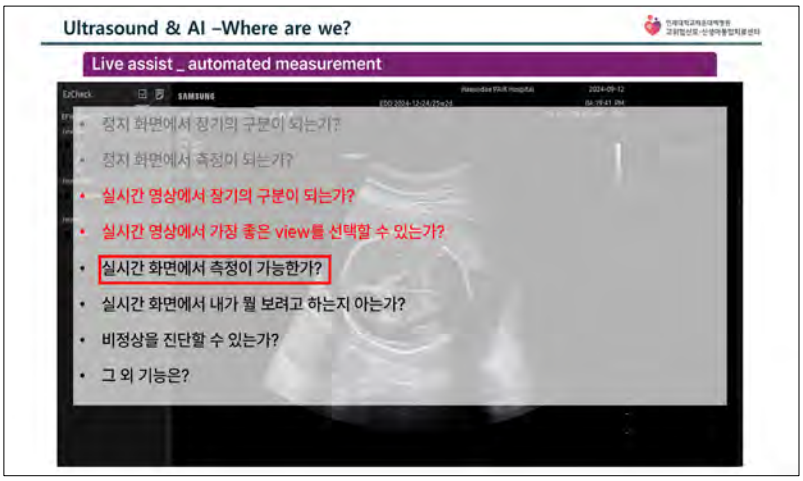
Ultrasound & AI –Where are we?

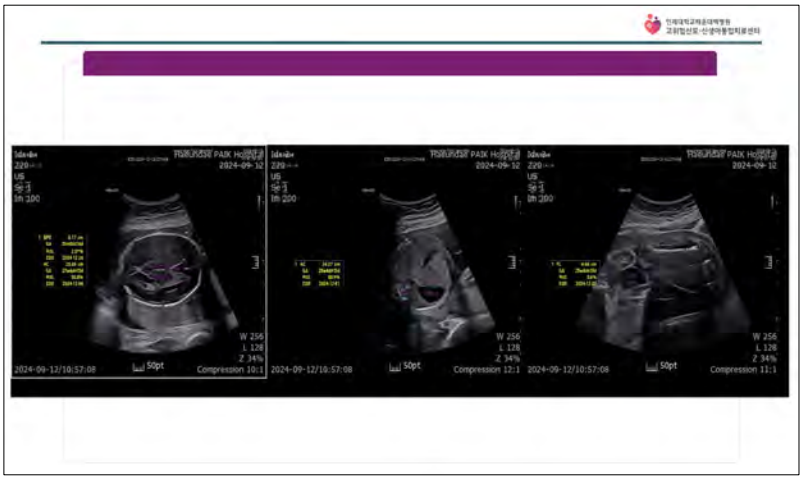
Automated measurement

- 정지 화면에서 장기의 구분이 되는가? Y
- 정지 화면에서 측정이 되는가? Y

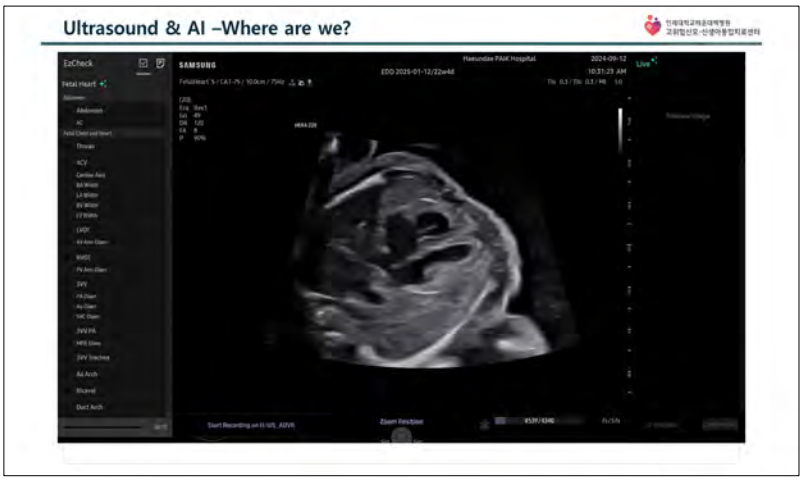
Ultrasound & AI –Where are we?

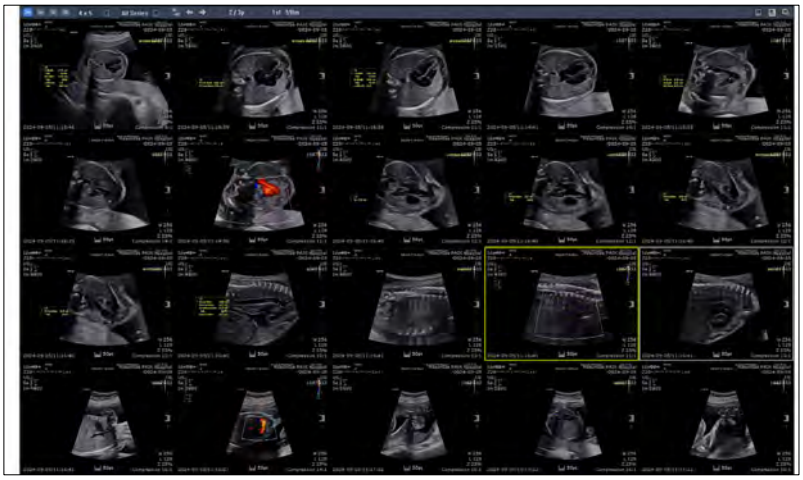
Live assist _ automated measurement

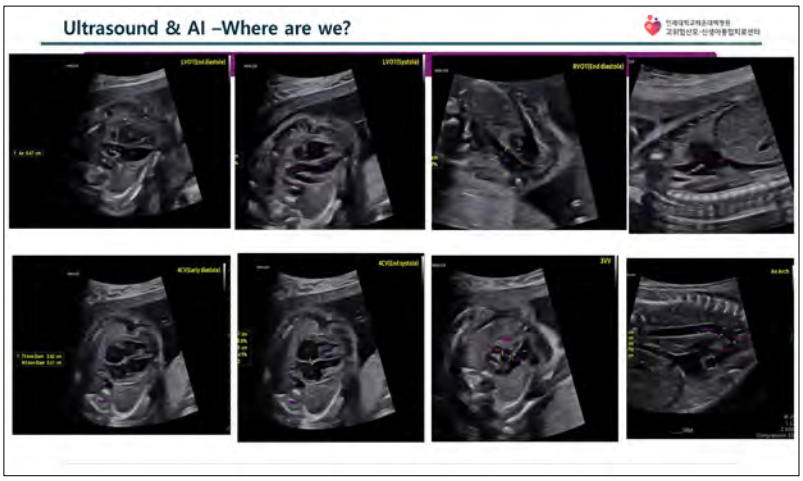

Ultrasound & AI –Where are we?
Live assist _ automated measurement
정지 화면에서 장기의 구분이 되는가?
정지 화면에서 측정이 되는가?
실시간 영상에서 장기의 구분이 되는가?
실시간 영상에서 가장 좋은 view를 선택할 수 있는가?
실시간 화면에서 측정이 가능한가?
실시간 화면에서 내가 뭘 보려고 하는지 아는가?
비정상을 진단할 수 있는가?
그 외 기능은?

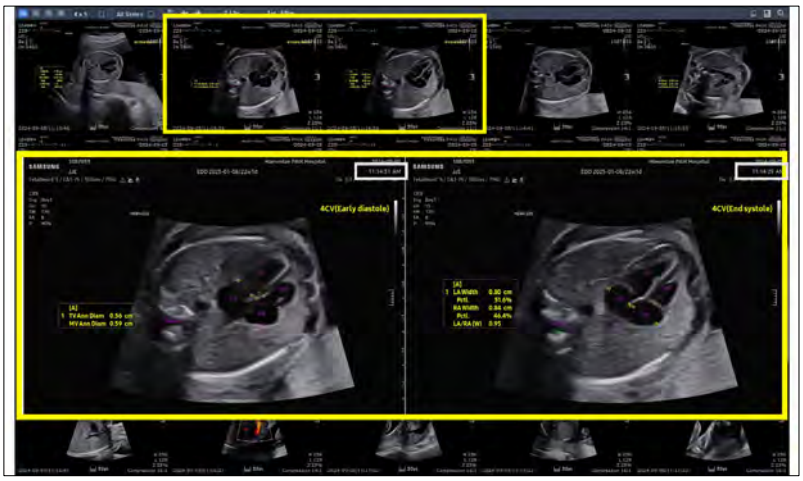



Ultrasound & AI –Where are we?


Ultrasound & AI –Where are we?
SAMSUNG

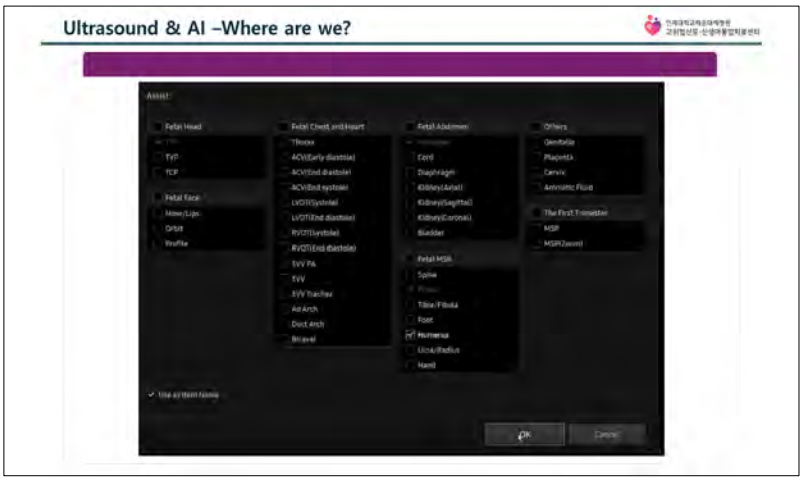



Ultrasound & AI –Where are we?

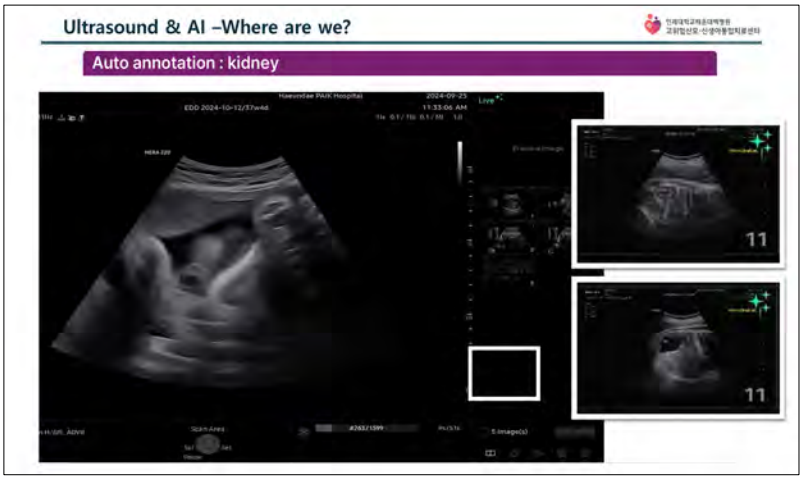

4CV(Early diastole)
4CV(End systole)

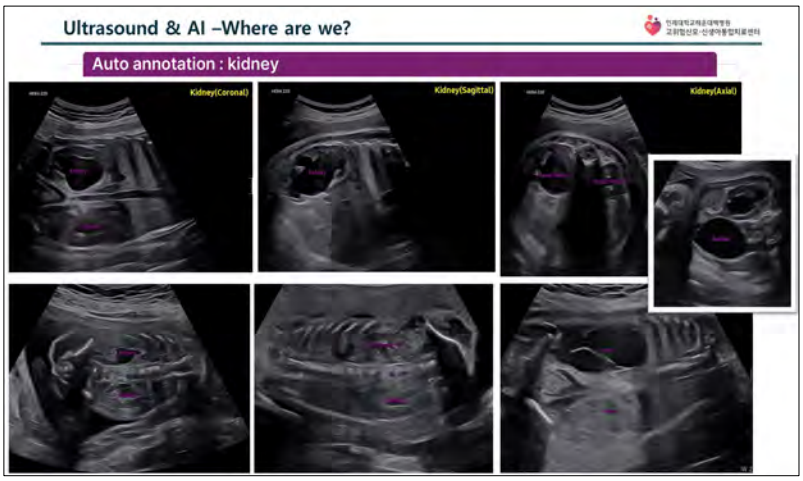

Ultrasound & AI –Where are we?
정지 화면에서 장기의 구분이 되는가?
정지 화면에서 측정이 되는가?
실시간 영상에서 장기의 구분이 되는가?
실시간 영상에서 가장 좋은 view를 선택할 수 있는가?
실시간 화면에서 측정이 가능한가?
실시간 화면에서 내가 뭘 보려고 하는지 아는가?
비정상을 진단할 수 있는가?
그 외 기능은?


Ultrasound & AI –Where are we?


Ultrasound & AI –Where are we?

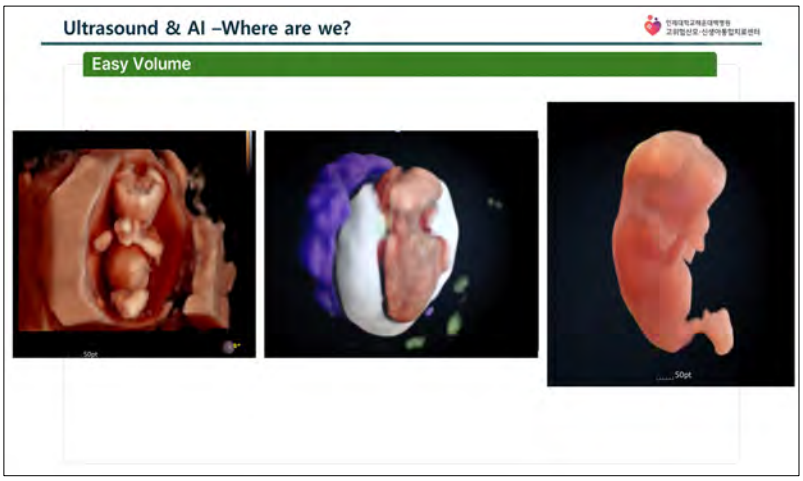

Ultrasound & AI –Where are we?
정지 화면에서 장기의 구분이 되는가?
정지 화면에서 측정이 되는가?
실시간 영상에서 장기의 구분이 되는가?
실시간 영상에서 가장 좋은 view를 선택할 수 있는가?
실시간 화면에서 측정이 가능한가?
실시간 화면에서 내가 뭘 보려고 하는지 아는가?
비정상을 진단할 수 있는가?
그 외 기능은?

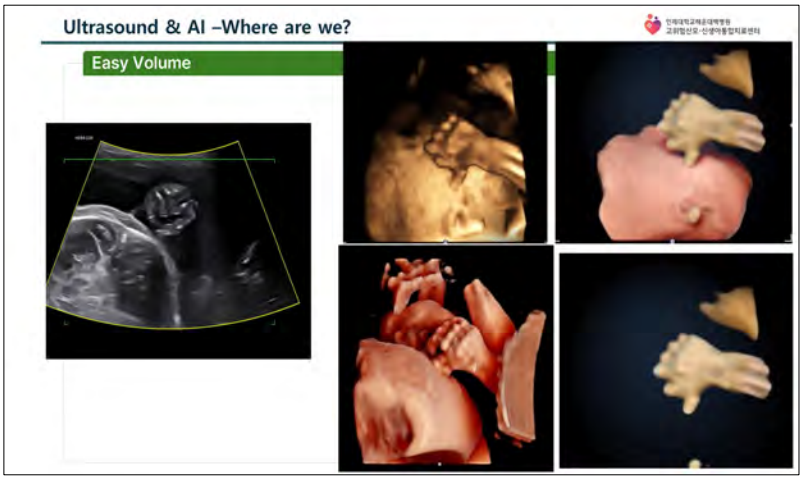

Ultrasound & AI –Where are we?
Auto annotation : kidney


Ultrasound & AI –Where are we?
Auto annotation : kidney
Kidney(Coronal)
Kidney(Sagittal)
Kidney(Axial)

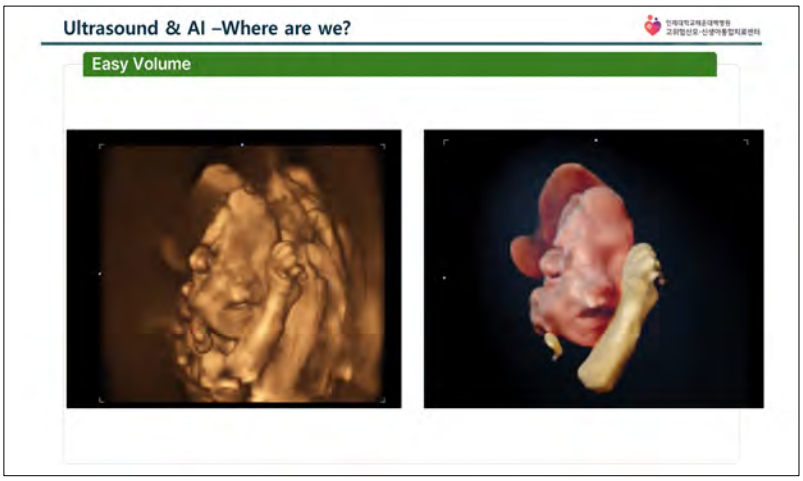

Ultrasound & AI –Where are we?
Auto annotation : kidney
Haeundae PAIK Hospital
2024-09-05
• 비정상을 진단할 수 있는가?
• 그 외 기능은?

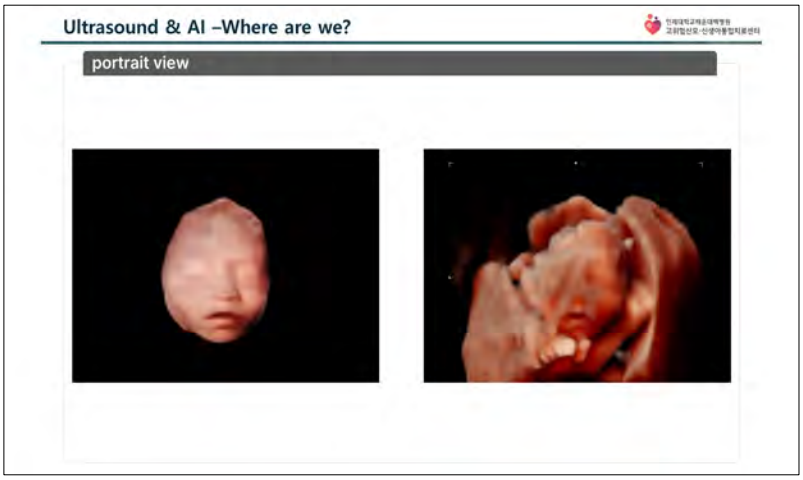

Ultrasound & AI –Where are we?
Easy Volume
• 정지 화면에서 장기의 구분이 되는가?
• 정지 화면에서 측정이 되는가?
• 실시간 영상에서 장기의 구분이 되는가?
• 실시간 영상에서 가장 좋은 view를 선택할 수 있는가?
• 실시간 화면에서 측정이 가능한가?
• 실시간 화면에서 내가 뭘 보려고 하는지 아는가?
• 비정상을 진단할 수 있는가?
• 그 외 기능은?


Ultrasound & AI –Where are we?
Easy Volume


Ultrasound & AI –Where are we?
Easy Volume


Ultrasound & AI –Where are we?
Easy Volume
Club foot


Ultrasound & AI –Where are we?
Easy Volume


Ultrasound & AI –Where are we?
portrait view


Ultrasound & AI –Where are we?
portrait view

Ultrasound & AI –Where are we?

Cleft Lip 21weeks

Ultrasound & AI –Where are we?

Cleft Lip 21weeks

Take-Home Message

- 정지 화면에서 장기의 구분이 되는가?
- 정지 화면에서 측정이 되는가?
- 실시간 영상에서 장기의 구분이 되는가?
- 실시간 영상에서 가장 좋은 view를 선택할 수 있는가?
- 실시간 화면에서 측정이 가능한가?
- 실시간 화면에서 내가 뭘 보려고 하는지 아는가?
- 비정상을 진단할 수 있는가?
- 그 외 기능은?

CURRICULUM VITAE

방 원 철

1) 주요 경력

2024-	삼성메디슨 한국사업개발팀장
2022-2023	삼성메디슨 AI/영상개발팀장 겸 학술연구팀장
2020-2021	삼성전자 의료기기사업부 상품전략팀장
2017-	삼성전자 개발임원/상무
2002-2014	삼성전자 종합기술원, 전문연구원

2) 대표 실적

2021	실시간 AI 초음파기기 최초 상용화
2020	초음파 전체 라인업 AI 기술 도입
2017	초음파/MRI 퓨전이미징 조직형상 변형보정 최초 상용화
2016	AI 초음파기기 최초 상용화
2005	동작인식 휴대폰 최초 상용화

3) 주요 수상

2014-2016	삼성전자 연구부문 공적상/금상, 삼성논문상 금상
2006-2013	삼성전자 종합기술원 무한탐구상 3회
2006	대한전자공학회 감사장
2001-2005	AI 분야 국제학술대회 Best Paper Award 3회

4) 저술

의료영상/AI 분야 임상/종설/기술 SCI 30편, 국제학술발표 43건
미국등록특허 95건, 역서/공저 3권, h-index 35

5) 초청 강연

2024.10	KCR (대한영상의학회) 학술대회
2023.12	대한임상초음파학회 추계학술대회

2023.4 Int'l Summit Forum on Fetal Echocardiography (Hangzhou, China)
2023.3 이화여대 인공지능 산학협력포럼
2022.11 대한신경근골격초음파학회 (KANMS-SONO) 추계학술대회
2022.5 KSUM (대한초음파의학회) Annual Congress
2022.5 KoSAIM (대한의료인공지능학회) 춘계학술대회
2021.11 대한신경근골격초음파학회 (KANMS-SONO) 추계학술대회
2020.6 KAIST 기계공학과 특강
2019.5 Avison Biomedical Symposium (연세대 의과대학)
2018.10 연세대 의공학부 특강
2017.11 KAIST 바이오및뇌공학과 특강
2017.6 서울의대 RGR 1334회 특강 (Radiology Grand Round)
2016.5 연대세브란스 심포지엄
2015.5 KSUM (대한초음파의학회) Annual Congress

Breaking New Ground: Unveiling the Latest Advancement in Ultrasound Technology for ObGyn

방 원 철

삼성메디슨

제27차 대한산부인과초음파학회
추계학술대회

Oral presentation 1

좌장 : 박중신 (서울의대)
원혜성 (울산의대)

Korean Society of Ultrasound
in Obstetrics and Gynecology

Oral | -01

A multicenter analysis on the prognosis and management of vasa previa in Korea

Gi Su Lee[1], Jin Gon Bae[1*], Hee-Sun Kim[2], HyunSoo Park[2], Hyun-Hwa Cha[3], Han-Sung Hwang[4*]

[1]Department of Obstetrics and Gynecology, Keimyung University School of Medicine, Daegu, Korea, [2]Department of Obstetrics and Gynecology, Dongguk University Ilsan Medical Center, Goyang-si, Republic of Korea, [3]Department of Obstetrics and Gynecology, Kyungpook National University Hospital, Kyungpook National University School of Medicine, [4]Division of Maternal and Fetal Medicine, Department of Obstetrics and Gynecology, Research Institute of Medical Science, Konkuk University School of Medicine, Republic of Korea

Introduction: Vasa previa is a rare obstetric complication where fetal blood vessel run unprotected across the fetal membranes, posing significant risks during delivery. This retrospective study aimed to analyze the timing of diagnosis, vasa previa type, and both maternal and neonatal outcomes in mothers diagnosed with vasa previa in Korea.

Methods: A total of 24 mothers diagnosed with vasa previa were included from five institutions. Clinical data on maternal characteristics, delivery method, and neonatal outcomes were collected and analyzed. The study specifically focused on gestational age at the time of diagnosis and delivery, as well as neonatal outcomes, including NICU admission and neonatal complications.

Results: The mean gestational age at the diagnosis was 30.1 weeks. The mean gestational age at delivery was 35.1 weeks, with most mothers undergoing cesarean section, and about 45.5% requiring emergency surgery. Of the 23 neonates, 15 (65.2%) required NICU admission, with 4 (21.1%) experiencing respiratory distress syndrome and 1 (5.3%) suffering from intraventricular hemorrhage. The majority of neonates had favorable Apgar scores, with a mean score of 7.0 at 1 minute and 8.5 at 5 minutes.

Conclusion: Early diagnosis and appropriate management of vasa previa are crucial for ensuring favorable maternal and neonatal outcomes. With diagnosis typically occurring after 30 weeks and deliveries often taking place around 35 weeks of gestation, timely intervention is crucial. Despite the high rate of NICU admissions, most neonates had favorable outcomes with low rates of severe complications.

Key words: vasa previa, neonatal outcome, maternal outcome

Oral | -02

Ultrasonographic Evaluation and Maternal Characteristics of Placenta Accreta Spectrum: A Prospective Study

Gi-Soo Um[1], Su-BeenHong[1*], Byung-SooKang[1], Hyun-SunKo[1], In-YangPark[1]

[1]*Department of Obstetrics and Gynecology, Seoul St. Mary's Hospital, College of Medicine, The Catholic University of Korea*

Objective: In recent decades, the incidence of placenta accreta spectrum (PAS) has markedly increased, attributed to factors such as rising cesarean delivery rates, uterine procedures, and advanced maternal age. Although relatively rare, PAS poses a significant clinical challenge due to its association with severe and life-threatening postpartum hemorrhage. This prospective study aimed to assess the clinical correlation between ultrasonographic imaging and PAS diagnosis and to evaluate the prevalence and associated characteristics of PAS.

Material and methods: A prospective study was conducted involving 238 pregnant women who delivered at Seoul St. Mary's Hospital between June 2021 and January 2024. Maternal baseline characteristics-including age, parity, history of uterine surgeries, and obstetric outcomes were collected. Ultrasonographic findings relevant to PAS disorders were evaluated based on the criteria established by European Working Group on PAS. Maternal baseline characteristics and specific ultrasonographic parameters between the PAS and non-PAS patients were compared.

Results: Among the 238 pregnant women included in this study, 19 patients (7.9%) were diagnosed with PAS. Placenta accreta was the most prevalent subtype, identified in 15 patients, followed by placenta increta in 3 patients, and placenta percreta in 1 patient. The analysis of PAS group demonstrated a significantly higher prior uterine surgeries and an increased rate of cesarean delivery compared to non-PAS patients. Key ultrasonographic findings in the PAS group included abnormal placental lacunae (61.1%), subplacental hypervascularity (58.8%), presence of vessels supplying placental lacunae (38.9%), myometrial thinning (37.5%), loss of the clear zone (23.5%), and uterovesical hypervascularity (22.2%), all of which were more frequent than in the Non-PAS group. Ultrasonographic findings were scored on a scale of 1 point each, with the results indicating that a normal placenta received a score of 0 points, placenta increta scored between 2 and 3 points, and placenta percreta scored more than 4 points. The area under the ROC curve of scoring was 0.765, with its sensitivity of 66.7% and specificity of 77.2% for prediction of PAS.

Conclusion: The ultrasonographic scoring system effectively stratifies the severity of placental invasion, enhancing antenatal diagnostic accuracy and clinical decision-making for PAS management. Early identification and stratification of PAS severity may be useful for optimizing peripartum care in pregnancies with risk factors.

Keywords: Placenta accreta spectrum, ultrasonographic images

Oral | -03

Semi-quantitative grading of placental morphologies in preterm FGR and clinical significance

You-ri Lee[1], Soo-ji Ham[1], Ji-hee Sung[1], Suk-joo Choi[1], Cheong-Rae Roh[1], Soo-young Oh[1*]

[1]Department of Obstetrics and Gynecology, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Korea

Objective: To introduce semi-quantitative grading of placental morphologies and to determine the association between these grading system and perinatal outcomes in fetal growth restriction (FGR) delivered early preterm.

Methods: This retrospective study includes 47 singleton pregnancies with FGR delivered between 23+0 and 33+6 weeks in our institution from January 2019 to December 2021

The morphology of the placenta was assessed by in in combination with Grannum Placental Grading System[1], placental shape, presence of Lacunae, and texture analysis of the placental images. Grannum Placental Grading System was independently reviewed by two physician blinded. Texture analysis of the placenta was performed using the programming language Python[2] to obtain quantitative and qualitative results on the coarseness and smoothness of the placental images. Maternal characteristics and perinatal outcomes were reviewed.

Results: The higher Grannum grading was correlated with the higher the level of coarseness in the texture analysis by Python. Regarding to perinatal outcomes, the integrated semi-quantitative grading of placental morphologies was associated with the earlier gestational age at delivery and lower neonatal birth weight.

Conclusion: We identified several relevant placental morphologies associated with adverse perinatal outcomes in FGR delivered preterm. Given the importance of placenta imaging, further assessment using artificial intelligence system is necessary in prospective study.

Reference: 1. Grannum PA, Berkowitz RL, Hobbins JC. The ultrasonic changes in the maturing placenta and their relation to fetal pulmonic maturity. Am J Obstet Gynecol 1979;133:915-22
2. Python 3.130. freely download from http://www.python.org

Keywords: placental morphology, placental texture analysis, fetal growth retardation

Oral | -04

Automatic fetal Nuchal translucency measurement using deep learning-based 3D segmentation network in Non-supine positioned fetus

Hyewon Hur[1], Hayan Kwon[1], Yun Ji Jung[1], Suhra Kim[1], Hyun Cheol Cho[2], Hanjun Kim[2], Jinyong Lee[2], Ja-Young Kwon[1,3*]

[1]Division of Maternal-Fetal Medicine, Department of Obstetrics and Gynecology, Institute of Women's Medical Life Science, Yonsei University College of Medicine, Seoul, Korea, [2]Department of AI Vision group, SAMSUNG MEDISON Co., Ltd, Seoul, Korea

Objective: The increased Nuchal translucency (NT) is related to chromosomal defects and early cardiac failure in first trimester of pregnancy. Detecting the mid-sagittal plane (MSP) is an essential part to measure NT. However, there are many difficulties in measuring NT, such as inappropriate fetal pose, high fetal mobility and maternal abdominal wall thickness. Though there has been an automated system proposed, its clinical use has been limited to the supine fetal position with an angle of deviations under 20 degrees. In light of this, we present a novel solution for automated NT measurement in non-supine positioned fetus from three-dimensional (3D) ultrasound images.

Methods: The provided images were obtained by an expert with W10 (Samsung Medison, Seoul, Korea) ultrasound machine using a 2-6 MHz transabdominal transducer.

We propose a method that uses a deep learning-based algorithm. The method initially localizes the fetal head and segment key landmark structures, such as the fetal head, mid-lines, choroid plexus, nuchal translucency, and diencephalon. Then automatically navigate the MSP based on these landmarks.

Results: A total of 200 3D volume dataset of fetal head and upper thorax was obtained from 78 patients during first trimester NT screening at our institution of which 150 were used for training and 50 testing for 3D auto-labeling system, and validation of automated NT detection system, respectively. A success rate of 95% for 3D segmentation and an accuracy of 92.3% for MSP detection was achieved with an inference time of 0.5 seconds. The mean difference in NT measurements was -0.05 mm (p 0.18), and the intraclass correlation coefficient was 0.923 between the two-dimensional NT (2D-NT) and the automated 3D volume NT system (5D NT-AI).

Conclusion: A novel deep learning algorithm is reproducible and comparable with conventional 2D techniques for NT measurement.

Keywords: Artificial intelligence, Nuchal translucency, 3D ultrasonography

Oral | -05

Assisted reproductive technology and risk of congenital heart disease in children

김호연, 정희철, 송관흡, 안기훈, 홍순철, 오민정, 조금준*

Department of Obstetrics and Gynecology, Korea University School of Medicine

목적(Objective): The aim of this observation study was to evaluate whether the risk of congenital heart disease (CHD) of offspring increases in singleton pregnancy following assisted reproductive technology(ART).

방법(Methods): This retrospective nationwide study included women with singleton pregnancy who had their delivery between 2017-2021. Newborns who were diagnosed with CHD were identified by ICD 10 code in National Health Database. Comparisons among natural, intrauterine insemination, fresh embryo transfer and frozen embryo transfer were carried out. Any CHD of babies constituted the primary outcome, whereas perinatal outcome were considered secondary outcomes. Perinatal and CHD outcomes were compared using logistic regression analysis.

결과(Results): In this study, 1,169,619 mother-child pairs were included. 69,769 (5.9%) children were diagnosed with CHD. Overall, the incidence of CHD was significantly higher in pregnancy following ART (9.3% vs 5.78%). Fresh and frozen ET were associated with an increased risk of conotruncal(aOR 1.46, 1.23), arterioventricular septal defect(aOR 1.64, 1.56) and right outflow malformation(aOR 1.81, 1.16) after adjustment for maternal age, primiparity, cesarean section, and hypertension and diabetes before and during pregnancy. IUI and all ET were associated with an increased risk of left outflow malformation(aOR 1.42, 1.62, 1.19) and PDA(aOR 1.37, 1.48, 1.43). Overall risk of CHD was higher in fresh ET than IUI and frozen ET.

결론(Conclusion): CHD is a serious and life-threatening condition. In this population based study, we observed an increased rate of CHDs in ART-conceived babies. The findings of the the current study should be conveyed to patients undergoing counselling before ART.

Keywords: Congenital heart disease, assisted reproductive technology, fresh embryo transfer
Preferred presentation: Oral

Oral | -06

The Prenatal Ultrasound Findings and Chromosomal Outcomes of Pregnancies with Mosaic Embryo Transfer

You Mi Hong[1], Se Jeong Kim[2], Soo Hyun Kim[1], Yeon Kyung Cho[1], Ji Yeon Kim[1], Sung Shin Shim[1], Hee Jin Park[1], June Seek Choi[1], Joong Sik Shin[1], Dong Hyun Cha[1], Moon Young Kim[1], You Jung Han[1*]

[1]Department of Obstetrics and Gynecology, CHA Gangnam Medical Center, CHA University School of Medicine, Seoul, Republic of Korea, [2]Department of Obstetrics and Gynecology, Fertility Center of CHA Gangnam Medical Center, CHA University School of Medicine, Seoul, Republic of Korea

Objective: To investigate prenatal ultrasound findings and chromosomal outcomes of pregnancies with mosaic embryo transfer (ET).
Method: This retrospective study was conducted on pregnant women who underwent mosaic ET following blastocyst-stage preimplantation genetic testing for aneuploidy (PGT-A) at CHA Gangnam Medical Center from February 2022 to July 2024. Trophectoderm biopsy specimens were collected using standard protocols and next-generation sequencing profiles were defined as mosaic when displaying copy number counts in the 20%–80% range. The results of PGT-A, amniocentesis, prenatal ultrasounds, and pregnancy outcomes were analyzed.
Results: There was a total of 37 cases of mosaic ET in which pregnancy was confirmed by ultrasound. Among these, 9 patients underwent the transfer of two embryos, and only one resulted in a twin pregnancy. The remaining 36 patients, including the 8 who transferred two embryos, maintained singleton pregnancies. Based on PGT-A result, among the 43 mosaic embryos transferred, 20 were of the whole type (46.5%), 16 were of the segmental type (37.2%), and 7 were of the complex type (16.3%). In 22 cases (51.2%), two or more chromosomes were involved. The most frequently involved chromosomes were 10 and 18, each with 4 cases. Additionally, there were 3 cases of chromosome 21, 4 of chromosome 18, and 1 of chromosome 13. Amniocentesis was performed in 31 cases (72.1%), all showing a normal karyotype. Among the 9 cases where chromosomal microarray analysis was conducted, there was one case with an abnormal result classified as a variant of uncertain significance. Except for 2 cases that showed renal pyelectasis on detailed ultrasound, all other findings were normal. The average gestational age at delivery for the 15 patients with available delivery data was 38.5 weeks, with an average birth weight of 3281.3 grams. Except for 2 cases of transient tachypnea of the newborn, there were no neonatal complications or congenital anomalies detected after birth
Conclusion: Our study indicated that mosaic embryos with various levels or types of mosaicism can develop into euploid-healthy infants. This study is invaluable for counseling clinical results after mosaic embryo transfer, reassuring that if patients do not have euploid embryos available, mosaic embryos can also be a viable option for transfer.

Keywords: In Vitro Fertilization, Mosaic Embryo Transfer, Pregnancy outcome, Preimplantation genetic testing for aneuploidy, Prenatal ultrasound

Oral | -07

Postnatal outcomes of referred abnormal ultrasound findings for fetal gall bladder and hepatic cyst

Soo Ran Choi[1], Hye-Sung Won[2*], Jin Hoon Chung[2], Mi-Young Lee[2], Jihye Koh[2], Yu Jin Lee[2]

[1]Department of Obstetrics and Gynecology, Inha University Hospital, Incheon, Korea, [2]Department of Obstetrics and Gynecology, University of Ulsan College of Medicine, Asan Medical Center, Seoul, Korea

목적(Objective): To evaluate postnatal outcomes of referred abnormal ultrasound findings for fetal gall bladder and hepatic cyst.

방법(Methods): This retrospective study included 366 referred pregnant women with abnormal prenatal ultrasound findings for fetal gall bladder and fetal hepatic cyst between June 2005 and October 2022 in Asan Medical Center. 92 cases did not meet eligibility. Then the remained 274 cases were consisted with 214 of abnormal ultrasound finding of fetal gall bladder (GB) and 60 of fetal hepatic cyst. Among them 113 cases were finally delivered in this institution (69 of abnormal GB and 44 of hepatic cyst). Prenatal ultrasound findings and postnatal neonatal results of clinical, radiologic, and operation were evaluated and compared.

결과(Results): The mean referred gestational age was 27.1±4.7 weeks of gestation and delivered gestational age was 38.1±1.8 weeks of gestation, and the mean birth weight was 3017±511.7g. Enlarged GB prenatally were revealed as normal GB (82.6%) and the remained enlarged GB had findings as GB stone, sludge, septate GB, and GB wall thickening postnatally. 14 cases of persistent non-visible fetal GB prenatally were revealed as 6 of isolated GB agenesis, 3 of biliary atresia, 2 hypoplastic small GB, 2 of hepatic parenchymal disease with cholestasis, and one of collapsed GB with normal biliary duct postnatally. 40 cases of choledochal cyst (CDC) with visible GB had findings as 50% of CDC type I and 17.5% of CDC type IV postnatally. 4 cases of CDC with non-visible GB had findings as 2 of biliary atresia and one of CDC type I, and normal biliary duct at 2 years old. One neonate had liver transplantation and 2 babies are under the candidate for liver transplantation.

결론(Conclusion): If there are abnormal ultrasound findings for fetal gall bladder and hepatic cyst during the targeted 2nd trimester ultrasound scan, follow-up ultrasound scans must need.

Keywords: fetal gall bladder, fetal hepatic cyst

제27차 대한산부인과초음파학회

추계학술대회

Kenote lecture I

Issues & Updates

좌장 : 전종관 (이화의대)

오민정 (고대의대)

Korean Society of Ultrasound
in Obstetrics and Gynecology

CURRICULUM VITAE

나 성 훈

1) 학력

충남대학교 의학사
울산대학교 의학석사
울산대학교 의학박사

2) 주요경력

서울아산병원(울산의대) 인턴 및 전공의, 임상강사 (모성태아의학)

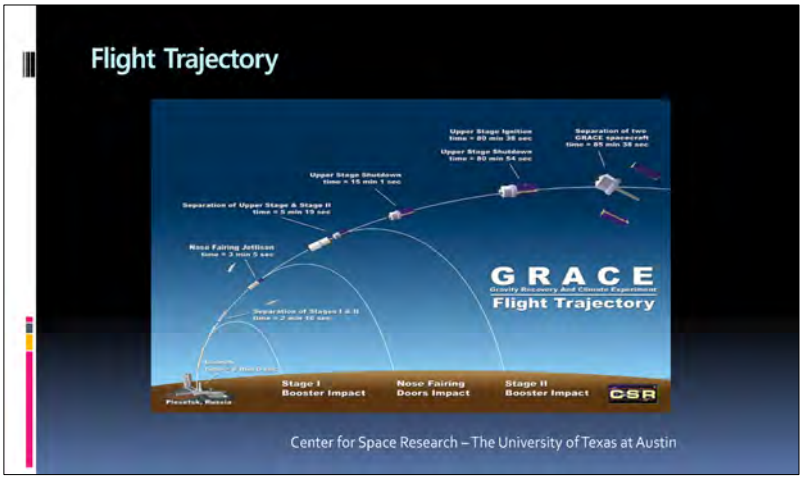
2008년10월-2010년02월	강원대학교병원 임상조교수
2010년03월-현재	강원대학교 의학전문대학원 전임강사, 조교수, 부교수, 교수
2013년07월-2015년07월	강원대학교 어린이병원 분만실장
2014년10월-2015년07월	강원대학교 의학전문대학원 의학과장 겸 학생부원장, 강원대학교 보건진료소 소장
2015년-2016년	미국 브라운의대 Visiting Professor
2016년08월-2021년08월	강원대학교병원 산부인과 과장 겸 주임교수
2017년03월-2023년08월	강원대학교병원 진료지원실장,의료질관리실장, 기획조정실장, 어린이병원장
2022년09월-2023년08월	강원대학교 의학전문대학원 교무부원장
2021년07월-2023년12월	지역환자안전센터장

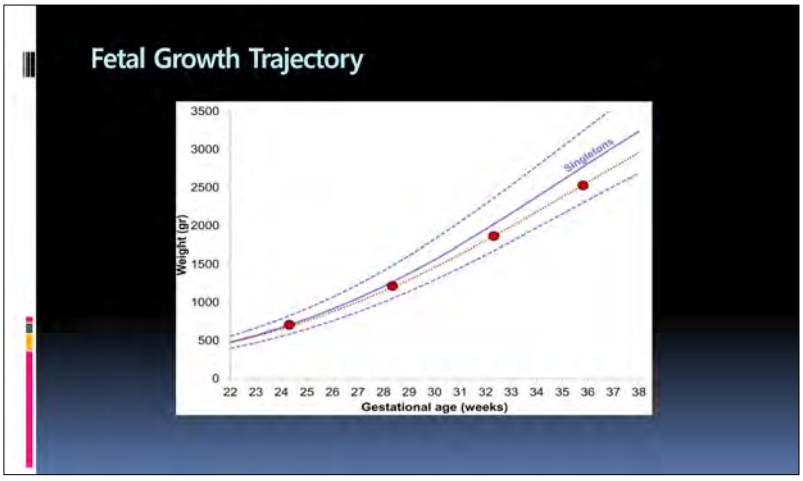
재단법인 건강한여성재단 사무총장(현)
대한산부인과학회 심사위원, 윤리위원(현)
대한모체태아의학회 윤리위원장(현)
대한산부인과초음파학회 강원지회장(현)
대한주산의학회 법제위원장, 편집위원 부편집장, 기획위원 (현)
식품의약품안전처 의료기기임상전문가(현)
식품위약품안전처 의료제품 분야 국가표준(KS) 전문위원(현)
한국의약품안전관리원 의약품 부작용 전문위원회 전문가(현)
중앙약사심의위원회 위원(현)
한국의료분쟁조정중재원 의료사고감정단 자문위원, 예방위원(현)

Comprehensive insights into fetal growth restriction: Understanding fetal growth trajectory

나 성 훈

강원의대





Fetal Growth Restriction

Definition

SMFM-ACOG-AIUM	ISUOG	
	Early (<32 weeks)	Late (≥32 weeks)
AC or EFW <10th centile for GA	AC or EFW <3rd centile for GA or UA-AEDF or AC or EFW <10th centile	AC or EFW <3rd centile for GA or Any two of the following:
	b. UA-PI >95th centile	growth centiles c. CPR <5th centile or UA-PI >95th centile

None of these criteria is ideal for identification of FGR as all have poor performance for predicting adverse neonatal outcome

singleton nonanomalous fetuses

US: United States; SMFM: Society for Maternal-Fetal Medicine; ACOG: American College of Obstetricians and Gynecologists; AIUM: American Institute of Ultrasound in Medicine; ISUOG: International Society of Obstetricians and Gynecologists; AC: abdominal circumference; EFW: estimated fetal weight; GA: gestational age; UtA: uterine artery; UA: umbilical artery; AEDF: absent end-diastolic flow (estimated by Doppler ultrasonography); PI: pulsatility index; CPR: cerebroplacental ratio

Risk factors for fetal growth restriction

History-based risk factors

a. Maternal demographics
- Advanced age
- Underweight
- Living in high altitude
- Severe anemia, hemoglobinopathies
- Environmental factors (air pollution, heavy metals, heat)

b. Medical conditions
- Chronic hypertension
- Chronic kidney disease
- Systemic lupus erythematosus
- Inflammatory bowel disease
- Antiphospholipid syndrome
- Pregestational diabetes (long standing)

c. Obstetric history
- Previous pregnancy affected by FGR or pre-eclampsia

Biochemical markers
- Low PlGF
- Low PAPP-A
- High AFP

Ultrasound-based markers
- Uterine artery: pulsatility index >95th percentile
- Uterine artery: bilateral notching
- Marginal or velamentous cord insertion
- Two-vessel cord (single umbilical artery)
- Abnormal placental morphology[a]
- Decreased fetal growth velocity

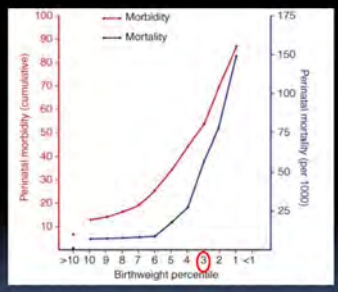
Nir Melamed et al. *Int J Gynecol Obstet.* 2021

Fetal size percentile

- Fetuses <3rd percentile are at greatest risk of adverse outcome
- Most fetuses with EFW or AC between the 5th and 10th percentiles are constitutionally small and thus have normal neonatal outcomes
- still need to be monitored closely because a proportion are FGR and at increased risk of adverse outcome

Unterscheider J et al. Am J Obstet Gynecol. 2013
Mlynarczyk M et al. Am J Obstet Gynecol. 2017

Fetal size percentile



Williams Obstetrics. 23rd ed

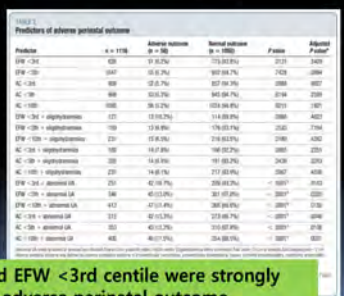
RESEARCH www.AJOG.org

OBSTETRICS Am J Obstet Gynecol 2013;208:290.e1-6.

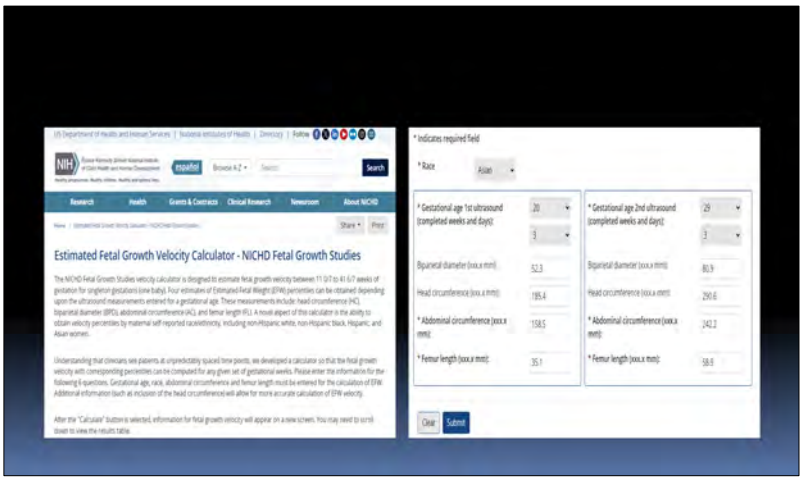
Optimizing the definition of intrauterine growth restriction: the multicenter prospective PORTO Study

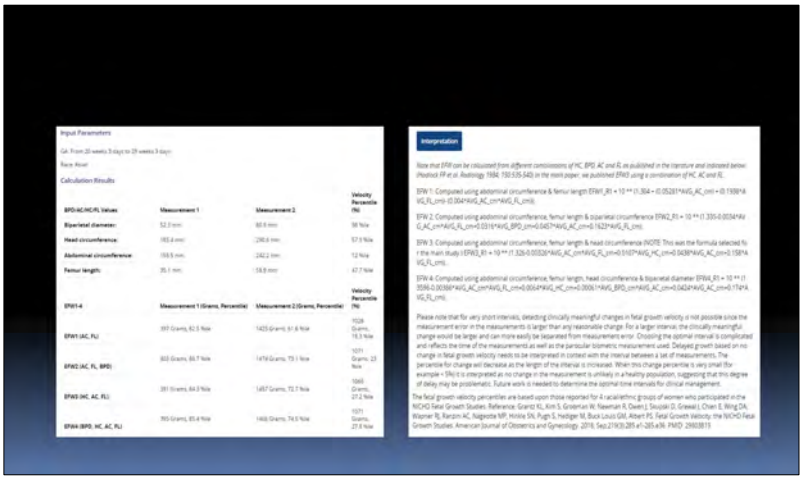
Julia Unterscheider, MD; Sean Daly, MD; Michael Patrick Geary, MD; Mairead-Mary Kennelly, MD; Fionnuala Mary McAuliffe, MD; Keelin O'Donoghue, PhD; Alyson Hunter, MD; John Joseph Morrison, MD; Gerard Burke, FRCOG; Patrick Dicker, PhD; Elizabeth Catherine Tully, PhD; Fergal Desmond Malone, MD

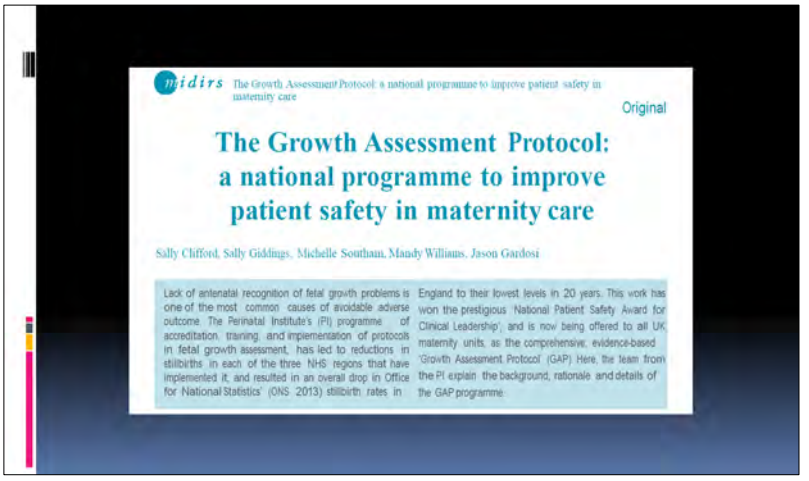
- over 1100 nonanomalous fetuses with EFW <10th percentile at 24+0 to 36+6 weeks of gestation
- only 2 percent of those at the 3rd to 10th percentile (5 of 254) experienced adverse perinatal outcome
- 6.2 percent of those <3rd percentile (51 of 826) had an adverse outcome and all eight mortalities were in this group

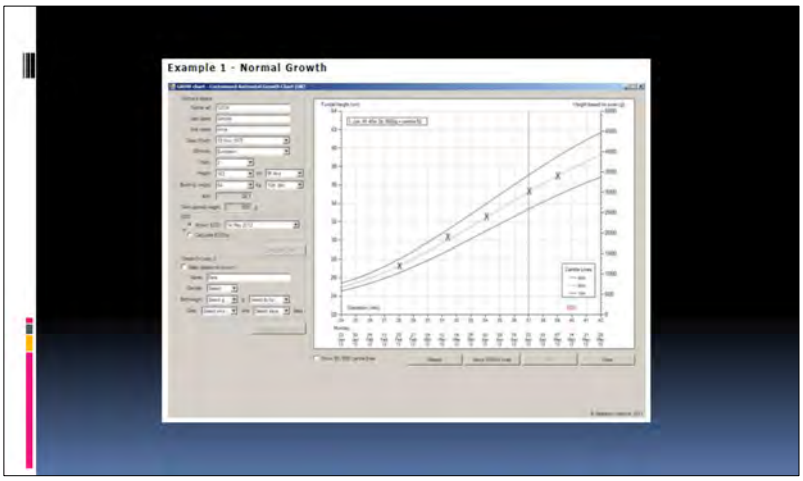


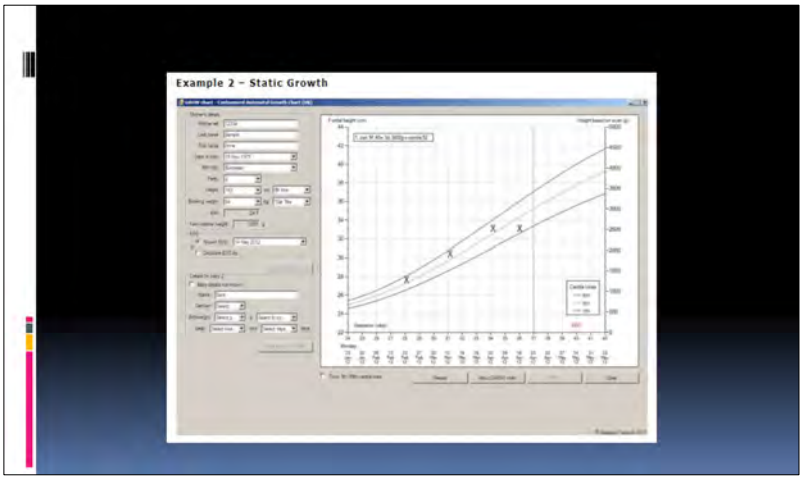
Abnormal umbilical artery Doppler and EFW <3rd centile were strongly and most consistently associated with adverse perinatal outcome

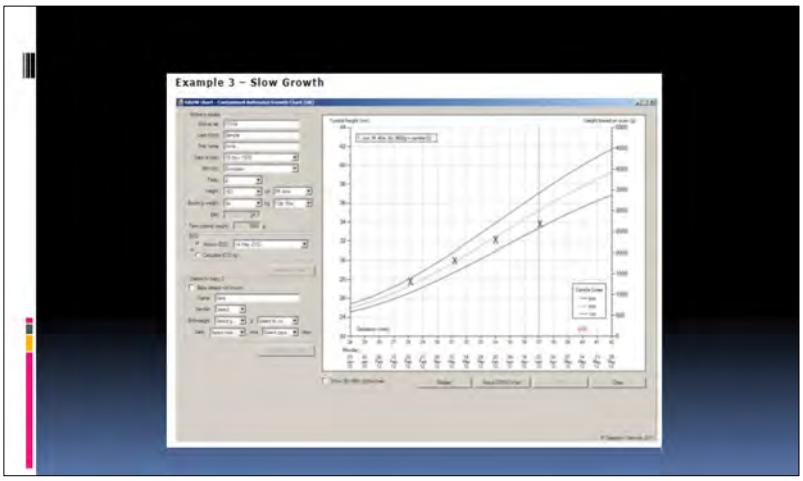

Estimated Fetal Growth Velocity Calculator - NICHD Fetal Growth Studies
* Indicates required field
* Race
Asian
* Gestational age 1st ultrasound (completed weeks and days):
* Gestational age 2nd ultrasound (completed weeks and days):
Biparietal diameter (xxx.x mm):
52.3
Head circumference (xxx.x mm):
195.4
* Abdominal circumference (xxx.x mm):
158.5
* Femur length (xxx.x mm):
35.1
Biparietal diameter (xxx.x mm):
80.9
Head circumference (xxx.x mm):
290.6
* Abdominal circumference (xxx.x mm):
242.2
* Femur length (xxx.x mm):
58.9
Clear
Submit

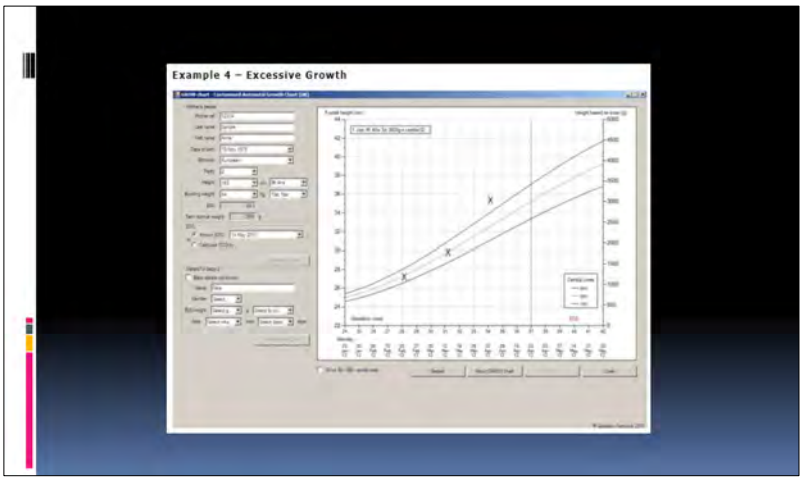

Input Parameters
Calculation Results
Interpretation


midirs
The Growth Assessment Protocol: a national programme to improve patient safety in maternity care
Original
The Growth Assessment Protocol: a national programme to improve patient safety in maternity care
Sally Clifford, Sally Giddings, Michelle Southam, Mandy Williams, Jason Gardosi
Lack of antenatal recognition of fetal growth problems is one of the most common causes of avoidable adverse outcome. The Perinatal Institute's (PI) programme of accreditation, training, and implementation of protocols in fetal growth assessment, has led to reductions in stillbirths in each of the three NHS regions that have implemented it, and resulted in an overall drop in Office for National Statistics' (ONS 2013) stillbirth rates in England to their lowest levels in 20 years. This work has won the prestigious 'National Patient Safety Award for Clinical Leadership', and is now being offered to all UK maternity units, as the comprehensive, evidence-based 'Growth Assessment Protocol' (GAP). Here, the team from the PI explain the background, rationale and details of the GAP programme.


Example 1 - Normal Growth


Example 2 - Static Growth


Example 3 - Slow Growth



Antenatal detection of SGA

- While, traditionally, the third-trimester scan has been performed at 32–34 weeks, it appears that a scan later in pregnancy is more effective in predicting SGA/FGR

A. Khalil et al. Ultrasound Obstet Gynecol 2024

Antenatal detection of SGA

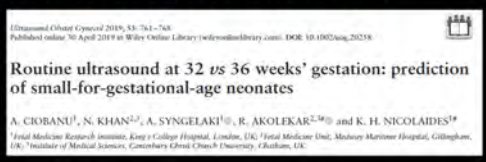

Routine Ultrasound at 30th–33rd weeks versus 30th–33rd and 35th–37th weeks in Low-Risk Pregnancies: A Randomized Trial


Ultrasound screening for fetal growth restriction at 36 *vs* 32 weeks' gestation: a randomized trial (ROUTE)

E. ROMÀ*, A. ARNAU†, R. BERDALA*, C. BERGÓS*, J. MONTESINOS† and F. FIGUERAS‡

- have shown that a scan at around 36 weeks is more effective at detecting FGR than is a scan closer to 32 weeks
- The detection rate (39% vs 22%), as well as the overall accuracy, was higher at the later compared with the earlier scan

Antenatal detection of SGA



Routine ultrasound at 32 *vs* 36 weeks' gestation: prediction of small-for-gestational-age neonates

A. CIOBANU[1], N. KHAN[2,3], A. SYNGELAKI[1], R. AKOLEKAR[2,3] and K. H. NICOLAIDES[1]*

- large prospective observational study of 22,000 fetuses
- showed that the sensitivity of EFW < 10th centile to predict birth weight < 10th centile and birth weight < 3rd centile
  - 35 + 0 / 36 + 6 weeks: 46% / 65%
  - 31 + 0 / 33 + 6 weeks: 38% / 52%
- The sensitivity of the late scan was even higher (70% and 84%, respectively) when delivery occurred within 2 weeks following the scan

Antenatal detection of SGA

- Ultrasound assessment of fetuses at increased risk of FGR has the ability to identify those at greatest risk of perinatal complications, and patients with more than double the risk of FGR compared to the general population should undergo evaluation of fetal biometry and fetal Doppler earlier than the third trimester, between 26 and 28 weeks' gestation

RCOG. Green-Top Guideline 31, 2014

Antenatal detection of SGA

- While parameters like uterine artery Doppler and cerebroplacental ratio, longitudinal fetal growth assessment and a third-trimester combined screening test may not substantially improve the prediction of SGA/FGR when used in isolation compared to cross-sectional determination of EFW, they constitute key components of the Delphi criteria for diagnosing FGR

Rial-Crestelo M et al. J Matern Neonatal Med 2019
Caradeux J et al. Ultrasound Obstet Gynecol 2018
Miranda J et al. Ultrasound Obstet Gynecol 2017

Grwoth velocity

- The diagnosis of FGR on a single ultrasound based on an EFW <5th percentile in a well-dated pregnancy, oligohydramnios, and abnormal Doppler indices does not require serial scans for confirmation
- assessing growth velocity (trajectory) has the potential to assist in the diagnosis of less severe forms of FGR not captured by current diagnostic criteria

Deter RL et al. Ultrasound Obstet Gynecol. 1995
Barker ED et al. Obstet Gynecol. 2013
Gordijn SJ et al. Ultrasound Obstet Gynecol. 2016
Grantz KL et al. Am J Obstet Gynecol. 2018
Salomon LJ et al. Ultrasound Obstet Gynecol. 2019
Wu T et al. BMC Pregnancy Childbirth. 2021
Grantz KL et al. Am J Obstet Gynecol. 2022

Grwoth velocity

- A normal growth velocity (ie, parallel to the growth curve of fetuses with EFW or AC >10th percentile) appears to be predictive of a favorable outcome, while an abnormal growth velocity (a percentile drop between consecutive ultrasound scans of >50 percentiles in EFW or AC [eg, from the 75th percentile to the 20th percentile]) appears to predict perinatal complications (eg, preterm birth, preeclampsia, neonatal morbidity)

Deter RL et al. Ultrasound Obstet Gynecol. 1995
Barker ED et al. Obstet Gynecol. 2013
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Growth velocity

- A normal growth velocity (ie, parallel to the growth curve of fetuses with EFW or AC >10th percentile) appears to be predictive of a favorable outcome, while an abnormal growth velocity (a percentile drop between consecutive ultrasound scans of >50 percentiles in EFW or AC [eg, from the 75th percentile to the 20th percentile]) appears to predict perinatal complications (eg, preterm birth, preeclampsia, neonatal morbidity)
- Routine fetal growth velocity assessment is not endorsed by the American College of Obstetrics and Gynecology, Society for Maternal-Fetal Medicine, and American Institute of Ultrasound in Medicine (AIUM) for management of pregnancies affected by FGR

SMFM Consult Series #52. Am J Obstet Gynecol. 2020
ACOG Practice Bulletin, Number 227. Obstet Gynecol.2021

Ultrasound Obstet Gynecol 2024; 63: 564–571
Published online in Wiley Online Library (wileyonlinelibrary.com). DOI: 10.1002/uog.27610

Assessment of fetal growth trajectory identifies infants at high risk of perinatal mortality

M. L. LARSEN[1,2,3], L. KREBS[3,4], C. E. HOEI-HANSEN[1,4] and S. KUMAR[3,5,6]

[1]Center for Cerebral Palsy, Department of Paediatrics and Adolescent Medicine, Copenhagen University Hospital - Rigshospitalet, Copenhagen, Denmark, [2]Department of Obstetrics and Gynecology, Copenhagen University Hospital – Amager-Hvidovre, Hvidovre, Denmark, [3]Mater Research Institute, University of Queensland, Brisbane, Queensland, Australia; [4]Department of Clinical Medicine, University of Copenhagen, Copenhagen, Denmark; [5]Centre for Maternal and Fetal Medicine, Mater Mother's Hospital, Brisbane, Queensland, Australia; [6]NHMRC Centre for Research Excellence in Stillbirth, Mater Research Institute, University of Queensland, Brisbane, Queensland, Australia

- Cohort study of women with singleton 5,319 pregnancies delivering between 32+0 and 41+6 wks
- two or more ultrasound scans, at least 4 weeks apart, from 18+0wks
- compared three growth trajectories:

Group 1: SGA(EFW or AC <10%) with appropriate growth.
Group 2: Decreased growth trajectory(≥50%) but non-SGA(EFW or AC ≥10%)
Group 3: Decreased growth trajectory (≥50%) and SGA

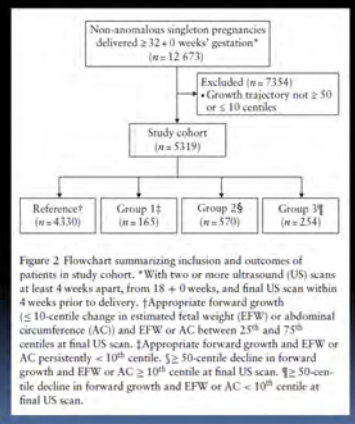

Figure 2 Flowchart summarizing inclusion and outcomes of patients in study cohort. *With two or more ultrasound (US) scans at least 4 weeks apart, from 18 + 0 weeks, and final US scan within 4 weeks prior to delivery. †Appropriate forward growth (≤ 10-centile change in estimated fetal weight (EFW) or abdominal circumference (AC)) and EFW or AC between 25th and 75th centiles at final US scan. ‡Appropriate forward growth and EFW or AC persistently < 10th centile. §≥ 50-centile decline in forward growth and EFW or AC ≥ 10th centile at final US scan. ¶≥ 50-centile decline in forward growth and EFW or AC < 10th centile at final US scan.

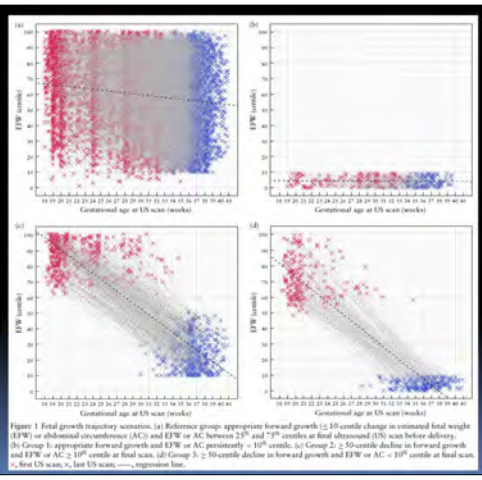

Figure 1 Fetal growth trajectory scenarios. (a) Reference group: appropriate forward growth (≤ 10-centile change in estimated fetal weight (EFW) or abdominal circumference (AC)) and EFW or AC between 25th and 75th centiles at final ultrasound (US) scan before delivery. (b) Group 1: appropriate forward growth and EFW or AC persistently < 10th centile. (c) Group 2: ≥ 50-centile decline in forward growth and EFW or AC ≥ 10th centile at final scan. (d) Group 3: ≥ 50-centile decline in forward growth and EFW or AC < 10th centile at final scan. ×, first US scan; ×, last US scan; ——, regression line.

Table 1 Descriptive characteristics of study cohort (n = 5319), according to fetal growth trajectory group

Characteristic	Reference (n = 4330)*	Group 1 (n = 165)†	Group 2 (n = 570)‡	Group 3 (n = 254)§
Maternal age (years)	31.2 ± 5.5	30.0 ± 6.2	30.2 ± 6.0	30.0 ± 6.1
< 25 years	519 (12.0)	29 (17.6)	104 (18.2)	53 (20.9)
25–34 years	2638 (60.9)	97 (58.8)	329 (57.7)	137 (53.9)
> 35 years	1173 (27.1)	39 (23.6)	137 (24.0)	64 (25.2)
Maternal BMI (kg/m²)	24.1 (21.3–29.4)	21.5 (19.4–24.8)	23.1 (20.3–28.1)	22.1 (19.7–26.4)
< 18.5 kg/m²	235/4307 (5.9)	28/162 (17.3)	71/565 (12.6)	30/249 (12.0)
18.5–29.9 kg/m²	3050/4307 (70.8)	123/162 (75.9)	395/565 (69.9)	184/249 (73.9)
> 29.9 kg/m²	1002/4307 (23.3)	11/162 (6.8)	99/565 (17.5)	35/249 (14.1)
Ethnicity				
Caucasian	2174/4328 (50.2)	76 (46.1)	256 (44.9)	112/252 (44.4)
Asian	1242/4328 (28.7)	57 (34.5)	156 (27.4)	71/252 (28.2)
Indigenous	336/4328 (7.8)	8 (4.8)	50 (8.8)	24/252 (9.5)
Other	576/4328 (13.3)	24 (14.5)	108 (18.9)	45/252 (17.9)
Nulliparous	2619/4329 (60.5)	77 (46.7)	313 (54.9)	121/252 (48.0)
Use of ART	263/4322 (6.1)	12/164 (7.3)	43/569 (7.6)	12/252 (4.8)
Smoker¶	539 (12.4)	28 (17.0)	92 (16.1)	53 (20.9)
Illicit drug use¶	122 (2.8)	15 (9.1)	36 (6.3)	21 (8.3)
Diabetes¶	1420 (32.8)	28 (17.0)	90 (15.8)	25 (9.8)
Hypertension¶	307 (7.1)	18 (10.9)	61 (10.7)	31 (12.2)
Male fetal sex	2156 (49.8)	97 (58.8)	254 (44.6)	137 (53.9)
Deepest vertical pocket (cm)	5.4 ± 1.6	4.5 ± 1.4	4.7 ± 1.5	4.4 ± 1.5
CPR < 5th centile	67/1359 (4.9)	8/56 (14.3)	21/164 (12.8)	29/71 (40.8)
UA-PI ≥ 95th centile	202/4319 (4.7)	28/160 (17.5)	49/549 (8.9)	65/241 (27.0)
Interval between US scans (weeks)	9 + 0 (6 + 0 to 14 + 1)	7 + 3 (5 + 1 to 10 + 1)	15 + 3 (11 + 5 to 17 + 0)	15 + 5 (13 + 0 to 17 + 1)
GA at first US scan (weeks)	27 + 3 (21 + 4 to 30 + 1)	28 + 1 (24 + 1 to 30 + 5)	20 + 4 (19 + 4 to 24 + 0)	20 + 1 (19 + 3 to 21 + 4)
GA at last US scan (weeks)	36 + 2 (35 + 5 to 37 + 1)	36 + 1 (34 + 5 to 37 + 1)	36 + 3 (35 + 4 to 37 + 4)	36 + 1 (34 + 4 to 37 + 3)
GA at birth (weeks)	38 + 4 (37 + 6 to 39 + 3)	37 + 6 (36 + 5 to 38 + 4)	38 + 2 (37 + 1 to 39 + 1)	37 + 4 (36 + 0 to 38 + 4)

Data are given as mean ± SD, n (%), median (interquartile range) or n/N (%). Data missing for deepest vertical pocket (n = 103). *Appropriate forward growth (≤ 10-centile change in estimated fetal weight (EFW) or abdominal circumference (AC)) and EFW or AC between 25th and 75th centiles at final ultrasound (US) scan before delivery. †Appropriate forward growth and EFW or AC persistently < 10th centile. ‡≥ 50-centile decline in forward growth and EFW or AC ≥ 10th centile at final US scan. §≥ 50-centile decline in forward growth and EFW or AC < 10th centile at final US scan. ¶During pregnancy. ART, assisted reproductive technology; BMI, body mass index; CPR, cerebro-placental ratio; GA, gestational age; UA-PI, umbilical artery pulsatility index.

Table 2 Perinatal outcomes of study cohort (n = 5319), according to fetal growth trajectory group

Outcome	Reference (n = 4330)*	Group 1 (n = 165)†	Group 2 (n = 570)‡	Group 3 (n = 254)§	P¶
BW (g)	3179 ± 460	2265 ± 432	2804 ± 394	2269 ± 439	< 0.001
BW < 3rd centile	59 (1.4)	79 (47.9)	28 (4.9)	123 (48.4)	< 0.001
SGA at birth (BW < 10th centile)	357 (8.2)	152 (92.1)	153 (26.8)	205 (80.7)	< 0.001
Spontaneous VD	2157 (49.8)	70/164 (42.7)	307 (53.9)	117 (46.1)	< 0.001
Instrumental VD	477 (11.0)	17/164 (10.4)	57 (10.0)	22 (8.7)	
Planned CS	839 (19.4)	38/164 (23.2)	89 (15.6)	33 (13.0)	
Emergency CS	857 (19.8)	39/164 (23.8)	117 (20.5)	82 (32.3)	
Emergency CS for NRFS	292 (6.7)	10/164 (6.1)	46 (8.1)	47 (18.5)	< 0.001
Induction of labor	1900 (43.9)	82 (49.7)	216 (37.9)	108 (42.5)	0.02
Preterm birth	503 (11.6)	47 (28.5)	108 (18.9)	92 (36.2)	< 0.001
5-min Apgar score < 4	16 (0.37)	2 (1.2)	5 (0.9)	2 (0.8)	0.06
Severe acidosis	39 (0.90)	1 (0.6)	7 (1.2)	3 (1.2)	0.74
Cardiopulmonary resuscitation	75 (1.7)	9 (5.5)	11 (1.9)	8 (3.1)	0.003
Severe respiratory distress	498 (11.5)	44 (26.7)	70 (12.3)	58 (22.8)	< 0.001
Composite severe neonatal morbidity	536 (12.4)	46 (27.9)	80 (14.0)	63 (24.8)	< 0.001
Stillbirth	10 (0.23)	1 (0.6)	4 (0.7)	3 (1.2)	0.02
Perinatal mortality	10 (0.23)	1 (0.6)	5 (0.9)	4 (1.6)	0.002

Data are given as mean ± SD, n (%) or n/N (%). Perinatal mortality was defined as stillbirth or neonatal mortality (within first 28 days after gestational age; VD, vaginal delivery.

Assessing the fetal growth trajectory in the latter half of pregnancy can help identify infants at increased risk of perinatal mortality and birth weight <3rd centile for gestation

Table 3 Multivariable analysis of perinatal outcomes and their association with fetal growth for infants delivered ≥ 32 weeks' gestation

Outcome	Group 1 (n = 165)*	Group 2 (n = 570)†	Group 3 (n = 254)‡
SGA at birth			
Crude OR	130.12 (73.10–231.62)	4.08 (3.29–5.06)	45.56 (33.47–64.76)
Adjusted OR§	111.86 (62.58–199.95)	3.65 (2.93–4.55)	40.63 (29.01–56.92)
Emergency CS for NRFS			
Crude OR	1.80 (1.10–2.95)	1.21 (0.88–1.68)	3.14 (2.24–4.40)
Adjusted OR§	1.62 (0.97–2.72)	1.19 (0.86–1.66)	2.83 (1.98–4.06)
Preterm birth			
Crude OR	3.03 (2.13–4.30)	1.78 (1.41–2.24)	4.32 (3.29–5.67)
Adjusted OR¶	3.08 (2.16–4.40)	1.83 (1.45–2.30)	4.27 (3.23–5.64)
Composite severe neonatal morbidity			
Crude OR	2.74 (1.92–3.89)	1.15 (0.90–1.49)	2.33 (1.73–3.15)
Adjusted OR**	2.73 (1.90–3.91)	1.13 (0.87–1.46)	2.15 (1.58–2.93)
Stillbirth			
Crude OR	2.63 (0.34–20.70)	3.06 (0.96–9.78)	5.18 (1.42–18.95)
Adjusted OR††	2.89 (0.37–22.80)	3.17 (0.99–10.17)	5.69 (1.55–20.93)
Perinatal mortality	not have significantly increased		
Crude OR	odds of demise 2.63 (0.34–20.70)	3.82 (1.30–11.22)	6.91 (2.15–22.19)
Adjusted OR††	2.94 (0.37–23.23)	4.00 (1.36–11.22)	7.71 (2.39–24.91)

Data in parentheses are 95% CI. Odds ratios (OR) were calculated relative to reference group (n = 4330), defined as appropriate forward growth (≤ 10-centile change in estimated fetal weight (EFW) or abdominal circumference (AC)) and EFW or AC between 25th and 75th centiles at final ultrasound (US) scan before delivery. Small-for-gestational age (SGA) at birth was defined as birth weight < 10th centile. Preterm birth was defined as birth < 37 + 0 weeks' gestation. Perinatal mortality was defined as stillbirth or neonatal mortality (within first 28 days after delivery). *Appropriate forward growth and EFW or AC persistently < 10th centile. †≥ 50-centile decline in forward growth and EFW or AC ≥ 10th centile at final US scan. ‡≥ 50-centile decline in forward growth and EFW or AC < 10th centile at final US scan. §Adjusted for maternal body mass index (BMI), smoking, diabetes and parity. ¶Adjusted for maternal BMI and parity. **Adjusted for maternal BMI, smoking, illicit drug use and parity. ††Adjusted for parity. CS, Cesarean section; NRFS, non-reassuring fetal status.

Fetal cranial growth trajectories are associated with growth and neurodevelopment at 2 years of age: INTERBIO-21st Fetal Study

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- cohort of pregnant women (n = 3,598), followed-up between 2012 and 2019 at six sites worldwide
- the associations between ultrasound-derived fetal cranial growth trajectories, measured longitudinally from <14 weeks' gestation, against international standards and growth and neurodevelopment up to 2 years of age
- identified five trajectories associated with specific neurodevelopmental, behavioral, visual and growth outcomes, independent of fetal abdominal growth, postnatal morbidity and anthropometric measures at birth and age 2

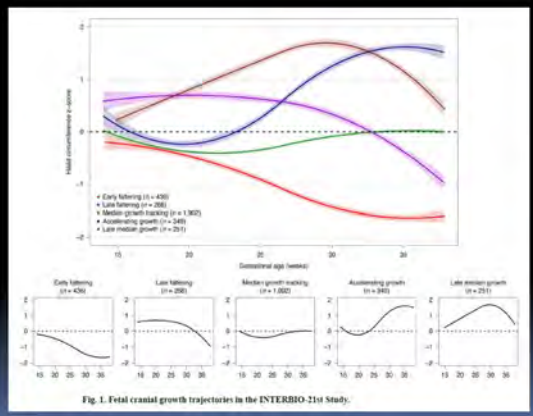

Fig. 1. Fetal cranial growth trajectories in the INTERBIO-21st Study.

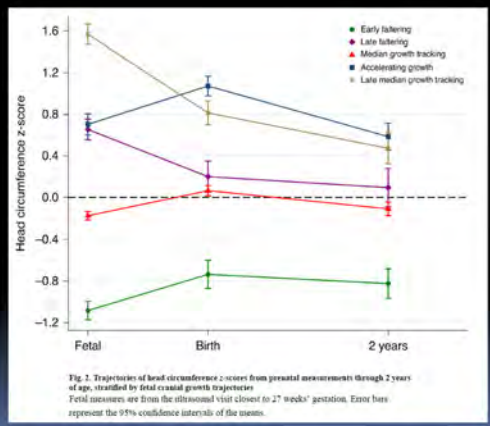

Fig. 2. Trajectories of head circumference z-scores from prenatal measurements through 2 years of age, stratified by fetal cranial growth trajectories.
Fetal measures are from the ultrasound visit closest to 27 weeks' gestation. Error bars represent the 95% confidence intervals of the means.

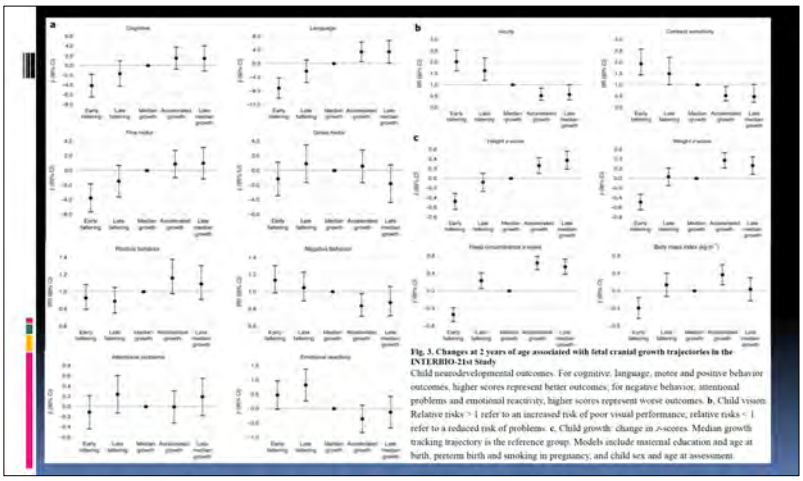

Fig. 3. Changes at 2 years of age associated with fetal cranial growth trajectories in the INTERBIO-21st Study
Child neurodevelopmental outcomes. For cognitive, language, motor and positive behavior outcomes, higher scores represent better outcomes; for negative behavior, intentional problems and emotional reactivity, higher scores represent worse outcomes. **b**, Child vision. Relative risks > 1 refer to an increased risk of poor visual performance, relative risks < 1 refer to a reduced risk of problems. **c**, Child growth: change in *Z*-scores. Median growth tracking trajectory is the reference group. Models include maternal education and age at birth, preterm birth and smoking in pregnancy, and child sex and age at assessment.

- The trajectories, which changed within a 20-25-week gestational age window, were associated with brain development at 2 years of age according to a mirror (positive/negative) pattern, mostly focused on maturation of cognitive, language and visual skills
- Further research should explore the potential for preventive interventions in pregnancy to improve infant neurodevelopmental outcomes before the critical window of opportunity that precedes the divergence of growth at 20-25 weeks' gestation

THE TAKE-HOME MESSAGE

- FGR은 어렵다! 그래서 이것저것 다 해봐야 한다!
- 태아가 작으면 내가 측정하는 초음파의 단면이 정확한지 다시 한 번 확인한다
- 초기 여러가지 평가 후 주기적으로 예측태아몸무게와 제대동맥을 포함한 도플러가 이상이 없는지 확인하고 NST 등을 이용한다
- 결국에는 태아의 성장이 멈추면서 양수양이 줄어들면 분만시기를 결정하고 초기에 작지 않은 태아도 잘 봐야 한다

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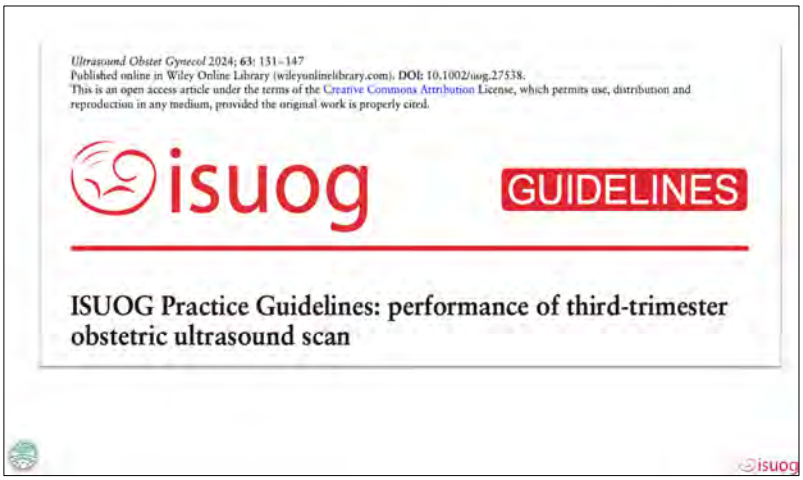
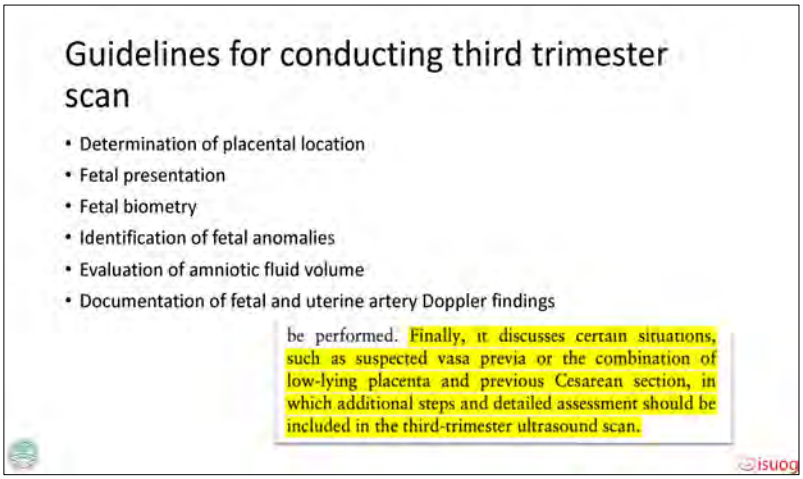
한국모자보건학회 학술위원

2024 ISUOG new guideline: Third trimester ultrasound

설 현 주

경희의대





GA for third trimester ultrasound scan

- 32-34 weeks: anatomy scan
- ~ 36 weeks: detection of growth deviation (LGA, SGA)
- GA estimation: HC + FL or HC alone

Recommendation

- The timing of the third-trimester scan, if indicated, between 32 and 36 weeks, should be decided based on individual maternal and fetal characteristics, the risk level of the pregnancy and local objectives and resources (**GOOD PRACTICE POINT**)

Fetal anomlies

- Some fetal anomalies were visible after the second trimester scan

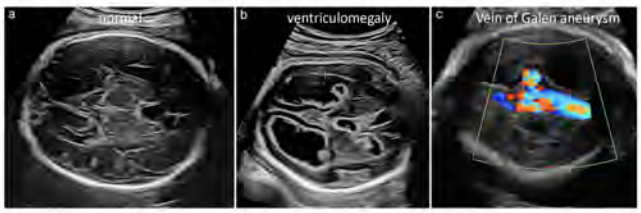
Ex) urogenital (55%), CNS (18%), heart (14%)

Recommendations

- Depending on the objectives of the third-trimester scan, anatomical evaluation may be undertaken and, if this is done, should target examination of the head, brain, heart, chest, abdomen and urinary system (**GRADE OF RECOMMENDATION: C**)

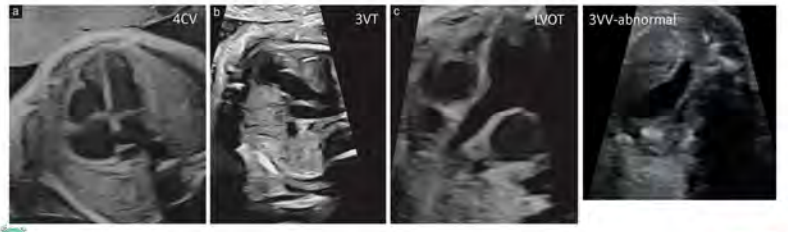
Head and brain

- Microcephaly: HC smaller than -3SDs from the mean associated with cortical anomalies and a sloping forehead
- Marked deformation combined with a small HC: craniosynostoses
- Agyria/lissencephaly/polymicrogyria/pachygyria



Heart

- Cardiothoracic circumference ratio (~0.45) < 0.5
- Mild asymmetry of the ventricles (right > left): normal



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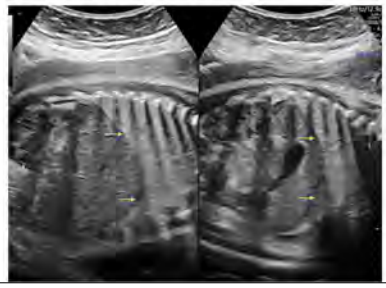
Chest

- The diaphragm: sagittal and coronal
- 20% of CDH are detected only in the third trimester



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Abdomen

- Fluid collection, calcifications, cystic structure
- Pathologic bowel dilatation: small bowel dilatation > 14 mm

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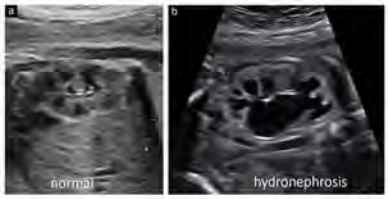
Urinary system

- Hydronephrosis
  - The normal limit of renal pelvis VP diameter < 7 mm
  - High risk of postnatal surgery > 15 mm
- Ureter (normally invisible) and bladder



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Placenta previa (1)

- The location of the placenta should be examined in any scan performed in the third trimester.
- Vasa previa/ velamentous cord insertion
- Transvaginal approach (PPV 99%, NPV 98%)/ transabdominal (FNV 2.3%)
- Previa with cervical length ≤ 3.1 cm

✓ increased risk of preterm birth < 34 weeks d/t hemorrhage
(sensitivity 83%, specificity 77%)

- Placental edge > 20 mm from cervical os: safe option for vaginal birth
- Placental edge 10-20 mm at 36 weeks: 56-93% successful vaginal birth

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Placenta previa (2)

Recommendations

- Assessment of placental location should be a component of third-trimester ultrasound (**GRADE OF RECOMMENDATION: C**). Women diagnosed with a low-lying placenta or placenta previa at the routine second-trimester scan should have a follow-up assessment for placental location in the third trimester.
- Women with major placenta previa or a uterine scar may be offered a scan at around 28 weeks, while women with minor placenta previa may be assessed later in the third trimester (**GOOD PRACTICE POINT**)
- The transvaginal approach is preferred in cases of suspected posterior placenta previa (**GRADE OF RECOMMENDATION: B**)

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Placenta accreta spectrum (PAS)

- previa (+) + prior cesarean section, myomectomy, multiple curettage

➔Increased risk of PAS

- Heterogeneity of ultrasonographic marker for PAS

➔~ 90%, diagnostic accuracy of USG for PAS

➔5-10%, only detectable during cesarean section

- Ultrasound signs of PAS should be assessed

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Ultrasonographic findings of PAS

✓loss of the retroplacental 'clear zone'
✓myometrial thinning
✓bladder-wall interruption and the presence of a placental bulge
✓exophytic mass
✓uterovesical hypervascularity
✓placental lacunae and bridging vessels

(a) Thickened placenta (arrows) abutting bladder (b) Placental lacunae with irregular uterovesical interface

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Placenta accreta spectrum (PAS)

Recommendations

- Women with placenta previa and prior Cesarean birth or uterine surgery should undergo a detailed ultrasound assessment to rule out PAS disorders (GRADE OF RECOMENDATION: C)
- Irrespective of ultrasound findings, a woman with placenta previa and a prior Cesarean birth or uterine surgery should be considered as a potential case of PAS and managed in a center with experience in the surgical management of morbidly adherent placenta (GOOD PRACTICE POINT)
- MRI can be considered in pregnancies at risk for PAS in uncommon locations, including pregnancies with posterior placenta previa and prior uterine scarring or if the placenta is implanted in the area of a prior myomectomy (GOOD PRACTICE POINT)
- MRI can be considered in the case of inconclusive ultrasound diagnosis or in cases of severe PAS, especially when parametrial invasion is suspected (GOOD PRACTICE POINT)
- Longitudinal assessment of fetal growth is not required in women with placenta previa or PAS unless other risk factors coexist (GRADE OF RECCOMENDATION: C)

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Abnormalities of amniotic fluid volume

- AFI or VDP (vertical deepest pocket)
- Oligohydramnios: AFI < 5 cm, VDP ≤ 2 cm
- Polyhydramnios: AFI > 25 cm, VDP > 8 cm
  mild: AFI, 25 – 30 cm; moderate: AFI, 30.1 – 35.0 cm; severe: AFI ≥ 35.1 cm

Oligohydramnios

- Fetal urinary system/ IUGR/ PROM
- Idiopathic (isolated oligohydramnios)
  - meconium aspiration (RR 2.83)
  - cesarean delivery for fetal distress (RR 2.10)
  - NICU admission (RR 1.71)
  - Stillbirth (few data)
- Uncertain optimal management: induction vs. expectancy
- AFI vs. DVP
  - more induction (12.7% vs. 3.6%)
  - abnormal cardiotocographic tracings (32.3% vs. 26.2%)
  - similar NICU admission (4.2% vs. 5.0%)

Polyhydramnios

- Maternal diabetes (20 – 25% of cases)
- Fetal abnormalities (GI obstructions/ cardiac/ CNS), placental tumors, fetal infections, conditions that result in anemia and hyperdynamic circulation, and chromosomal and genetic abnormalities
- Detailed sonographic examination/ MCA-PSV/ review of aneuploidy screening
- Idiopathic (50 – 60%): diagnosis of exclusion
  - higher risk of neonatal death (OR, 8.7),
  - intrauterine fetal demise (OR, 7.6)
  - NICU admission (OR, 1.9)
  - macrosomia (OR, 2.9)
  - Cesarean delivery (OR, 2.3)
- Spontaneous resolution of polyhydramnios, 38%

Management of polyhydramnios

- Mild idiopathic polyhydramnios in the third trimester: no treatment
- Symptomatic severe polyhydramnios: amnioreduction
- relatively uniform mild echogenicity of the amniotic fluid: vernix

Recommendations

- DVP is preferred over AFI for diagnosing isolated oligohydramnios, as it is associated with fewer inductions of labor, while having similar perinatal outcomes (**GRADE OF RECOMMENDATION: C**)
- The detection of polyhydramnios should lead to a targeted investigation for underlying causes, as idiopathic polyhydramnios is a diagnosis of exclusion (**GOOD PRACTICE POINT**)

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Recent perspectives on the management of the short cervix

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서울의대

최근 short cervix의 관리에 대한 연구가 활발히 진행되고 있다. Short cervix 는 조산의 위험을 증가시킬 수 있으며, 이에 따라 적절한 평가와 이에 따른 적절한 처치가 중요하다. 특히 프로게스테론과 같은 치료 방법이 도입되면서, 고위험군 뿐만 아니라 저위험군에서도 short cervix에 대한 평가와 관리가 더욱 강조되고 있다.

본 강의에서는 short cervix의 management 에 대한 최신지견과 임상적 관리 방안에 대해 살펴보고, 이를 통해 산모와 태아의 안전을 확보하는 데 필요한 다양한 접근법을 논의하고자 한다. 특히 치료 전략에 대한 구체적인 정보를 제공함으로써, 효과적인 관리 방안을 모색해보고자 한다.

1. 자궁경부 평가의 방법

(1) 초음파 탐촉자의 선택

자궁경부를 평가하는 방법으로는 경복부 (transabdominal) 초음파, 경회음 (translabial) 초음파, 경질 (transvaginal) 초음파로 평가하는 방법이 있다. 이 중 경질 초음파가 가장 널리 사용되고 있다.

복부 경유 초음파는 다음과 같은 단점 때문에 잘 사용되지 않는다.

- 방광을 채워서 봐야 하는 경우가 많은데 이 경우 자궁경부가 길어짐
- 태아의 신체의 일부 때문에 가려서 자궁 경부가 보이지 않는 경우가 있음
- 탐촉자와 자궁경부 사이의 거리가 상대적으로 멀기 때문에 영상의 질이 떨어짐

경회음 초음파는 경복부 초음파에 비해 영상의 질은 우수하지만,

- 직장 내의 가스로 인해 자궁 경부가 잘 평가가 되지 않는 경우가 있고

- 경질 초음파에 비해 습득이 조금 더 어려운 단점이 있다.

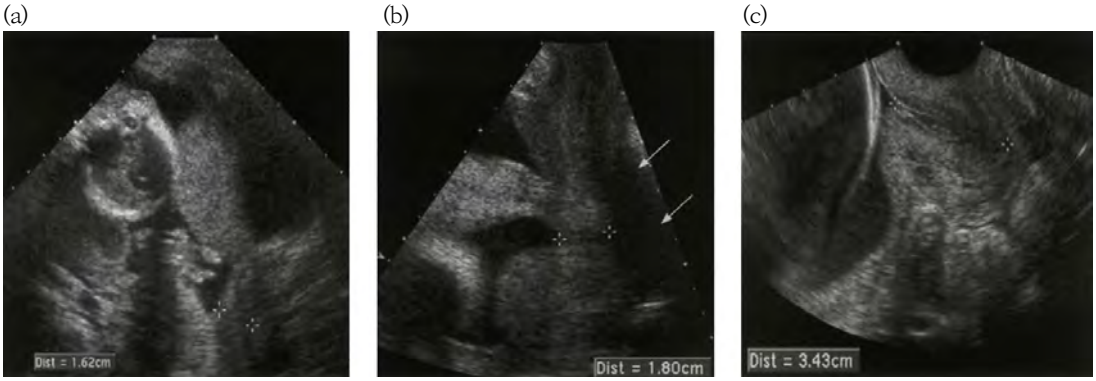

그림 1. (a) 경복부 초음파 (b) 경회음 초음파 (c) 경질 초음파를 이요한 자궁경부의 평가

(2) 경질 초음파를 통한 자궁 경부 평가의 방법(1)

1) 검사 전 방광을 비운다
2) 탐촉자에 커버를 씌어 준비한다
3) 탐촉자를 질 내에 삽입하고 anterior fornix 로 이동한다
4) 자궁목관 (endocervical canal) 의 장축 이미지를 확인한다
5) 탐촉자를 조금 뒤로 뺐다가 자궁목관의 장축 이미지가 보이는 최소한의 압력을 가하는 수준까지만 전진한다 (과한 압력은 자궁경부를 길어 보이게 만들 수 있다)
6) 자궁 경부가 전체 영상의 2/3 이상을 차지하도록 이미지를 확대한다
7) 자궁내구 (internal os)로부터 자궁입구 (external os)까지 길이를 측정한다
8) 최소한 3번 이상 측정하고 가장 짧은 길이를 기록한다
9) Transfundal pressure 를 약 15 초간 가하고 자궁경부 변화를 확인한다

5% 미만의 일부의 환자에서는 자궁경부 길이를 측정하는 시간 동안 자궁경부 길이가 변할 수 있다. 자궁의 수축이나 transfundal pressure 를 가하면서 생길 수 있는데 (그림 2), 이런 자궁 경부 길이의 변화가 확인되었을 때 가장 짧은 자궁경부 길이가 조산의 위험을 가장 잘 예측할 수 있는 것으로 알려져 있기 때문에 가장 짧은 자궁 경부 길이를 기록하는 것이 추천된다(2).

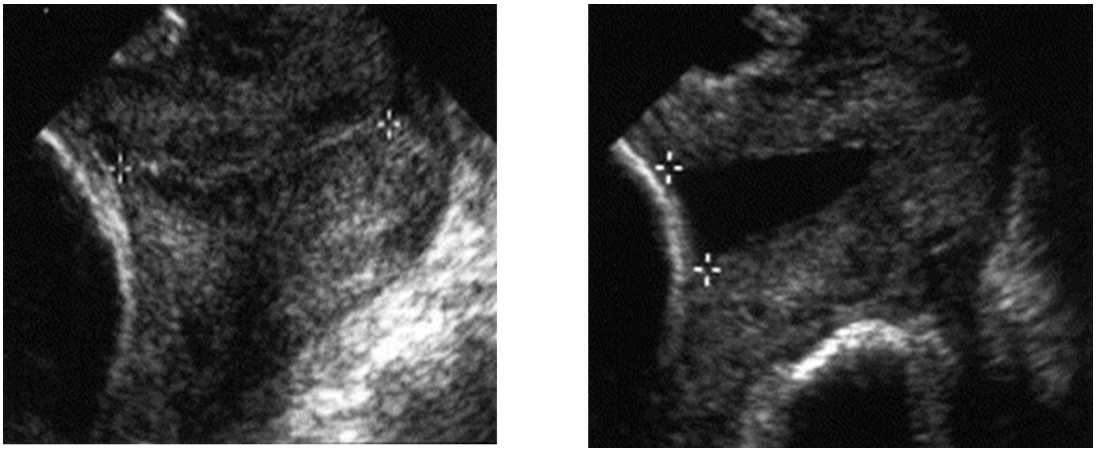

그림 2. 자궁경부 길이의 변화 (자궁 수축이 없을 때 (좌) 와 자궁 수축이 있을 때 (우)). 이 경우 가장 짧은 자궁 경부 길이를 기록하도록 권고된다.

(3) 자궁경부를 평가하기 위한 적절한 임신 주수

임신 14주 전에는 임신낭이 자궁의 아래 부분을 완전히 확장시키기에 충분한 크기가 아니기 때문에 이 시기에는 자궁 하부 (lower uterine segment) 와 자궁경부를 구별하기가 힘들다. 그래서 이 시기에는 자궁경부 길이를 측정하는 것이 용이하지 않다. 이 때문에 실제 조산의 고위험군에서도 임신 10-14주 사이에 자궁경부 길이가 25mm 이하인 경우는 5%에 불과하며 실제 나중에 조산을 한 환자도 이 시기의 평균 자궁경부 길이는 33.7mm 였는데, 이는 같은 군에서 14-24주에 다시 측정한 평균 자궁 경부 길이가 25mm 이하인 경우는 36% 이고, 나중에 조산을 한 환자 중 이 시기의 평균 자궁경부 길이가 18.7mm 인 것과 비교되는 소견이다(3). 또한 임신 14-18주에는 자궁 수축으로 자궁 하부가 서로 맞닿아서 마치 자궁경부처럼 보일 수 있기 때문에 주의해야 한다.

반면, 임신 30주 이후에는 정상 parturition 의 과정으로도 자궁경부가 짧아질 수 있기 때문에 특히 무증상 산모에서 짧은 자궁경부 길이는 조산의 위험과의 관련성은 높지 않다(4).

2. 짧은 자궁경부 길이나 진통 없는 자궁경부 개대

2.1. 짧은 자궁 경부 길이

산모에서 짧은 자궁경부 길이가 확인 되었을 때 조산의 위험이 증가되어 있는지 그리고 그에 따른 특정한 처치가 필요한지에 대해서는 산모의 증상과 과거력에 따라 상이하다 (표 1).

표 1. 자궁경부길이 측정과 조산의 위험도

연구 대상	측정 주수	대상 수	조산의 정의	조산 (%)	자궁경부길이 경계 (mm)	민감도 /특이도	양성예측도 /음성예측도
무증상							
저위험군(5)	22-25	2915	〈35 주	4.3	25	0.37/0.92	0.18/0.97
조산의 과거력(6)	16-24	183	〈35 주	26	25	0.69/0.80	0.55/0.88
자궁경부원추절제술(7)	16-24	109	〈35 주	13	25	0.64/0.78	0.30/0.94
쌍태임신(8)	22-24	147	〈35 주	32	25	0.30/0.88	0.54/0.74
유증상							
조기진통(9)	19-36	200	〈37 주	41	30	0.83/0.88	0.54/0.80

짧은 자궁경부 길이가 확인된 환자들에서 시행할 수 있는 처치는 자궁경부 봉축술 및 프로게스테론 투여가 있다.

(1) 자궁경부 봉축술

현재 임신에서 짧은 자궁경부길이가 발견되었을 때 자궁경부 봉축술 효과는 다른 조산의 고위험 요소의 유무에 따라 상이한 결과를 보였다. 일반 산모를 대상으로 한 경우 47,123명의 일반 산모를 대상으로 자궁경부길이를 측정하였을 때 이 중 자궁경부길이가 15mm이하인 산모는 470명 (1%)였다(10). 이 중 253명이 연구대상이 되어 자궁경부 봉축술 군 또는 대조군에 무작위 배정되었고, 그 결과 조산율은 두 군간에 차이가 없었다.

반면 현재 임신에서 짧은 자궁경부 길이와 함께 다른 조산의 고위험 요소를 동시에 가진 군에서는 자궁경부 봉축술의 유용성에 대해 일치된 결과가 보고되고 있진 않으며, 이는 연구 대상군이 혼재되

표 2. 짧은 자궁경부길이를 가진 산모에서 자궁경부 봉축술의 효과에 대한 연구 대상에 따른 다른 결과(11)

연구대상	임신 결과	상대위험도 (95% 신뢰구간)
전체 연구대상*	조산 (〈35 주)	0.84 (0.71-0.99)
단태임신		
단태임신 전체*	조산 (〈35 주)	0.74 (0.57-0.96)
조산의 저위험군	조산 (〈35 주)	0.76 (0.52-1.15)
기왕의 조산력 (〈37 주) *	조산 (〈35 주)	0.63 (0.48-0.85)
기왕의 조산력 (16~23 주) *	조산 (〈35 주)	0.57 (0.33-0.99)
자궁경부원형절제술	조산 (〈35 주)	1.18 (0.57-2.45)
D&E 〉 1회	조산 (〈35 주)	0.91 (0.57-1.47)
쌍태임신	조산 (〈35 주)	2.15 (1.15-4.01)

* : 유의한 차이를 보이는 군

어 있음에 기인할 것으로 생각된다. 실제 Berghella 등(11) 11)의 메타분석에 의하면 연구 대상에 따라, 단태임신 중 특히 이전에 조산의 과거력이 있는 여성에서는 자궁경부 봉축술이 조산율을 유의하게 줄이는 효과를 보였으나, 쌍태임신에서는 조산율이 오히려 증가하는 양상을 보였고, 이전에 자궁경부원형절제술을 시행한 산모에서는 조산율이 차이가 없었다(표2).

2024년 8월 발표된 SMFM 가이드라인에서는 이전의 조산 과거력이 없는 임산부의 경부길이가 10-25mm 일 경우, 자궁경부가 개대되어 있지 않는 이상 자궁경부 봉축술을 시행하지 않도록 권하고 있다

경부길이 10mm 미만인 경우의 자궁경부 봉축술의 필요성에 대해서는 근거가 부족하다.

일부 문헌에서는 progesterone 사용에도 불구하고 경부길이가 10mm 미만인 경우 자궁경부봉축술을 고려해볼 수 있다고 하나(12), 대부분 후향적 연구에 의한 것이며 quality of evidence가 낮아 명확한 권고사항으로 고려되지는 않는다. 2024년 SMFM 가이드라인에서는, 경부 길이 10mm 미만인 경우, 자궁경부개대가 없는 경우라도 shared decision making 을 통해 자궁경부봉축술을 시행할 수는 있다고 기술하고 있다.

또한, 경부길이가 11mm 또는 15mm 미만으로 매우 짧은 경우, 자궁경부 개대가 1cm 이상인 경우가 30-70% 가량으로 보고되었으므로(13-15), 경부 길이가 11mm 또는 15mm 미만인 경우에는 cervical examination 을 시행하여, examination-indicated cerclage 의 candidate 가 되는지를 확인해야 한다.(16)

(2) 프로게스테론 투여

짧은 자궁경부길이를 보이는 산모에서는 프로게스테론 투약이 이전의 조산의 과거력 유무에 상관없이 조산을 예방하는 것으로 보고되었다. 무증상 일반 산모에서 발견된 짧은 자궁경부길이의 경우, Fonseca 등(17) 은 임신 20-25주의 무증상 산모 24,620명을 대상으로 자궁경부길이를 측정하여 15mm 미만의 짧은 자궁경부길이를 가진 산모 413명을 선별하여 이들에게 임신 24-34주 동안 프로게스테론 질정 200mg 을 투약하였다. 그 결과 조산의 빈도 및 신생아 패혈증이 감소하는 효과를 확인할 수 있었다. Hassan 등의 연구에서도 짧은 자궁경부 길이가 확인된 산모를 대상으로 vaginal progesterone gel (90mg/d) 를 투여한 군에서 33주 미만의 자연 조산율이 약 절반 정도 감소한 것으로 보고되었다(18). 이 연구 대상 중 16% 는 이전에 조산의 과거력이 있는 산모들이었는데, 이런 자연조산의 과거력을 가진 산모를 제외하고 조산의 과거력이 없는 여성만을 대상으로 분석하였을 때도 프로게스테론 투약은 조산의 위험을 낮추는 것으로 보고되었다.

이전 조산의 과거력이 있는 고위험군에서 발견된 짧은 자궁경부길이의 경우, 이전의 조산병력이

있는 임신 18-22+6 주 사이의 산모에서 progesterone vaginal gel 또는 위약을 투약하였는데(19), 이 중 자궁경부길이가 28mm미만으로 짧은 산모 46명을 대상으로 분석한 결과, 프로게스테론 투약군에서 조산 및 신생아중환자실 입원의 빈도가 유의하게 낮았다(20).

2024년 8월 발표된 SMFM guideline 에 따르면, 증상이 없는 24주 미만 단태아 산모의 질초음파로 측정한 경부 길이가 20mm 이하인 경우 조산의 위험을 감소시키기 위해 질내 프로게스테론을 사용하는 것을 권고한다. 경부 길이 21-25mm 에서의 프로게스테론 사용에 대해서는 shared decision making 할 것을 권하고 있다.(16)

프로게스테론의 다른 유형인 17α-hydroxyprogesterone caproate의 효용에 대해서는, Grobman 등의 연구에 따르면 30mm 미만의 짧은 자궁경부 길이를 가진 초산모를 대상으로 17α-hydroxyprogesterone caproate를 투여한 군과 그렇지 않은 군을 비교하였을 때 조산의 위험이 감소하지 않았다(21). 또한 25mm 미만의 짧은 자궁경부 길이를 가진 조산의 고위험군을 대상으로 한 연구에서도 17α-hydroxyprogesterone caproate 의 투여가 조산의 위험을 감소시키지 않았다(22). 이 때문에 짧은 자궁경부 길이를 가진 여성에서 17α-hydroxyprogesterone caproate 의 사용은 현재로서는 권장되지 않는다.

2023년 미국 FDA 는 17-a-hydroxyprogesterone caproate 에 대한 승인을 efficacy 부족을 이유로 철회하였다.(16)

한편, 자궁경부 봉축술과 프로게스테론의 동시 사용에 대해서는 아직 근거가 부족한 실정이다.

(3) 자궁경부 페서리

자궁경부 페서리 사용에 대한 여러 대규모 무작위 임상시험이 진행되었으나, 조산 위험 감소에 대한 일관되지 않은 결과가 보고되었다. 또한 일부 연구 결과에서는 페서리를 사용한 경우 신생아 또는 태아 사망률이 일반 치료 그룹보다 높게 나타나기도 하였다.

따라서, 짧은 자궁 경부에 대해 자궁경부 페서리를 사용하는 것은 일관된 데이터가 부족하고, 잠재적인 안전문제가 있으므로, SMFM 가이드라인에서는 조산 예방을 위한 자궁경부 페서리 사용을 권장하지 않는다.

2.2. 진통 없는 자궁경부 개대

임신 중기에 진통이나 양막 파수 없이 자궁경부가 개대 되거나 양막이 팽윤되어 (bulging) 우연히 발견되는 경우가 있다. 진단을 위해서는 진찰 소견으로 자궁 경부 개대를 확인해야 하지만 복식 또는 질식 초음파 상 자궁 경부 개대 또는 양막 팽윤 소견이 먼저 발견되기도 한다 (그림 3).

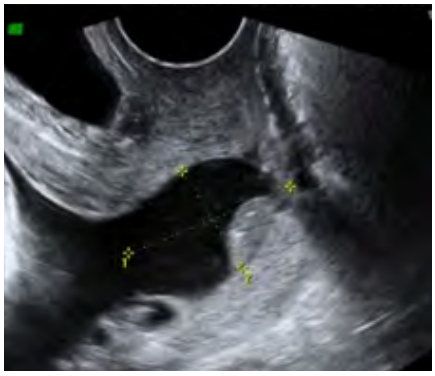

그림 3. 임신 20주에 증상 없이 자궁 경부가 개대된 산모의 질식 초음파 사진.

이런 산모의 경우 응급 자궁경부 봉축술 (Physical examination-indicated cerclage)을 고려해 볼 수 있다. 이런 산모를 대상으로 응급 자궁경부 봉축술에 대한 최근의 연구에서는 대부분 자궁경부 봉축술이 조산의 위험을 낮추는 효과를 보이고 있다(표 3). 하지만 대규모의 무작위 임상시험 결과는 부재한 상태이므로, ACOG 에서는 자궁경부 개대가 있는 산모에서 자궁경부 봉축술을 시행하고자 할 때는 현재 연구 결과들의 제한점 및 한계에 대해 같이 상담할 것을 권고하고 있다(23) 23)

표 3. 응급 자궁경부 봉축술 결과

저자	연구대상	대상 수	대상기준	자궁경부 봉축술 시행 주수	대조군	결과
Olatunbosun(24)	단태임신	43	자궁경부 개대〉 4 cm	20-27	침상안정	분만 주수 연장, 분만 체중 증가
Althuisius(25)	단태임신 또는 쌍태임신	23	양막이 개대된 자궁경부 또는 그 밑으로 내려온 경우	〈27	침상안정	조산 (〈34주) 감소 (53.8% vs 100%)
Daskalakis(26)	단태임신 또는 다태임신	46	자궁경부 개대 및 양막 팽윤 (bulging)	18-26	침상안정	조산 (〈32주) 감소 (31% vs 94.1%)

하지만, 임신 중기에 진통이나 양막 파수 없이 자궁경부가 개대되거나 양막이 팽윤 (bulging)되어 있는 산모에서 프로게스테론의 효능에 대해서는 아직 연구가 부족한 실정이다.

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제27차 대한산부인과초음파학회
추계학술대회

Luncheon symposium

좌장 : 김 암 (을지의대)
김사진 (가톨릭의대)

Korean Society of Ultrasound
in Obstetrics and Gynecology

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- [아름, 다운 증후군] (꿈꿀자유, 2024, 공저)
- [임신당뇨병, 걱정하지 마세요] (마루, 2023, 공저)

임신 제 1삼분기 및 2, 3 삼분기 정밀초음파 체크리스트: 대한산부인과초음파학회

오 수 영

성균관의대

KSUOG 제 1삼분기 초음파 체크리스트 (제태 연령 11-14주)

Patient: **ID number:**

Date of birth:

Date of exam:

Sonographer/Supervisor:

Number of fetus: ☐ Singleton ☐ Twins: ☐ triplet ☐ others ( )

Number of chorion[2]: ☐ 1 ☐ 2 ☐ 3 ☐ Number of amnion[2]: ☐ 1 ☐ 2 ☐ 3 ☐

Fetus ☐A ☐B ☐C			
Fetal heart beat[2]	☐Yes ☐No	( ) bpm	
CRL	( ) mm	( ) week	
Uterus and adnexa	☐Normal ☐Abnormal Findings:		
Nuchal translucency[4]	( ) mm	( ) percentile	
Head and brain	Shape, ossification	☐Normal ☐Abnormal ☐Not visualized	
	Falx, choroid plexus	☐Normal ☐Abnormal ☐Not visualized	
Heart	Intrathoracic position	☐Normal ☐Abnormal ☐Not visualized	
	Regular rhythm	☐Normal ☐Abnormal ☐Not visualized	
Abdomen	Stomach	☐Normal ☐Abnormal ☐Not visualized	

	Abdominal wall[5]	□Normal □Abnormal □Not visualized
	Bladder	□Normal □Abnormal □Not visualized
Extremities	Upper limbs with three segments	□Normal □Abnormal □Not visualized
	Lower limbs three segments	□Normal □Abnormal □Not visualized
Placenta[6]	Normal appearance	□Normal □Abnormal □Not visualized
Causes for Not-visualization	□ fetal position □ maternal obesity □ others ( )	
Conclusion:	□ Normal and complete examination. □ Normal but incomplete examination: Recheck: □ Abnormal examination: Detailed findings:	
Diagnosis		
Plan		

ISUOG recommendations (good practice point)

- ALARA (as low as reasonably achievable)의 원칙을 따라 검사를 진행합니다.

1. 1삼분기 초음파는 경복부, 경질 초음파 모두 가능합니다.
2. 다태 임신의 경우 융모막성(chorionicity)과 양막성(amniocity)의 평가가 이루어져야 합니다.
3. 태아의 생존성 평가가 이루어진 후 자궁 전체를 스캔하여 자궁내 임신 여부를 확인합니다. 특히 이전에 제왕절개 병력이 있다면 제왕절개 반흔에 임신낭이 위치해 있는지 확인합니다.
4. 다음과 같은 조건을 충족시키며 태아 목덜미 투명대를 평가합니다.
   A. 태아의 정중시상면에서 측정합니다.
   B. 태아의 머리와 흉부만 포함되도록 확대합니다.
   C. 캘리퍼가 0.1mm 단위로 측정할 수 있도록 확대합니다.
   D. 목덜미 영역 전체를 평가하고 최대 두께에서 평가합니다.
   E. 태아의 중립적인 자세에서 평가합니다. (과도한 신전이나 굴곡을 피합니다.)
   F. 태아가 양막에서 분리되어 적절한 공간이 측정되도록 합니다.

Table 1. The expected 5th, 50th, and 95th percentile values of nuchal translucency (NT) with crown-rump length (CRL)

CRL (mm)	Expected nuchal translucency (mm)		
	5th percentile	50th percentile	95th percentile
40	0.31	1.22	2.14
45	0.40	1.32	2.24
50	0.50	1.42	2.34
55	0.60	1.52	2.44
60	0.70	1.62	2.54
65	0.80	1.72	2.64
70	0.90	1.82	2.73
75	0.99	1.91	2.83
80	1.09	2.01	2.93
85	1.19	2.11	3.03

출처: Chung et al. The distribution of fetal nuchal translucency thickness in normal Korean fetuses. J Korean Med Sci. 2004 Feb;19(1):32-6.

5. 생리적 탈장이 11주까지 존재하므로 복벽에서 탯줄 삽입부에 대한 평가는 12주 이후에 시행합니다.
6. 태아와 태반, 자궁 전체적인 스캔을 시행합니다. 태반은 균일하고 균질한 에코 텍스쳐를 가져야 하며, 낭종이나 빈 공간, 태반하 출혈 등을 평가합니다. 자궁에서는 근종, 양막 띠, 자궁 유착 유무를 평가합니다.

KSUOG 제 2삼분기 중기 (정밀) 초음파 체크리스트

Patient: **ID number:**

Date of birth:

Date of exam:

Sonographer/Supervisor:

Indication for scan:

Number of fetus: ☐ Singleton ☐ Twins: ☐ triplet ☐ others ( )

Number of chorion[2]: ☐ 1 ☐ 2 ☐ 3 ☐ Number of amnion[2]: ☐ 1 ☐ 2 ☐ 3 ☐

Placenta	☐Anterior ☐posterior ☐Fundus ☐Rt lateral ☐Lt lateral		
	Relation to cervical os: ☐clear ☐covering __mm from os ☐Placenta previa ☐ suspected PAS		
	Appearance: ☐Normal ☐Abnormal		
Umbilical cord	☐ 2A 1V, ☐ 1A 1V ☐Normal ☐Abnormal		
Umbilical cord (optional)	☐ Vasa previa	☐ Velamentous insertion	
Amniotic fluid	☐Adequate ☐Increased ☐Decreased, AFI ( ) cm (SDP : cm)		
Fetal movement	☐Normal	☐Abnormal	
Biometry	mm		
Biparietal diameter		( ) percentile or ( ) weeks sized	
Head circumference		( ) percentile or ( ) weeks sized	
Abdominal circumference		( ) percentile or ( ) weeks sized	
Femur diaphysis length		( ) percentile or ( ) weeks sized	
Humerus length (optional)		( ) percentile or ( ) weeks sized	
EFW		( ) percentile or ( ) weeks sized	
Cervical length (optional)	☐TA ☐TV length ( ) cm, Funneling : ☐No ☐Yes		
SONOGRAPHIC APPEARANCE OF FETAL ANATOMY:			
HEAD			
Intact cranium/normal shape	☐Normal	☐Abnormal	☐Not visualized
Cavum septi pellucidi	☐Normal	☐Abnormal	☐Not visualized
Midline falx	☐Normal	☐Abnormal	☐Not visualized
Choroid plexus	☐Normal	☐Abnormal	☐Not visualized
Thalami	☐Normal	☐Abnormal	☐Not visualized
Lateral ventricle	Atrial diameter: Rt ( ) mm Lt ( ) mm		
	☐Normal	☐Abnormal	☐Not visualized
Cerebellum	( ) mm, ( ) weeks sized		
	☐Normal	☐Abnormal	☐Not visualized
Cisterna magna	( ) mm		

	☐Normal	☐Abnormal	☐Not visualized
Nuchal fold (optional)	( ) mm in thickness		
FACE and NECK			
Lips and nostrils	☐Normal	☐Abnormal	☐Not visualized
Orbits and bulbs	☐Normal	☐Abnormal	☐Not visualized
Midsagittal profile (optional)	☐Normal	☐Abnormal	☐Not visualized
Maxilla & mandible (optional)	☐Normal	☐Abnormal	☐Not visualized
Ears (optional)	☐Normal	☐Abnormal	☐Not visualized
Neck mass	☐Normal	☐Abnormal	☐Not visualized
THORAX			
Shape	☐Normal	☐Abnormal	☐Not visualized
Cyst or mass	☐No ☐Yes		
Pleural effusion	☐No ☐Yes Maximal depth ( ) cm		
HEART			
Heart rate	☐Normal	☐Abnormal	☐Not visualized
Size	☐Normal	☐Abnormal	☐Not visualized
Cardiac axis and situs	☐Normal	☐Abnormal	☐Not visualized
Four-chamber view	☐Normal	☐Abnormal	☐Not visualized
Left ventricular outflow tract	☐Normal	☐Abnormal	☐Not visualized
Right ventricular outflow tract	☐Normal	☐Abnormal	☐Not visualized
3VV and 3VT	☐Normal	☐Abnormal	☐Not visualized
Thymus (optional)	☐Normal	☐Abnormal	☐Not visualized
ABDOMEN			
Stomach	☐Normal	☐Abnormal	☐Not visualized
Liver	☐Normal	☐Abnormal	☐Not visualized
Bowel	☐Normal	☐Abnormal	☐Not visualized
Abdominal wall	☐Normal	☐Abnormal	☐Not visualized
Gallbladder (optional)	☐Normal	☐Abnormal	☐Not visualized
Genito-urinary			
Kidneys	AP diameter: Rt ( ) mm Lt ( ) mm		
	☐Normal	☐Abnormal	☐Not visualized
Bladder	☐Normal	☐Abnormal	☐Not visualized
Cord insertion	☐Normal	☐Abnormal	☐Not visualized
External genitalia (optional)	☐ M ☐ F		
	☐Normal	☐Abnormal	☐Not visualized
SPINE	☐Normal	☐Abnormal	☐Not visualized
LIMBS*			
Right arm and hand	☐Normal	☐Abnormal	☐Not visualized
Left arm and hand	☐Normal	☐Abnormal	☐Not visualized
Right leg and foot	☐Normal	☐Abnormal	☐Not visualized

Left leg and foot	☐Normal	☐Abnormal	☐Not visualized
Causes for non-visualization	☐ Fetal position ☐ Maternal obesity ☐ Others ( )		
Conclusion: ☐ Normal and complete examination. ☐ Normal but incomplete examination: Recheck: ☐Abnormal examination: Detailed findings:			
☐ Explained that the detection rate for fetal structural anomalies is known to be approximately 70-80% by mid-trimester ultrasound scan and some abnormality may become apparent only later in pregnancy or after birth.			
Diagnosis:			
Plan:			

** Counting fingers or toes are not required as part of the routine mid-trimester scan*

ISUOG recommendations (good practice point)

- ALARA (as low as reasonably achievable)의 원칙을 따라 검사를 진행합니다.

▷ **머리**
- 두개골 검사는 크기, 형태, integrity, bone density 평가를 포함합니다.
- 뇌 검사는 두개의 평면(transventricular and transthalamic plane)을 포함하여 대뇌 반구를 평가하고, 추가로 transcerebellar plane을 포함하여 후두부를 평가합니다.

▷ **얼굴**
- 얼굴은 윗입술을 확인하고 안와/눈의 위치와 존재여부 평가, 가능하다면 midsagittal profile 평가합니다.

▷ **목**
- 목은 일반적으로 원통형으로 보이며, 돌출된 부분, 덩어리 또는 액체 저류가 없어야 합니다. 목의 종양 여부를 확인합니다.

▷ **흉부**
- 흉부의 형태와 복부로의 연결, 갈비뼈의 형태, 양쪽 폐의 질감, 횡격막을 확인합니다.

▷ **심장**
- 심장은 기본적으로 위치와 축, 리듬을 평가하는 것부터 시작합니다.
- 해부학적 검사는 four-chamber view, outflow tract views, three-vessel view를 포함합니다.

▷ **복부**
- 위의 존재와 위치 및 형태를 평가합니다.
- 왼쪽에서 오른쪽으로 위, 제대정맥, 담낭을 차례로 확인합니다.

- 태아의 제대 삽입 부위를 검사합니다.
- 내 또는 장 주위의 비정상적인 액체가 없는지 확인합니다.
- 장의 echogenicity 가 뼈와 동등하게 증가한 경우 의뢰가 필요합니다.

▷ **비뇨생식기**
- 태아의 방광과 양쪽 신장을 확인합니다.
- 방광이나 신우가 확장되어 보이는 경우, 상세한 평가가 필요합니다.
- 생식기의 정상적인 모양을 확인합니다.

▷ **척추**
- 가로 및 시상면을 모두 확인합니다.

▷ **사지 및 팔다리**
- 장골을 확인하고 대칭, 길이, 형태, 정렬 및 움직임을 평가합니다.

▷ **태반**
- 태반의 자궁경부 내경과의 관계를 검사합니다.
- 태반의 하부 가장자리와 자궁경부 내경 사이의 거리가 15mm 이하일 경우, 제 3삼분기에서 추적 검사를 권고합니다.
- Vasa previa의 위험요소가 있으면 질초음파를 이용하여 집중 검사가 필요합니다.

By KSUOG 초음파 지침 TFT

이기수 (계명의대), 정진하 (인제의대), 권하얀 (연세의대), 이미영 (울산의대), 차현화 (경북의대)
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2015-2020	부교수, 가톨릭대학교 의정부성모병원 산부인과
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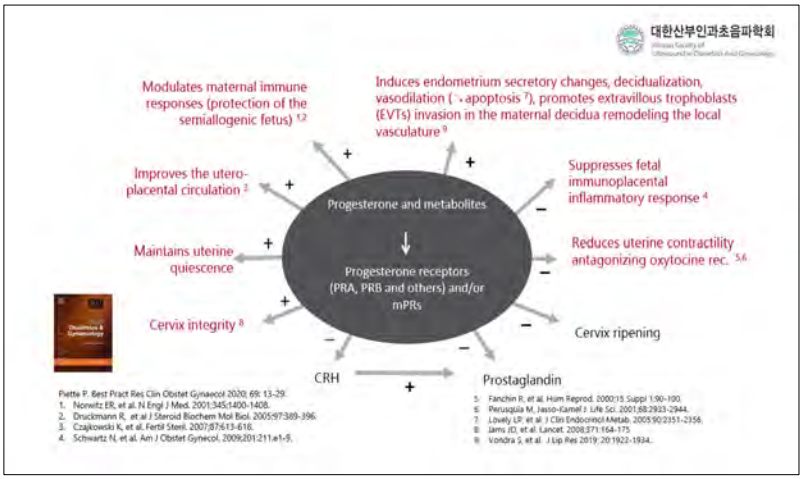
대한모체태아의학회 고혈압연구회
대한모체태아의학회 산전약물상담연구회
생식독성학 연구회
한국의약품안전관리원 자문위원

유산방지를 위한 프로게스테론의 효능

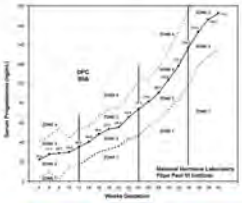
김 연 희

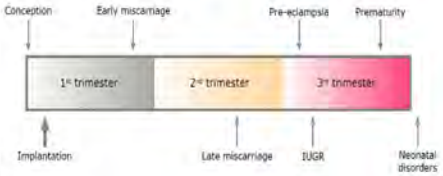
가톨릭의대



대한산부인과초음파학회

Progesterone is crucial during the all pregnancy





Low progesterone in early pregnancy is associated with threatened miscarriage

Piette P et al. Clin Obstet Gynaecol 2020
Quenby S, et al. Lancet 2021
Rai R, et al. Lancet 2006
Coomarasamy A Lancet 2021

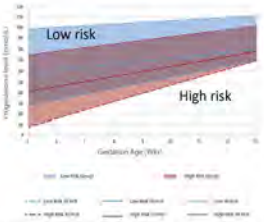
대한산부인과초음파학회

Etiology of Miscarriage

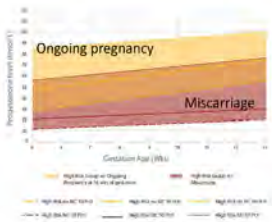
- Chromosomal abnormality (>50%), other genetic etiologies
- Luteal phase defects
- Diabetes, thyroid function abnormalities
- Anatomic factor
- Infections
- Acquired thrombophilia (antiphospholipid syndrome)
- Exogenous agents
- Unexplained causes

대한산부인과초음파학회

Serum progesterone distribution in threatened miscarriage



serum progesterone across gestation weeks
5-13 amongst women with normal pregnancy [NP] vs threatened miscarriage [TM]



Subgroup analysis of TM : ongoing pregnancy vs spontaneous miscarriage

Ku et al. BMC Pregnancy and Childbirth 2018; 18(1): 360-366

Pregnancy is continuum

대한산부인과초음파학회

Bleeding in early pregnancy
Increased risk of miscarriage and preterm delivery ≤34 weeks in ongoing pregnancy [1,2]

Recurrent miscarriage
In women with ≥ 3 previous miscarriages, the risk of miscarriage in subsequent pregnancies exceeds 40 % [2]

The risk of preterm birth demonstrates a biological gradient, with the highest rates observed in women who have had three or more previous miscarriages[2]

1.van Oppenraaij et al. Human Reproduction Update, 2009
2.Coomarasamy A et al. Lancet. 2021
3. Quenby S et al. Lancet. 2021

Progestogens and preventing miscarriage: a meta-analysis

Cochrane Library
Cochrane Database of Systematic Reviews

Cochrane Database of Systematic Reviews 2021, Issue 4. Art. No.: CD0137922021, Issue 4

- Searched for evidence in December 2020 and seven studies involving 5,682 women (6 comparison studies with placebo)
- Patients : threatened miscarriage, or had a history of 3 or more previous miscarriages (recurrent miscarriage)
- Four different progestogens treatments
  - ✓vaginal micronized progesterone
  - ✓oral dydrogesterone
  - ✓oral micronized progesterone
  - ✓17-alpha-hydroxyprogesterone intramuscular injection

Devall AJ, et al. Cochrane Database Syst Rev. 2021;4(4):CD013792.

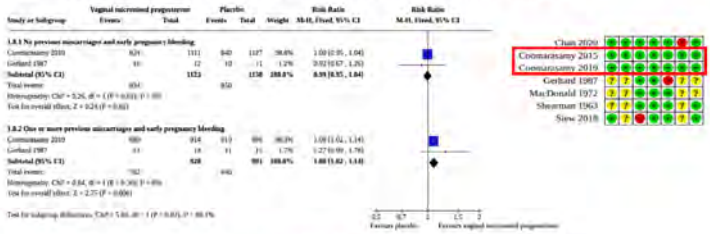
Summary : Live birth (progestogens vs placebo)

VMP

Treatment	Direct evidence		Indirect evidence		Anticipated absolute effects for direct estimate		
	RR (95% CI)	Certainty	RR (95% CI)	Certainty	Risk with intervention	Risk with comparator	Risk difference with intervention
Threatened miscarriage							
Vaginal micronized progesterone versus placebo	1.03 (1.00, 1.07)	⊕⊕⊕⊕ HIGH	Unavailable	-	761 per 1000 (vaginal micronized progesterone)	725 per 1000 (placebo)	**36 more per 1000** (from 36 fewer to 123 more)
Subgroup analysis: number of previous miscarriages							
No previous miscarriages and early pregnancy bleeding	0.99 (0.95, 1.04)	⊕⊕⊕⊕ HIGH	Unavailable	-	739 per 1000 (vaginal micronized progesterone)	747 per 1000 (placebo)	**7 fewer per 1000** (from 37 fewer to 30 more)
One or more previous miscarriages and early pregnancy bleeding	1.09 (1.02, 1.14)	⊕⊕⊕⊕ HIGH	Unavailable	-	755 per 1000 (vaginal micronized progesterone)	699 per 1000 (placebo)	**56 more per 1000** (from 14 more to 105 more)
Dydrogesterone versus placebo	0.98 (0.89, 1.07)	⊕⊕⊕○ MODERATE[a]	Unavailable	-	816 per 1000 (dydrogesterone)	833 per 1000 (placebo)	**17 fewer per 1000** (from 92 fewer to 58 more)
17-α-hydroxyprogesterone versus placebo	Unavailable	-	Unavailable	-	See comment[a]	See comment[b]	See comment[c]
Oral micronized progesterone versus placebo	Unavailable	-	Unavailable	-	See comment[a]	See comment[b]	See comment[c]
Vaginal micronized progesterone versus dydrogesterone	Unavailable	-	1.07 (0.93, 1.23)	⊕⊕⊕○ MODERATE[a]	See comment[a]	See comment[b]	See comment[c]

Progestogens for preventing miscarriage, Live birth

Analysis 1.8. Comparison 1: Threatened miscarriage: Vaginal micronized progesterone versus placebo, Outcome 8: Live birth (subgrouped by no previous miscarriages and one or more previous miscarriages)



For women with one or more previous miscarriages and early pregnancy bleeding, vaginal micronized progesterone increases the live birth rate compared to placebo: RR 1.08, 95% CI 1.02 to 1.14, high-certainty evidence

Congenital abnormalities

Treatment	Direct evidence		Indirect evidence		Anticipated absolute effects for direct estimate		
	RR (95% CI)	Certainty	RR (95% CI)	Certainty	Risk with intervention	Risk with comparator	Risk difference with intervention
Threatened miscarriage							
Vaginal micronized progesterone	1.00 (0.68, 1.46)	⊕⊕◯◯ MODERATE[a]	Unavailable	-	34 per 1000 (vaginal micronized progesterone)	34 per 1000 (placebo)	**0 fewer per 1000** (from 11 fewer to 16 more)
Dydrogesterone	0.71 (0.23, 2.21)	⊕◯◯◯ VERY LOW[b]	Unavailable	-	24 per 1000 (dydrogesterone)	34 per 1000 (placebo)	**10 fewer per 1000** (from 27 fewer to 42 more)

The Comparison with placebo for congenital anomaly and Adverse reactions

- **Vaginal micronized progesterone** : There is probably **no difference compared with placebo** for threatened miscarriage and recurrent miscarriage.
- **Other progestogens** : There are **limited data and very low-certainty evidence** on congenital abnormalities and adverse drug events.

Progestogens – threatened miscarriage and RPL

Authors' conclusions:

- The overall available evidence suggests that progestogens probably make little or no difference to live birth rate for women with threatened or recurrent miscarriage
- **Vaginal micronized progesterone may increase the live birth rate for women with a history of one or more previous miscarriages and early pregnancy bleeding, with likely no difference in adverse events**
- There is still uncertainty over the effectiveness and safety of alternative progestogen treatments for threatened and recurrent miscarriage.

대한산부인과초음파학회

Management [MVP]

Preve ntion

PROMISE trial [1]

pregnancy test +

Rescue

PRISM trial [2]

Vaginal bleeding

1. Coomarasamy, A et al. *A Randomized Trial of Progesterone in Women with Recurrent Miscarriages.* N Engl J Med, 2015. **373**(22): p. 2141-8.
2. Coomarasamy, A et al. *A Randomized Trial of Progesterone in Women with Bleeding in Early Pregnancy.* N Engl J Med, 2019. **380**(19)

대한산부인과초음파학회

PROMISE trial

PROMISE

TABLE 1
PROMISE trial: vaginal micronized progesterone in women with unexplained recurrent miscarriages

Population	Women with unexplained recurrent miscarriages (≥3 consecutive or nonconsecutive miscarriages), trying to conceive naturally
Intervention	400 mg of micronized progesterone taken vaginally twice daily from no later than 6 weeks until 12 weeks of gestation
Comparison	Placebo
Primary outcome	Live birth beyond 24 weeks
Sample size and power	836 patients randomized; 90% power to detect a 10% difference in live births
Hospitals and countries	36 hospitals in the United Kingdom and 9 hospitals in the Netherlands

PROMISE, PROgesterone in recurrent MIScarriagE.

Coomarasamy, A., et al., *A Randomized Trial of Progesterone in Women with Recurrent Miscarriages.* N Engl J Med, 2015. **373**(22): p. 2141-8.

대한산부인과초음파학회

The NEW ENGLAND JOURNAL of MEDICINE

A Randomized Trial of Progesterone in Women with Recurrent Miscarriages

- No difference in live births in women with unexplained recurrent miscarriage given vaginal progesterone from positive pregnancy test (65.8%) compared to placebo (63.3%) (RR 1.04; 95% CI,0.94–1.15)

대한산부인과초음파학회

PRISM trial [2]

TABLE 2
PRISM trial: vaginal micronized progesterone in women with threatened miscarriages

Population	Women with vaginal bleeding during the first 12 weeks of pregnancy
Intervention	400 mg of micronized progesterone taken vaginally or rectally twice daily from randomization until 16 weeks of gestation
Comparison	Placebo
Primary outcome	Live birth ≥34 weeks
Sample size and power	4153 patients randomized, 90% power to pick up a 5% difference in live births
Hospitals	48 hospitals in the United Kingdom

PRISM PRogesterone in Spontaneous Miscarriage

Coomarasamy, A., et al., *A Randomized Trial of Progesterone in Women with Bleeding in Early Pregnancy.* N Engl J Med, 2019. **380**(19)

대한산부인과초음파학회

THE NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

A Randomized Trial of Progesterone in Women with Bleeding in Early Pregnancy

Table 2. Primary Outcome and Secondary Outcomes.*

Outcome	Progesterone (N = 2025)	Placebo (N = 2013)	Relative Rate or Mean Difference (95% CI)†
Primary outcome — no. (%)			
Live birth at ≥34 wk	1513 (75)	1459 (72)	1.03 (1.00 to 1.07)‡

- Among women with bleeding in early pregnancy, progesterone therapy administered during the first trimester did not result in a significantly higher incidence of live birth than placebo.

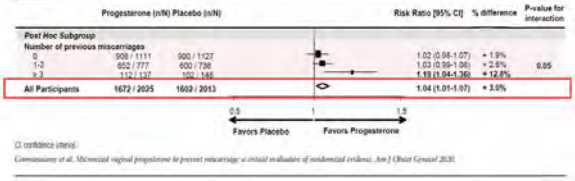
대한산부인과초음파학회

Expert Reviews

Micronized vaginal progesterone to prevent miscarriage: a critical evaluation of randomized evidence

Aryl Coomarasamy, MD, MRCOG; Adam J. Devall, PhD; Ian I. Brosens, PhD; Siobhan Quenby, MD, FRCOG; Mary D. Stephenson, MD; Sony Sierra, MD; Ole B. Christiansen, MD; Rachel Small, BSc; Jane Brewin, BSc; Tracy L. Roberts, PhD; Rima Obaliar-Smith, PhD, MRCOG; Hoda Harb, PhD; Hannah Noordali, PhD; Argyro Papadopoulou, BSc; Abey Rajen, PhD, MRBS; Matt Prior, MRCOG; Gian Carlo Di Renzo, MD; Kim Hinshaw, MBBS, FRCOG; Ben W. Mol, MD, PhD; Mary Ann Lumsden, MD, FRCOG; Yacoub Khalaf, MD, FRCOG; Andrew Shennan, MD, FRCOG; Mariette Goddijn, MD, PhD; Madeleine van Wely, PhD; Mora Al-Memar, PhD, MRCOG; Phil Bennett, PhD, FRCOG; Tom Bourne, PhD, FRCOG; Raj Rai, MD, MRCOG; Lesley Regan, MD, FRCOG; Ioannis D. Gallos, MD, MRCOG

FIGURE 3
Ongoing pregnancy at 12 weeks by the number of previous miscarriages

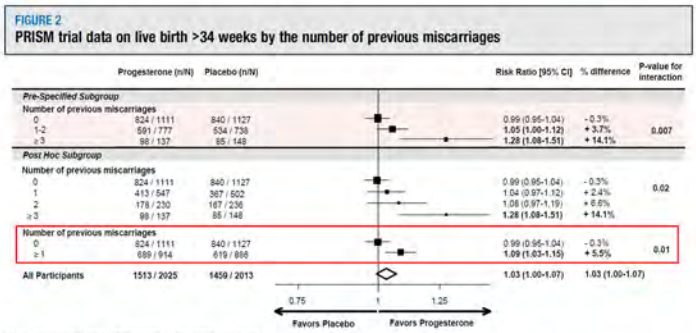


CI confidence interval.

Coomarasamy et al. Micronized vaginal progesterone to prevent miscarriage: a critical evaluation of randomized evidence. Am J Obstet Gynecol 2020.

대한산부인과초음파학회

FIGURE 2
PRISM trial data on live birth >34 weeks by the number of previous miscarriages



CI, confidence interval; PRISM, PRogesterone in Spontaneous Miscarriage.

Coomarasamy et al. Micronized vaginal progesterone to prevent miscarriage: a critical evaluation of randomized evidence. Am J Obstet Gynecol 2020.

Human Reproduction, Vol.35, No.4, pp. 766–768, 2020

Early pregnancy

Progesterone for women with threatened miscarriage (STOP trial): a placebo-controlled randomized clinical trial

대한산부인과초음파학회

Vaginal pessary

- randomized, double-blinded, placebo-controlled trial between February 2012 and April 2019 : 386 women (193 per group), single-center
- Eligible pregnant women under 10 weeks gestation with threatened miscarriage received 400 mg progesterone as vaginal pessaries, the control group received placebo vaginal pessaries, both until 12 weeks gestation

Conclusion

- In women with threatened miscarriage, 400 mg vaginal progesterone nightly, from onset of bleeding until 12 weeks, did not increase live birth rates

RESEARCH ARTICLE

OPEN ACCESS

대한산부인과초음파학회

Oral dydrogesterone for prevention of miscarriage in threatened miscarriage: a randomized, double-blind, placebo-controlled trial

Women with threated miscarriage received oral dydrogesterone 20 mg/day or placebo until one week after vaginal bleeding stopped or otherwise for a maximum of six weeks.

Table 2. Rate of continuation of pregnancy beyond 20 weeks of gestation and live birth ($n = 100$).

	Dydrogesterone ($n = 50$)	Placebo ($n = 50$)	Relative risk (95%confidence interval)	p value
Ongoing pregnancy beyond 20 weeks	45 (90.0%)	43 (86.0%)	1.19 (0.71–2.02)	0.538
Live birth	45 (90.0%)	43 (86.0%)	1.19 (0.71–2.02)	0.538

Data were presented as n (%).

Conclusion:
Oral dydrogesterone 20 mg/day could not prevent miscarriages in women with threatened miscarriage.

Kuptarak A, et al. J Matern Fetal Neonatal Med. 2024;37(1):2333929.

대한산부인과초음파학회

Guideline reviews RCOG

RCOG GREEN-TOP GUIDELINES

BJOG

Recurrent Miscarriage

Green-top Guideline No. 17

- Progestogen supplementation should be considered in women with recurrent miscarriage who present with bleeding in early pregnancy (for example 400 mg micronised vaginal progesterone twice daily at the time of bleeding until 16 weeks of gestation). [Grade B]

대한산부인과초음파학회

NICE National Institute for Health and Care Excellence

Guidance | Standards and Indicators | Life sciences | British National Formulary (BNF) | British National Formulary for Children (BNFC) | Clinical Knowledge Summaries (CKS)

1.5 Management of miscarriage

Threatened miscarriage

1.5.1 Advise a woman with a confirmed intrauterine pregnancy with a fetal heartbeat who presents with vaginal bleeding, but has no history of previous miscarriage, that:

- if her bleeding gets worse, or persists beyond 14 days, she should return for further assessment
- if the bleeding stops, she should start or continue routine antenatal care. **[2012, amended 2021]**

1.5.2 Offer vaginal micronised progesterone 400 mg twice daily to women with an intrauterine pregnancy confirmed by a scan, if they have vaginal bleeding and have previously had a miscarriage. **[2021]**

1.5.3 If a fetal heartbeat is confirmed, continue progesterone until 16 completed weeks of pregnancy. **[2021]**

ESHRE Guideline: Vaginal Progesterone for RPL

Recommendation in 2022

Vaginal progesterone may improve live birth rate in women with three or more pregnancy losses and vaginal blood loss in a subsequent pregnancy (Conditional; ⊕⊕⊕◯)

Human Reproduction Open

ESHRE guideline: recurrent pregnancy loss: an update in 2022†

The ESHRE Guideline Group on RPL, Ruth Bender Atik[1], Ole Bjarne Christiansen[2], Janine Elson[3], Astrid Marie Kolte[4,5], Sheona Lewis[6], Saskia Middeldorp[7], Sarla Mcheik[8], Braulio Peramo[9], Siobhan Quenby[10], Henriette Svarre Nielsen[11], Marie-Louise van der Hoorn[12], Nathalie Vermeulen[4], and Mariëtte Goddijn[4]*

대한산부인과초음파학회

The safety of concern

- New data were presented at ESHRE Annual Meeting 2023 looking at the fetal safety of dydrogesterone versus other drugs and progesterone.
- The analyses were performed using used VigiBase: a WHO (World Health Organisation) dataset.
- In all comparisons dydrogesterone had a higher rate of reported birth defects.

Henry A et al. ESHRE 39th Annual Meeting. O-150. Abstract citation ID: dead093.177

THE LANCET

ABSTRACTS | VOLUME 390, SPECIAL ISSUE, S8, AUGUST 01, 2017

Association between oral intake of dydrogesterone during early pregnancy and congenital heart disease: a case-control study

Dr Mahmoud Zaqout, MD · Emad Aslem, MD · Mazen Abuqamar, PhD · Osama Abughazza, MD · Joseph Panzer, MD · Prof Daniel De Wolf, PhD

Published: August, 2017 · DOI: https://doi.org/10.1016/S0140-6736(17)32059-7

ORIGINAL ARTICLE

The Impact of Oral Intake of Dydrogesterone on Fetal Heart Development During Early Pregnancy

Mahmoud Zaqout · Emad Aslem · Mazen Abuqamar · Osama Abughazza · Joseph Panzer · Daniel De Wolf

1. Zaqout M, et al. Pediatr Cardiol. 2015;36(7):1483-1488.

30

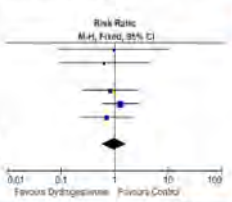
대한산부인과초음파학회

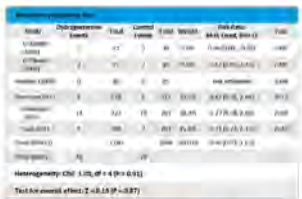
Safety on dydrogesterone : a scoping review and meta-analysis

A scoping review and meta-analysis on the risk of congenital abnormalities associated with first trimester use of dydrogesterone until 2021[1]

RISK OF CONGENITAL ABNORMALITIES

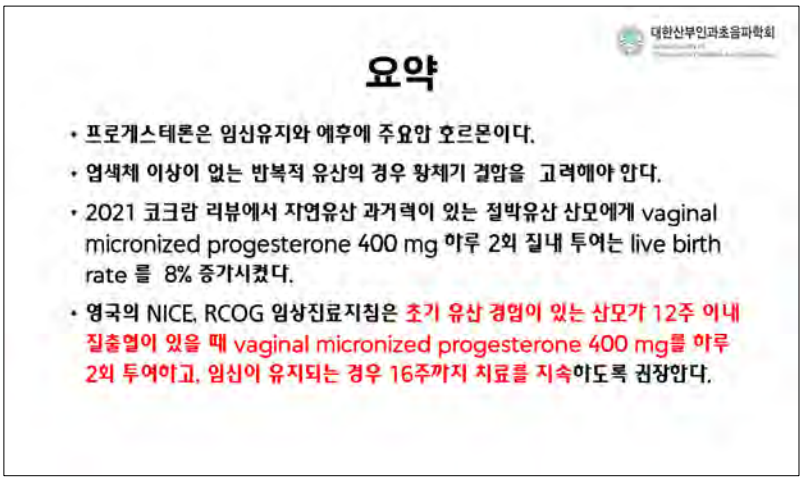
No significant increase in risk of congenital abnormalities. RR 0.96 (95% CI 0.57, 1.62)[1]





Dydrogesterone can be used in the treatment of threatened or recurrent miscarriage due to its favourable safety profile.

Katalinic A., et al, A critical appraisal of safety data on dydrogesterone for the support of early pregnancy: a scoping review and meta-analysis. Reprod Biomed Online. 2022 Aug;45(2):365-373.


대한산부인과초음파학회
요약
• 프로게스테론은 임신유지와 예후에 주요한 호르몬이다.
• 염색체 이상이 없는 반복적 유산의 경우 황체기 결함을 고려해야 한다.
• 2021 코크란 리뷰에서 자연유산 과거력이 있는 절박유산 산모에게 vaginal micronized progesterone 400 mg 하루 2회 질내 투여는 live birth rate 를 8% 증가시켰다.
• 영국의 NICE, RCOG 임상진료지침은 초기 유산 경험이 있는 산모가 12주 이내 질출혈이 있을 때 vaginal micronized progesterone 400 mg를 하루 2회 투여하고, 임신이 유지되는 경우 16주까지 치료를 지속하도록 권장한다.

제27차 대한산부인과초음파학회
추계학술대회

Oral presentation 2

좌장 : 김문영 (차의과학대)
박미혜 (이화의대)

Korean Society of Ultrasound
in Obstetrics and Gynecology

Oral II-01

The efficacy of deep learning-based automated cervical length measurement for predicting preterm birth

Ju-hee Yoon[1], Suhra Kim[1], Yun Ji Jung[1], Ja-young Kwon[1,2], Hayan Kwon[1,2*]

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목적(Objective): Mid-trimester cervical length (CL) measurement by transvaginal ultrasound (TVS) is one of the most commonly used tools for predicting preterm birth. However, the conventional method presented in the current guidelines are highly operator-dependent, time-consuming, and often underestimate actual cervical length, which can lead to overtreatment. We aimed to compare deep learning (DL)- based automated CL measurement with conventional method to determine any differences in the prediction of preterm birth.

방법(Methods): This retrospective cohort study included asymptomatic pregnant women with a singleton gestation and a CL measurement of 20-25mm between 16 to 24 weeks of gestation from 2019 to 2023. Women with multiple gestations, iatrogenic preterm birth, or who underwent cervical cerclage were excluded. The CL was measured using the conventional method and the DL algorithm tracing technique. The DL algorithm was automated CL measurement, which trace the cervical canal and obtain the CL along the cervical canal between the internal and external os. Participants were divided into the DL-Short CL group (cervical length of 20-25mm by both methods) and the DL-Normal CL group (20-25mm by conventional but more than 25mm by DL algorithm). The primary outcome was preterm birth, defined as delivery before 37 weeks.

결과(Results): Among a total of 1270 women with mid-trimester short CL (<25mm), 171 (13.5%) with CL between 20 and 25mm were eligible. The mean CL was 2.33±0.15 mm in the conventional method and 2.73±0.32 mm in the tracing technique. There were 39 women in DL-Short CL and 132 women in DL-Normal CL. There was a higher preterm birth rate in DL-Short CL (28.2%, 11/39) compared to DL-Normal CL (6.1%, 8/132) ($P<0.001$). The overall adjusted odds ratio of preterm birth in DL-Short CL compared to DL-Normal CL was 7.99 (95% CL, 2.73 to 23.40, $P<0.05$).

결론(Conclusion): Cervical length measurement through tracing technique using DL algorithm can improve prediction of spontaneous preterm birth compared to conventional methods. DL-based automated CL measurement can reduce patient discomfort, shorten examination times, and provide operator independence.

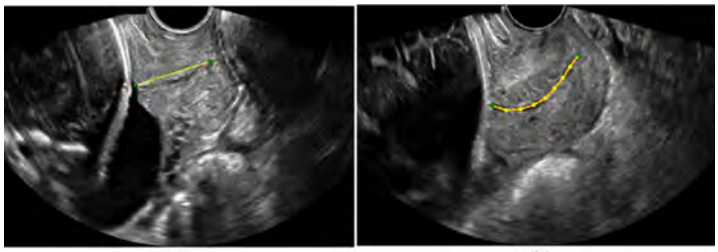

Figure 1. Methods of cervical length measurement (a) The conventional method, straight-line technique (b) Tracing technique using deep-learning-based automated measurement algorithm.

Keywords: cervical length, preterm birth, deep learning

Oral II-02

Automated fetal heart classification, annotation, and measurement using HeartAssist™, a deep learning-artificial intelligence tool using big data

Yoo Jin Lee M.D.[1], Rina Kim M.D.[2], Mi-Young Lee M.D., Ph.D.[1*], Jae Yi Jeong M.D.[1], Jihye Koh M.D.[1], Jin Hoon Chung M.D., Ph.D.[1], Hye-Sung Won M.D., Ph.D.[1]

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목적(Objective): This study aimed to assess the feasibility of HeartAssist™, an advanced artificial intelligence (AI) tool designed for the automated classification of fetal cardiac view images, annotation of cardiac structures, and measurement of cardiac parameters.

방법(Methods): A combination of prospective and retrospective analyses was conducted using fetal cardiac images from gestational ages 20 to 40 weeks, collected at Asan Medical Center, Seoul, Korea, between January 2016 and October 2018. HeartAssist™ was developed using convolutional neural networks for the automatic classification of 10 cardiac views, annotation of 26 cardiac structures, and measurement of 43 cardiac parameters. An expert in fetal echocardiography manually classified all images, annotated the cardiac structures, and measured the cardiac parameters to serve as the ground truth. The performance of HeartAssist™ was assessed by comparing the AI-based measurements with the expert's manual measurements.

결과(Results): A total of 65,334 cardiac images from 2,985 fetuses were analyzed. HeartAssist™ achieved an average classification accuracy of 99.4%, with a recall of 0.93, a precision of 0.95, and an F1-score of 0.94. The system also demonstrated an average annotation accuracy of 98.4%. Regarding the measurement of cardiac parameters, HeartAssist™ showed an average success rate of 97.6%, an average error rate of 7.62%, and an average caliper similarity of 0.613.

결론(Conclusion): HeartAssist™ proves to be a highly reliable tool for fetal cardiac screening, demonstrating excellent accuracy in the classification of cardiac views and annotation of cardiac structures. In addition, it produces comparable results in the measurement of cardiac parameters. This tool holds the potential to improve prenatal detection of congenital heart disease, thereby enhancing perinatal outcomes.

Keywords: artificial intelligence, congenital heart disease, deep learning, neural networks

Oral II-03

Analysis of placental microvascular architecture by MV-Flow imaging in twins with fetal growth restriction

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Objective: This study aimed to compare placental microvascular flow indices between twin pregnancies without fetal growth restriction (FGR) and those with FGR in one fetus.

Methods: A total of 40 twin pregnancies were included in the study, with 15 classified into the "no FGR" group and 25 into the "1 baby FGR" group. Placental microvascular structure ultrasound imaging by MV-Flow was performed. A placental vascular index (VI^{MV}) was acquired by application of MV-Flow, using both 2D and 3D imaging techniques to obtain VI^{MV} (2D) and VI^{MV} (3D), respectively. The difference in VI^{MV} represents the disparity in microvascular flow indices between the two placentas. Statistical analysis was performed using the chi-square test to assess significant differences between the groups.

Results: There was no significant difference in gestational age, maternal age, height, weight, or VI^{MV} (2D) between the two group. However, the VI^{MV} (3D) gap was significantly larger in the "1 baby FGR" group compared to the "no FGR" group (mean ± SD, 10.62 ± 7.03 versus 4.84 ± 3.97, $P = 0.002$).

Conclusion: The significant difference in VI^{MV} (3D) observed in twin pregnancies with one FGR fetus suggests that placental microvascular flow changes in cases of FGR. MV-Flow technology, which can visualize and quantify placental microvascular architecture, provides an accurate assessment of tissue vascularity. This technology offers a powerful and promising tool to explore placental microvascular perfusion, potentially offering new insights into pregnancy-related conditions such as FGR.

Keywords: fetal growth restriction; twin; MV-Flow; placental microvascular

Oral II-04

Appropriate delivery weeks according to twin chorionicity without high-risk factors: a systemic review and meta-analysis

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[1]*Department of Obstetrics and Gynecology, Konkuk University Medical Center, Konkuk University School of Medicine, Seoul, Korea*

목적(Objective): This systematic review and meta-analysis aimed to assess appropriate delivery weeks in twin pregnancies without high-risk factors according to chorionic differences.

방법(Methods): The literature with prognostic data on the birth of newborns by gestational week in twin pregnancy women without other high-risk factors was searched through a systematic literature review and selected by dividing monochorionic and dichorionic membranes according to chorionic villi. A total of 1 prospective study and 7 retrospective studies for monochorionic twins (6,697 of women, 13,394 of newborns) and of 1 prospective study and 5 retrospective studies for dichorionic twins (16,770 of women, 33,540 of newborns) were searched through a systematic literature review. The primary outcome is appropriate delivery weeks according to variables including stillbirth during pregnancy, neonatal mortality, neonatal respiratory distress syndrome, sepsis, intraventricular hemorrhage, and intraventricular hemorrhage.

결과(Results): As a result of analyzing data related to stillbirth and the prognosis of newborns after birth, delivery at 37 weeks gestation or 38 weeks gestation is an important decision time in monochorionic twins without high-risk factors. Through a meta-analysis between these two gestational weeks, it is recommended to deliver before 38 weeks (i.e., deliver at 37 weeks of gestation) has been shown to reduce complications, especially sepsis [Risk ratio 0.29 (95% CI 0.09-0.92)]. In dichorionic twins without high-risk factors, whether delivery at 38 weeks gestation or 39 weeks gestation is an acceptable decision time. As a result of the a meta-analysis between these two gestational weeks, delivery before 39 weeks (i.e., delivery at 38 weeks gestation) is recommended by reducing the complications, especially sepsis [Risk ratio 0.35 (95% CI 0.16-0.79)].

결론(Conclusion): Based on the results, it is recommended that monochorionic twin pregnancies deliver before 38 weeks of pregnancy, and dichorionic twins before 39 weeks of pregnancy with no high-risk factors.

Keywords: Twin pregnancy, Delivery timing, Chorionicity

Oral II-05

임신 전 공복 혈당 수치에 따른 현성 당뇨병을 가진 여성의 태아 기형 위험도

Subeen Hong[1,a], Kyung A Lee[2,a], Young Mi Jung[3], Heechul Jeong[4], Ji-Hee Sung[5], Hyun-Joo Seol[6], Won Joon Seong[7], Soo Ran Choi[8], Joon Ho Lee[9], Seung Cheol Kim[10], Sae-Kyoung Choi[11], Ji Young Kwon[12], Hyun Soo Park[13,14], Hyun Sun Ko[1*], Geum Joon Cho[1*]

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목적(Objective): 임신 전 공복 혈당 수치를 기준으로 현성 당뇨병을 가진 임산부에서 태아 기형의 위험성을 평가하고자 하였다.

방법(Methods): 한국 건강보험심사평가원 데이터베이스를 사용하여 임신 전 당뇨병을 가지고 있으며 임신 1년 이내에 공복 혈당 값이 있는 5,687명의 여성을 대상으로 하였다. 연구 대상자는 공복 혈당에 따라 잘 조절된 그룹(공복 혈당 < 100 mg/dL), 덜 조절된 그룹(공복 혈당: 100-125 mg/dL), 그리고 조절이 잘 되지 않은 그룹(공복 혈당 ≥ 126 mg/dL)으로 나누었다. 잘 조절된 그룹은 공복 혈당 수치에 따라 4개의 하위 그룹으로 나누어, 각 그룹의 태아 기형 상대위험도는 참조군(공복 혈당 < 84 mg/dL)과 비교하여 다변량 분석을 통해 계산되었다.

결과(Results): 태아 기형 발생률은 잘 조절된 그룹에서 10%, 덜 조절된 그룹에서 13.6%, 그리고 조절이 잘 되지 않은 그룹에서 18.6%로 나타났으며, 이는 통계적으로 유의하였다(P < 0.001). 기형 발생 위험은 덜 조절된 그룹에서 1.3배, 조절이 잘 되지 않은 그룹에서 1.8배 높았다. 조절이 잘 되지 않은 그룹은 심장 기형 발생 위험이 2.5배, 골격 기형 발생 위험이 3.3배 더 높았다.

결론(Conclusion): 임신 전 당뇨병을 가진 여성에서 공복 혈당 수치가 100 mg/dL 이상인 경우 태아 기형의 위험이 증가하며, 특히 공복 혈당이 126 mg/dL 이상일 때 심장 및 골격 기형의 위험이 더욱 높아진다.

Keywords: Fetal malformation, Pregnant women, Fasting plasma glucose, Diabetes mellitus

Oral II-06

Clinical Significance of Unilateral Renal Agenesis by Prenatal Fetal Sonography in Female Fetus

Ah-Young Choi[1], Seok-Young Kim[1], Jeong-In Yang[1*]

[1]*Department of Obstetrics and Gynecology, Ajou University College of Medicine*

Objective: Unilateral renal agenesis (URA) may be an isolated type that is not associated with other congenital malformation, or may be associated with chromosomal or nonchromosomal syndromes including VACTERL and MRKH syndrome. However, obstetricians tend to pay less attention to the patient with URA. In this study, we aimed to investigate the characteristics of URA and obstructed hemivagina and ipsilateral renal anomaly (OHVIRA) syndrome, or Herlyn-Werner-Wunderlich syndrome, which is a uterine anomaly that is diagnosed afterwards in female fetus

Methods: We retrospectively reviewed the electric medical records of the cases that were diagnosed with URA at Ajou University Medical Center between 1995 and 2023. URA was diagnosed as image DMSA, CT, or MRI. The uterine anomaly including OHVIRA were diagnosed through ultrasound or MRI. The data of prenatal diagnosis, symptoms, age at diagnosed by OHVIRA, associated anomaly, including uterine anomalies were collected and analyzed using SPSS ver. 28.

Results: Total of 115 cases of URA were registered. Among them, 48 (41.7%) was diagnosed as URA prenatally and 67 (58.2%) was postnatally. URA were isolated in 78 (68%), and associated with other congenital anomalies 37 (32%). Among them, 3 were diagnosed as VACTERL syndrome, and 4 were diagnosed as MRKH syndrome. Total of 21 cases were diagnosed as OHVIRA syndrome, 6 of them were prenatally diagnosed as URA, and 14 of them were not. The average age at diagnosed as OHVIRA was 2.5 years old in prenatally diagnosed group, and 18.1 years old in postnatally diagnosed group.

Conclusion: Fetal URA is commonly diagnosed by fetal sonography. Although the isolated type of URA is expected to have a good prognosis, it is necessary to confirm whether there is a combine genitourinary anomaly. In addition, re-evaluating any uterine anomalies including OHVIRA syndrome is important after birth, especially before puberty. Since early detection of such anomalies is helpful for patient management, prenatal counseling of fetal URA is important.

Keywords: Unilateral renal agenesis, Uterine anomaly, OHVIRA syndrome

Oral II-07

비정상 체중아 출산 후 대사증후군 발생 위험에 관한 연구

Jeesun Lee[1], Young Mi Jung[1], Haemin Kim[2], Ji Hoi Kim[1], Sang-Hyuk Jung[3], Manu Shivakumar[3], Dokyoon Kim[3], Chan-Wook Park[1], Joong Shin Park[1], Jae-Seung Yun[4], Seung Mi Lee[1*]

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목적(Objective): 비정상 체중아를 출산한 경험은 임신 관련 합병증 뿐 아니라, 태어난 아기의 장기적인 대사 합병증과도 관련이 있는 것으로 보고되어 있음. 그러나 비정상 체중아의 출산이 산모의 장기적인 건강에 미치는 잠재적 영향에 대한 연구는 부족한 실정임. 따라서 본 연구는 비정상 체중아 출산이 산모의 대사증후군 발병에 영향 여부에 미치는 장기적인 영향을 평가하고자 하였음.

방법(Methods): 본 연구는 대규모 전향적 코호트인 UK Biobank 의 데이터를 사용하여 진행되었음. 2006년부터 2010년까지 40~69세 대상자를 모집하였고, 지속적 추적 관찰 중임. 최소 한 번 이상 출산 경험이 있는 여성을 분석 대상에 포함시켰고, 첫 아기의 출생 체중에 따라 저출생체중아, 정상 체중아, 거대아의 세 그룹으로 나누었음. 대사증후군은 복부 비만, 고중성지방혈증, 낮은 고밀도 지단백 콜레스테롤, 고혈압, 고혈당 중 3가지 이상의 진단 요소가 있는 경우로 정의하였음. 저출생체중아와, 정상 체중아, 거대아를 출산한 여상들의 대사증후군 발생 위험도와 각 구성 요소에 대해 평가하였음

결과(Results): 저출생체중아 및 거대아를 출산한 여성들이 정상체중아를 출산한 여성에 비해 대사증후군 발생 위험이 높게 나타났음. 대사증후군의 각 구성 요소에 대한 결과는 저출생체중아 및 거대아 출산 군에서 다른 양상을 보였음

결론(Conclusion): 저출생체중아 및 거대아를 출산한 여성들에서 대사증후군 발생 위험이 높아짐을 확인하였음. 이러한 결과는 산모 건강에 부정적인 결과를 초래할 수 있는 잠재적 위험 요인으로 출생 체중 스펙트럼의 양쪽 끝을 고려하는 것이 중요하다는 것을 시사함

Keywords: birthweight, metabolic syndrome, macrosomia, low birthweight

제27차 대한산부인과초음파학회

추계학술대회

Kenote lecture II

Gynecologic ultrasound

좌장 : 김성훈 (울산의대)

이성종 (가톨릭의대)

Korean Society of Ultrasound
in Obstetrics and Gynecology

CURRICULUM VITAE

이 산 희

1) 현직

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3) 경력

2005.5-2009.2	신촌 세브란스 병원 전공의
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2012.3-2017.2	국민건강보험 일산병원 전문의 부인종양학
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대한 산부인과로봇수술학회 학술위원

Intra-operative ultrasound in gynecological surgery

이 산 희

연세원주의대

Intraoperative ultrasound (IOUS), first introduced in 1961 to detect renal calculi, has become increasingly widespread across various medical specialties, including gynecology. In gynecological procedures, IOUS is used for tasks ranging from **minor operations** like removing lost contraceptive implants and intrauterine devices to **more complex surgeries**, such as surgical termination of pregnancy, hysteroscopy, and laparoscopic myomectomy.

With advancements in ultrasound technology, the image quality has significantly improved, making real-time IOUS a valuable tool in gynecology. Its application has become even more critical as **minimally invasive surgeries** like laparoscopy have grown in popularity due to their benefits for patients. However, these procedures often lack direct tactile feedback, making it difficult for surgeons to assess tissue during surgery. IOUS and **laparoscopic US** helps overcome this limitation by providing real-time imaging, enhancing surgical accuracy.

The primary advantage of incorporating **Laparoscopic ultrasound (LUS)** into gynecological surgery is its ability to enhance **visualization**, making it easier to perform procedures through less invasive approaches. IOUS is portable, poses no additional risk to patients, and has a relatively low economic cost. While it remains unclear whether IOUS provides additional pathological information, its effectiveness in helping surgeons prevent complications and ensuring accurate incision placement in endoscopic procedures is well established.

However, IOUS does have some limitations. The quality of the imaging and its inter-

pretation is highly **operator-dependent**, requiring significant expertise from the surgeon. Additionally, the use of **transabdominal ultrasound (TAUS)** may require an extra healthcare professional to operate the equipment, and imaging quality can be affected by factors such as **body mass index (BMI)** and **abdominal scarring**.

Despite these challenges, the ongoing development of advanced tools such as **laparoscopic ultrasound (LUS) device**, **transvaginal ultrasound (TVS)**, and **transrectal ultrasound (TRUS)**, combined with improvements in equipment and imaging technology, will likely expand the use and effectiveness of LUS in gynecological surgeries

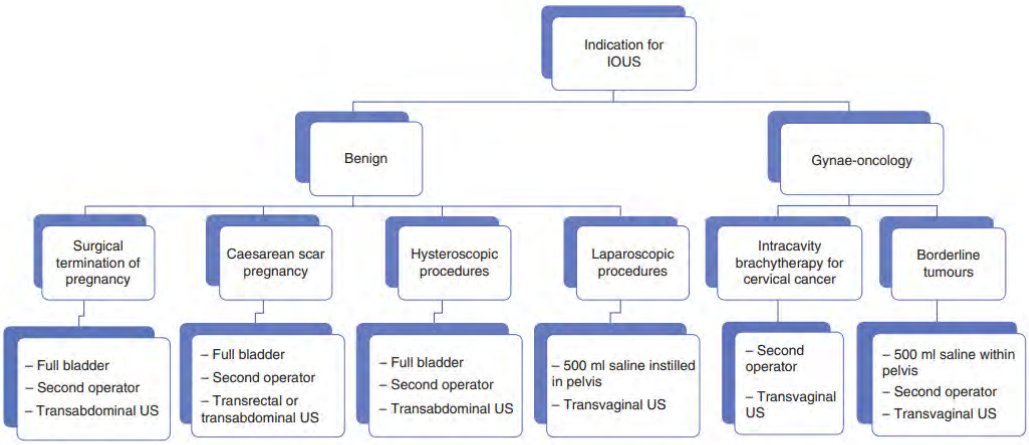

Figure 1. demonstrates the variety of indications for the use of intraoperative ultrasound in benign and gynecological oncology settings as well as outlining additional considerations.
IOUS: Intraoperative ultrasound; US: Ultrasound.

CURRICULUM VITAE

오 영 택

1) 현직

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2012.9-2019.2	고려대학교 산부인과학 박사

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2019.9-2023.8	강원대학교병원 산부인과 임상조교수
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대한부인종양학회 예방위원
대한부인종양학회 정보통신위원
대한심신의학회 학술위원
대한자궁근종선근증학회 총무이사

Differentiating uterine leiomyoma and malignant tumors: Key ultrasound markers

오 영 택

고려의대)

Uterine leiomyomas, also known as fibroids, are the most common benign tumors of the uterus, affecting women primarily during their reproductive years. Although these tumors are benign, distinguishing them from malignant uterine tumors such as leiomyosarcoma (LMS) is crucial for determining appropriate treatment strategies. Ultrasonography, including gray-scale and color Doppler, is a widely used diagnostic tool for this purpose. However, the challenge lies in accurately differentiating between benign leiomyomas and malignant tumors based on imaging alone. This document outlines the key ultrasound markers that are commonly assessed to aid in the differentiation of these uterine masses.

1. Tumor Size and Growth Patterns

Leiomyomas are generally slow-growing and well-defined masses, often remaining stable in size over time. In contrast, rapid growth, particularly in postmenopausal women, raises suspicion for malignancy. Leiomyosarcomas tend to be larger, with many tumors exceeding 8 cm in diameter at diagnosis. Sudden increases in size, especially after menopause, can be a critical red flag for malignant transformation.

2. Echogenicity

On gray-scale ultrasound, leiomyomas typically present with homogeneous or mildly heterogeneous echogenicity. This consistent echotexture reflects the benign nature of the

tumor. Malignant tumors, on the other hand, often demonstrate marked inhomogeneity. Leiomyosarcomas may display regions of low echogenicity indicative of necrosis or degeneration, a hallmark of malignancy that is less frequently observed in benign leiomyomas.

3. Vascularity (Color Doppler Imaging)

Color Doppler imaging plays a pivotal role in distinguishing benign from malignant uterine masses. Leiomyomas generally exhibit peripheral vascularity with low-resistance blood flow. In contrast, leiomyosarcomas often show increased vascularity both centrally and peripherally. Malignant tumors tend to have irregular, disorganized vessel patterns with lower resistance indices and higher peak systolic velocities. Despite these findings, vascularity alone is not sufficient for a definitive diagnosis.

4. Cystic Changes and Central Necrosis

Cystic degeneration is uncommon in benign leiomyomas but can occasionally occur, particularly in larger tumors. Leiomyosarcomas, however, are more prone to showing cystic areas or regions of central necrosis, which are often seen as irregular hypoechoic zones within the mass. These changes suggest rapid tumor growth and tissue breakdown, characteristics more commonly associated with malignancy.

5. Tumor Borders

The borders of a tumor can provide significant diagnostic clues. Leiomyomas typically have smooth, well-defined margins, consistent with their benign nature. In contrast, malignant tumors like leiomyosarcoma often present with irregular, poorly defined borders, indicative of invasive and infiltrative growth patterns. The presence of such irregular borders on ultrasound should prompt further diagnostic evaluation.

6. Shadowing

Posterior shadowing is commonly observed in benign leiomyomas due to their dense,

fibrous composition. Leiomyosarcomas, however, rarely exhibit this feature. When shadowing is present in malignant tumors, it tends to be irregular or fan-shaped, reflecting the heterogeneous nature of the mass.

Conclusion

Differentiating between uterine leiomyomas and malignant tumors like leiomyosarcoma using ultrasound markers can be challenging, as there is significant overlap in some imaging characteristics. However, certain key features—such as rapid tumor growth, increased central vascularity, irregular echogenicity, and poorly defined borders—should raise suspicion for malignancy. While these markers provide valuable diagnostic clues, histopathological confirmation remains essential for an accurate diagnosis. Further advancements in imaging techniques and a combined approach with other diagnostic modalities may improve the preoperative differentiation between benign and malignant uterine tumors.

CURRICULUM VITAE

구 화 선

1) 학위 및 경력
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관동대학교 대학원 의학석사
가톨릭 관동대학교 대학원 의학박사

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관동대학교 의과대학 제일병원 전임의
단국대학교 의과대학 제일병원 산부인과 초빙교수
차의과학대학교 차여성의학 연구소 분당센터 조교수
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대한보조생식학회 정회원
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대한생식면역학회 총무간사 및 학술위원
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대한폐경학회 부사무총장 역임
대한자궁내막증학회 학술위원 역임
대한자궁내시경학회 국제교류위원 역임
부인과 초음파(2판), 부인과내분비학(2판), 산과학(6판) 공동집필

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2013.9 제 99회 대한 산부인과학회 학술대회 우수 논문상
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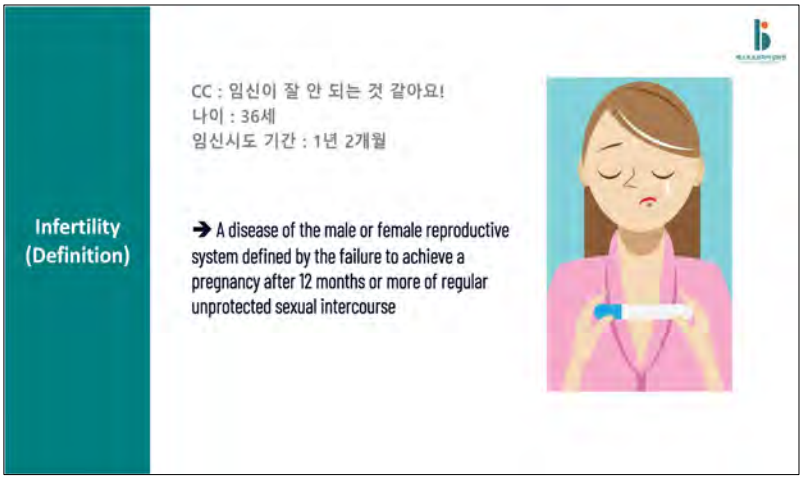
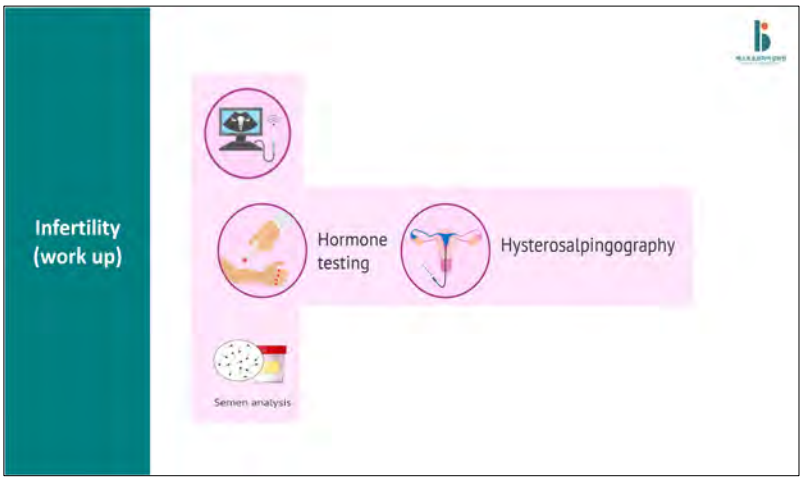
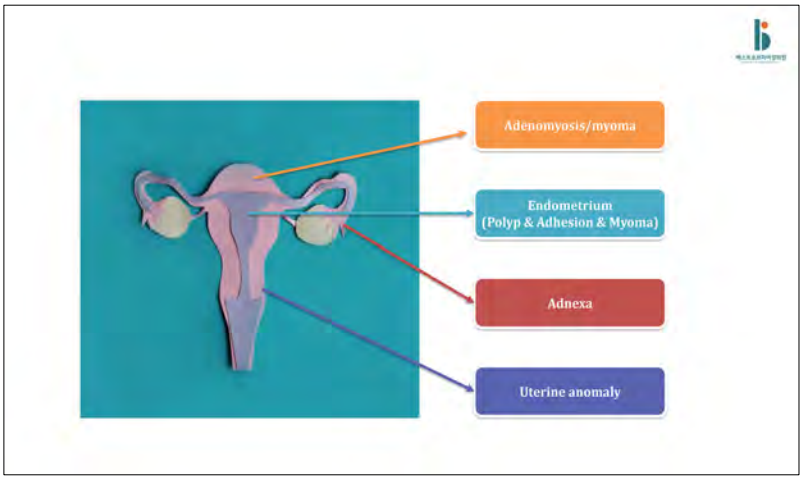
Ultrasound in infertility: From evaluation to treatment

구 화 선

베스트오브미여성의원




Infertility
(work up)
Hormone
testing
Hysterosalpingography
Semen analysis

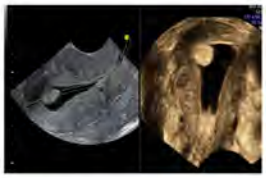

Adenomyosis/myoma
Endometrium
(Polyp & Adhesion & Myoma)
Adnexa
Uterine anomaly


Uterine factor
1. Myoma / Adenomyosis
Myoma and fertility
Natural fertility : +/-
IVF : - (submucosal & intramural)
초음파진단소견
경계가 명확한 둥근 모양
Homogeneous echo pattern
Hypoechoic or
Adenomyosis and fertility
Natural fertility : -
IVF : -
초음파진단소견
자궁비대(공 모양 또는 전후 비대칭)
경계가 불분명한 비정상 음영
애매한 junctional zone

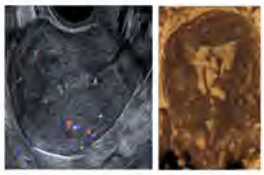
Uterine factor

2. Polyp / Synechia

- Uterine polyps and fertility
  - Endometrial receptivity & implantation : -
- 초음파진단소견
  - 자궁내막의 두꺼워 짐
  - 엷은 고음영에 둘러 쌓인 매끈한 윤곽을 가진 음영
  - Proliferative phase, 3D, color-doppler : 진단의 정확도 상승

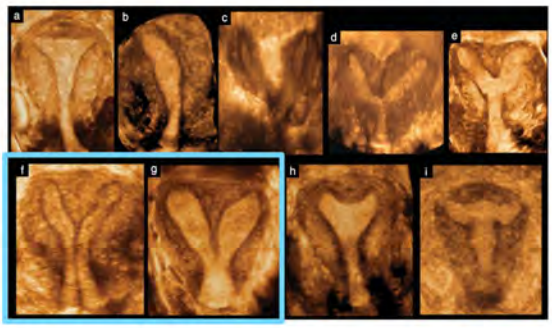


- Synechia (intrauterine adhesion)
  - Infertility and RPL
- 진단
  - HSG (imaging technique of choice)
  - Sonohysterogram
  - 2D or 3D ultrasound :석회화를 동반한 자궁내막의 불규칙한 두께



Uterine factor

3. Uterine anomaly



➔ The modality of choice in assessment of *uterine congenital anomalies*

Tubal factor

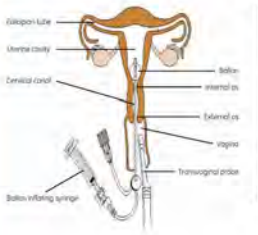
1. Hydrosalpinx

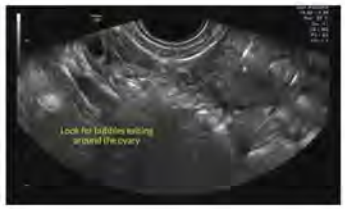
- vs. ovarian cyst
- 초음파상 자궁관은 질환으로 인해 ***변형이 되지 않는 한, 쉽게 보이지 않으며*** 특히 원위부는 소장 사이에 파묻혀서 관찰이 안 되는 경우가 많음
- 초음파진단소견
  - Cogwheel sign
  - Tubular shape
  - Waist sign
  - Small round projection

Tubal factor

2. HyCoSy (초음파자궁난관조영술)

- Hystero-Salpingo-Constrast-Sonography





Tubal factor

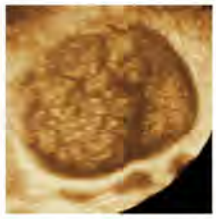
2. HyCoSy (초음파자궁난관조영술)

Ovary

1. Ovarian mass

- Benign or malignancy ?
- 3D surface imaging can demonstrate the internal tex ture of an ovarian cyst, thus showing the mural nodu larity in cystic masses such as ovarian tumor
- Ovarian reserve

	2D	3D
Sensitivity(%)	85.3	93.5
Specificity(%)	87.4	91.5



Ovary

2. Ovarian reserve

- Serum AMH correlated best with AFC from 3D TVUS, followed by MRI and 2D TVUS.
- OvAge : 3D TVUS + clinical + biochemical data

Infertility treatment

CC : 임신이 잘 안 되는 것 같아요!
나이 : 36세
임신시도 기간 : 1년 2개월

➔Unexplained infertility
➔Timed intercourse (with / without superovulation)
➔IUI
➔IVF

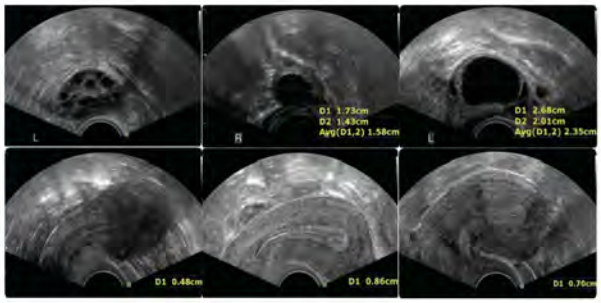
Timed intercourse

Follicle monitoring

- Generally measured by taking the mean of 2 orthogonal diameters in one plane
- >15 mm it is better to take the average of 3 diameters (d/t follicles become more asymmetrical as they enlarge)

Timed intercourse

Follicle monitoring



➔ Key point - Serial monitoring

IUI

IUI ((intra-uterine insemination)

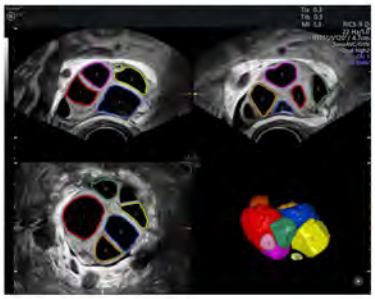

European Journal of Obstetrics & Gynecology and Reproductive Biology

Ultrasound guidance versus classical method for intrauterine insemination: A systematic review and meta-analysis of randomized controlled trials

➔ There is evidence of high quality that ultrasound-guided IUI improves the pregnancy rate and reduces the incidence of difficulty reported during the procedure.

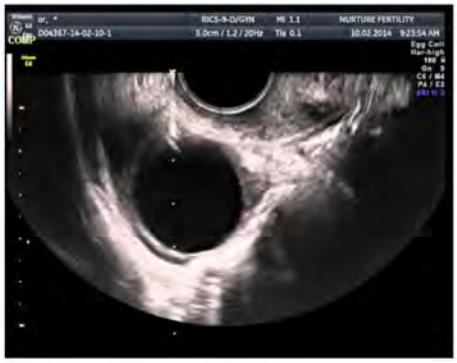
IVF (In-vitro-fertilization)

1. Follicle monitoring



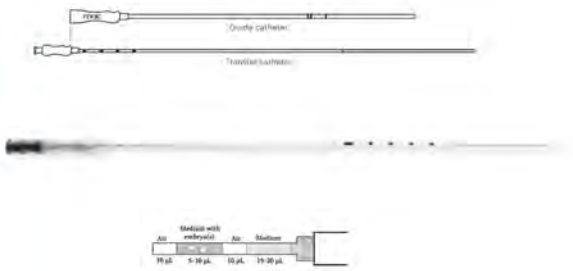
IVF
(In-vitro-
fertilization)

2 . Oocyte Pick Up (OPU)



IVF
(In-vitro-
fertilization)

3 . Embryo Transfer (ET)

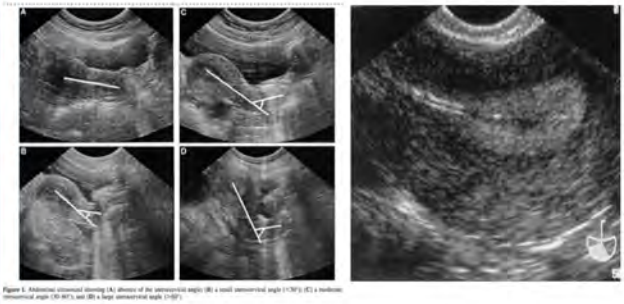


IVF
(In-vitro-
fertilization)

3 . Embryo Transfer (ET)

IVF
(In-vitro-
fertilization)

3 . Embryo Transfer (ET)

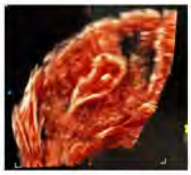


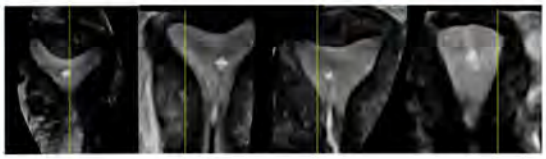
IVF
(In-vitro-
fertilization)

3 . Embryo Transfer (ET)

scientific reports

OPEN **Four-dimensional ultrasound guided embryo transfers improve live birth rates when compared to the clinical touch technique: a randomised controlled trial**

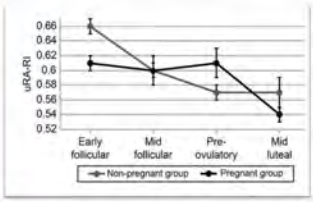


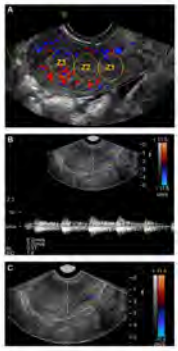


Resurrent
Implantation
Failure(RIF)

Endometrial blood flow assessment

Serial Evaluation of Endometrial Blood Flow for Prediction of Pregnancy Outcomes in Patients Who Underwent Controlled Ovarian Hyperstimulation and In Vitro Fertilization and Embryo Transfer





제27차 대한산부인과초음파학회

추계학술대회

Image contest

좌장 : 성원준 (경북의대)

한유정 (차의과학대)

Korean Society of Ultrasound
in Obstetrics and Gynecology

Image contest-01

Visualization of Amniotic Fluid Sludge Using Novel 3D Ultrasound Rendering Techniques

Eun-Jung Jung[1], Du-Nam Won[1], Do-Hwa Im[1], Young-Nam Kim[1*]

[1]*Department of Obstetrics and Gynecology, Inje University Busan Paik Hospital, Busan, South Korea*

Image contest case reports

Amniotic fluid "sludge" is a sonographic finding identified as an independent risk factor for preterm delivery, as well as for clinical or histologic chorioamnionitis and intraamniotic inflammation or infection in patients with a short cervix, cervical insufficiency, threatened midtrimester miscarriage, spontaneous preterm labor and intact membranes.

We report the case of a 39-year-old pregnant woman, admitted at 19 weeks of gestation, who presented with the sudden onset of pelvic pain, uterine contractions, and vaginal bleeding. A transvaginal ultrasound revealed the protrusion of amniotic membranes with U-shaped cervical funneling and dense hyperechoic particulate matter, identified as amniotic fluid sludge, in close proximity to the internal cervical os (Figure 1). A 3D-rendered image showed the irregular intra-amniotic surface of the amniotic fluid sludge conglomerate (Figure 2, Videoclip 1).

The patient was counseled about amniocentesis testing to monitor the microbiologic and inflammatory status of the amniotic cavity, but the procedure was declined. Broad-spectrum antibiotics were initiated. Two days after admission, spontaneous rupture of membranes occurred, resulting in a mid-trimester pregnancy loss. Histological examination of the placenta revealed necrotizing chorioamnionitis and severe funisitis. Bacterial culture of the placenta was positive for *Enterococcus faecalis*.

Particulate material in the amniotic fluid, consistent with "sludge," was confirmed by histological evidence of chorioamnionitis, funisitis, and a positive placental culture, ultimately leading to midtrimester pregnancy loss.

Keywords: cervical insufficiency; histologic chorioamnionitis; intraamniotic infection; preterm delivery; short cervix; sludge.

Image contest-02

Nuchal translucency with nuchal cord compression

Bo Min Kim, In Sook Sohn, Han Sung Kwon, Han Sung Hwang*

Department of Obstetrics and Gynecology, Konkuk University Medical Center, Konkuk University School of Medicine, Seoul, Korea

Image contest case reports

냉동배아 이식으로 임신된 38세 초산모가 정기 산전검사를 위해서 내원함.

1. 내원당일 임신 12주 1일 초음파 검사

NT를 nuchal cord가 누르는 양상이어서 정확한 NT 측정이 어려웠고, 가장 크게 측정된 부위의 크기는 2.7mm로 측정되어 다시 F/U 하기로 함.

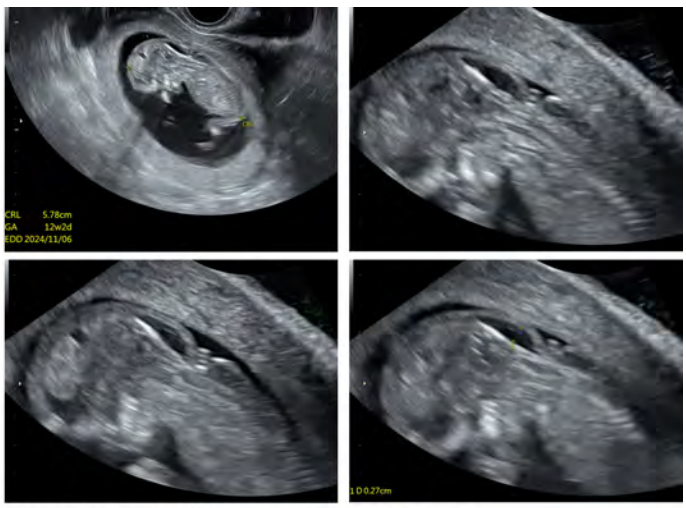


그림 1. 임신 12주 1일 NT가 nuchal cord에 눌려 있음

2. 임신 13주 1일 초음파 검사

- Nuchal cord가 NT를 계속 누르고 있는 양상이어서, 정확한 NT 측정이 나오지는 않았지만, 최소 3.0mm 이상 되는 NT임을 확인하고 CVS 시행함.
- CVS 결과에서 정상소견 확인됨.

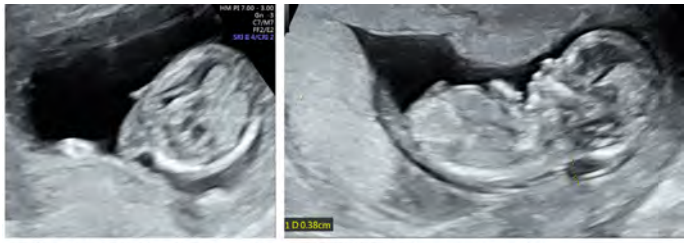


그림 2. 임신 13주 1일 Nuchal cord에 눌린 부위 외에 NT가 3.8mm로 측정됨

3. 임신 20주 5일 초음파 검사

임신 중기 정밀초음파 검사에서 태아에게 TOF 진단됨. 현재 계속 F/U 중임.

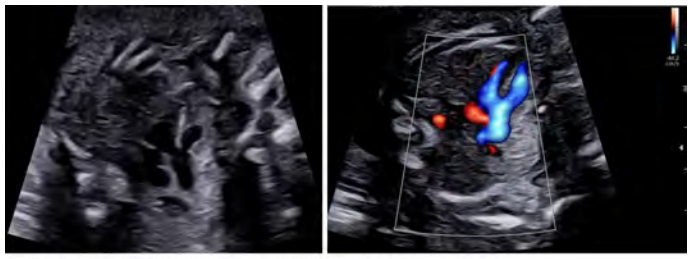


그림 3. 임신 20주 5일 임신중기 정밀초음파 검사에서 TOF 진단됨

Keywords: Nuchal translucency, nuchal cord compression

Image contest-03

산전 진단된 fetal incomplete cleft

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Image contest case reports

임신 24일 4일 임신부가 우측 난소 낭종 (7cm)이 있다고 본원에 내원하였다. 임신 20주에 개인병원에서 시행한 초음파검사에서는 이상소견이 없다고 했다.

1. 내원당일 임신 25주 4일 초음파 검사

자궁경부 주변에 7cm sized hypoechoic cyst (R/O endometriotic cyst)외에 특이소견 보이지 않았고, 태아의 얼굴이 가려져서 정확히 보이지는 않아 F/U 하기로 함.

그림 1. 임신 25주 4일 초음파 영상에서 얼굴

2. 임신 27주 1일 초음파 검사

태아의 lip이 incomplete cleft, left 가 의심되었음. 각도에 따라서는 normal lip처럼 보이나, left nostril이 내려앉아 있는 것을 확인할 수 있음.

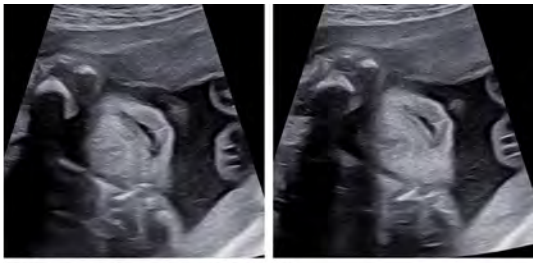

그림 2. incomplete cleft lip 의심되는 영상

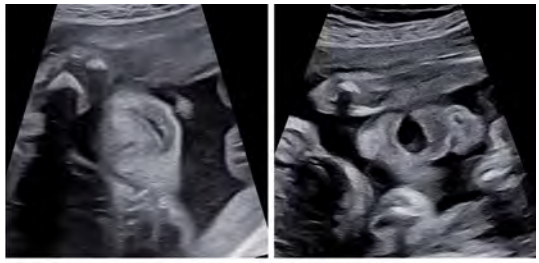

그림 3. normal lip처럼 보이나 nostril이 내려앉아 있음.

3. 출생 후 신생아의 incomplete lip 사진

그림 4. 출생 후 신생아 사진. Incomplete cleft lip, left 확인되고, left nostril 이 주저앉아 있음.

Incomplete cleft lip, left 소견 보이면서 해당 nostril이 초음파 영상처럼 주저앉아 있음. 산전 진단이 어렵고, 놓치기 쉬운 incomplete cleft lip의 경우 태아의 nostril 의 높이가 다르고, 해당 부위 nostril이 주저앉아 있는 것으로 진단하는데 도움을 받을 수 있겠음.

Keywords: Incomplete cleft lip, prenatal diagnosis

Image contest-04

Multimodal Ultrasound Insights: Doppler & 3D Imaging in Ovarian Torsion Diagnosis

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Image contest case reports

Ovarian torsion is a serious gynecological emergency that necessitates rapid diagnosis and intervention to prevent irreversible damage to ovarian tissue. However, accurate diagnosis can often be challenging due to the non-specific clinical presentation, resulting in delayed treatment or unnecessary surgical exploration in non-torsion cases. A 28-year-old nulliparous woman presented to the emergency department with sudden-onset left lower abdominal pain and vomiting, which began two hours prior. She had no significant medical history, and her pain was unresponsive to NSAIDs. Given the severity of her symptoms, immediate evaluation was critical. In this case, advanced ultrasound modalities, such as Doppler and 3D imaging, were utilized to assist in the diagnosis of ovarian torsion. Doppler imaging provided detailed assessment of ovarian blood flow, while 3D imaging offered a comprehensive view of the ovarian and pelvic structures, aiding in the early detection of torsion. By integrating these technologies, we aim to improve diagnostic accuracy and share this case to emphasize the utility of these techniques in real-world clinical scenarios, ultimately reducing unnecessary surgical interventions and enhancing patient care.

Keywords: Ovarian torsion, ultrasound, Doppler imaging, 3D imaging, gynecological emergency

Image contest-05

Fetal intrahepatic portosystemic shunt

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전주 한별여성의원

Image contest case reports

34세 미산부 (G1 P0)로 임신 20주 부터 본원에서 산전 진찰하였고 타병원 모체 혈청 태아염색체 이상 선별검사상 위험도는 저위험군이었고, 임신 20주에 시행한 정밀초음파상 특이소견 보이지 않았으며, 임신 24주에 시행한 임신성 당뇨 선별검사상 저위험군 이었다. 임신 32주 초음파상 태아 간부위에 확장된 이상 혈관 발견되어 임신 34주 초음파 시행 2D상 간내부에 abnormal large tortuous vessel보이고 , 심장 초음파상 심비대 (C/T area ratio 0.45) 및 소량의 흉수 확인, CD US상 shunt between the medial branch of LPV and the MHV 확인되어 intrahepatic portosystemic shunt 진단하에 지역 대학병원 전원 임신 37주 1일에 제왕절개술로 3.3kg 건강한 아이 출산하였고, 출생 후 CT로 산전 진단 확진 후 서울지역 대학병원 전원되어 현재 23개월로 특별한 합병증 없어 증재시술 및 수술 없이 추적 경과 관찰 중. 한 개의 shunt 혈관은 자연 소실되었고, 나머지 한 개는 아직 남아 있으나 크기 감소하는 경과 보이며 합병증 없이 추적 관찰 중입니다,

Keywords: (intrahepatic portosystemic shunt)

Image contest-06

부루펜! 나도 필요해!

Jin- Hee Park, Mi-Young Lee*, Jae Yi Jeong, Jihye Koh, Jin Hoon Chung, Hye-Sung Won

Department of Obstetrics and Gynecology, University of Ulsan College of Medicine, Asan Medical Center

Image contest case report

A 30-year-old primigravida was referred at 17.2 weeks of gestation due to right atrial (RA) enlargement. Fetal echocardiography revealed severe RA dilatation with significant tricuspid regurgitation, apical displacement of the septal leaflet of the tricuspid valve, hypoplastic pulmonary artery, and pulmonary regurgitation (PR), consistent with Ebstein's anomaly. Due to concerns over fetal demise from the the severely dilated RA, the patient was hospitalized at 29weeks of gestation for nonsteroidal anti-inflammatory drugs (NSAIDs) therapy. The therapeutic aim was to induce ductus arteriosus (DA) constriction, thereby reducing PR and limiting circulatory shunting. Treatment started with indomethacin 50 mg twice daily for 5 days, followed by ibuprofen (Brufen) 400 mg three times daily. At 32 weeks of gestation, the dosage was increased to 600 mg three times daily, and the medication was discontinued at 34 weeks. Post-treatment, improvement in PR was observed, and the fetus remained stable during the prenatal period. Delivery occurred at 38.0 weeks, with the newborn weighing 3,140 g. Postnatal echocardiography confirmed the prenatal findings, and the infant underwent successful surgical correction. To date, the baby is doing well.

Fetuses with Ebstein's anomaly may experience improved hemodynamics through DA constriction, which limits circular shunting. This narrowing of the DA can be effectively achieved via maternal administration of NSAIDs such as indomethacin or ibuprofen, offering a potential therapeutic option to improve perinatal outcomes.

Keywords: Ebstein anomaly, nonsteroidal anti-inflammatory drugs

Image contest-07

POWER O2

Young-Wha Seo, Mi-Young Lee*, Jae Yi Jeong, Jihye Koh, Jin Hoon Chung, Hye-Sung Won

Department of Obstetrics and Gynecology, University of Ulsan College of Medicine, Asan Medical Center

Image contest case report

A 35-year-old primigravida was referred at 26.2 weeks of gestation due to a suspected congenital diaphragmatic hernia. Ultrasonography revealed a left-sided diaphragmatic hernia containing the stomach, bowel, liver, and spleen, along with congenital pulmonary airway malformation in the left lung. The observed-to-expected lung-to-head ratio was measured at less than 25%. Maternal hyperoxygenation therapy was initiated at 31.0 weeks of gestation and continued until delivery, with the goal of increasing pulmonary blood flow. The baby was delivered at 38.2 weeks of gestation. Extracorporeal membrane oxygenation was necessary, and after surgery, the baby has remained stable to date.

Keywords: congenital diaphragmatic hernia

Image contest-08

3D ultrasound and Crystal vue rendering technology for the diagnosis of PAS

Haemin Kim[1], Hyun Mi Kim[1,2], Mi Ju Kim[1,2], Jong In Kim[1], Hyun-Hwa Cha[1,2], Won Joon Seong [1,2*]

[1]Department of Obstetrics and Gynecology, Kyungpook National University Chilgok Hospital, School of Medicine, Kyungpook National University, Daegu, Korea, [2]Department of Obstetrics and Gynecology, Kyungpook National University Hospital, School of Medicine, Kyungpook National University, Daegu, Korea

Image contest case reports

Disruption of the Tramline sign (inner bladder wall and outer uterine wall) is an ultrasound finding that mainly manifests as bladder wall neovascularization due to severe placenta accreta syndrome (PAS), which increases the likelihood of cesarean hysterectomy and massive intraoperative bleeding and bladder injury. We present a case of PAS3 with right parametrial hypervascularity on three-dimensional ultrasound that resulted in cesarean hysterectomy at 36 weeks' gestation.

Keywords: Placenta accreta, Placenta accreta syndrome, Tramline sign,cesarean hysterectomy

Image contest-09

Week 13: A Tiny One Room

Ji-Hye Park, Mi-Young Lee*, Jae Yi Jeong, Jihye Koh, Jin Hoon Chung, Hye-Sung Won

Department of Obstetrics and Gynecology, University of Ulsan College of Medicine, Asan Medical Center

Image contest case report

A 34-year-old pregnant woman, carrying twins, presented at 13.1 weeks for a routine prenatal examination. Detailed ultrasonography revealed that the male fetus was normal, but the female fetus showed signs of a heart abnormality. The four-chamber view was not fully visualized, and a single ventricle was identified. Color Doppler confirmed the presence of only one ventricular inflow, consistent with a single ventricle diagnosis. Both the aorta and pulmonary artery arose from this single ventricle, following a parallel course. Chromosomal analysis showed normal results. A follow-up fetal echocardiography at 20 weeks confirmed the initial findings. This case highlights the role of early fetal echocardiography in diagnosing congenital heart diseases as early as the first trimester.

Keywords: early fetal echocardiography

Image contest-10

CHAOS가 아닌 CLAOS

Sun Ah Park, Hye-Sung Won*, Jae Yi Jeong, Jihye Koh, Mi-Young Lee, Jin Hoon Chung

Department of Obstetrics and Gynecology, University of Ulsan College of Medicine, Asan Medical Center

Image contest case report

A 35-year-old multigravida was referred at 21.2 weeks of gestation due to a suspected large mass in the left thoracic cavity, accompanied by fetal ascites. Ultrasonography revealed a 53 x 38 mm hyperechoic lesion in the left thoracic cavity with an inverted diaphragm. The mass was supplied by the pulmonary circulation. The heart was severely compressed to the right. Skin edema and extensive ascites were observed, indicative of fetal hydrops. Based on these findings, congenital pulmonary airway malformation (CPAM) or unilateral bronchial atresia was suspected. At 25 weeks of gestation, magnetic resonance imaging confirmed a diagnosis of left unilateral bronchial atresia. The baby was delivered at 31 weeks following preterm premature rupture of membranes. The neonate weighed 1,540 g at birth and had poor Apgar scores. A postnatal X-ray revealed total haziness of the left lung, and the neonate died three days after birth.

Unlike congenital high airway obstruction syndrome (CHAOS), which typically presents with symmetrically enlarged both lungs and increased echogenicity, unilateral bronchial atresia results in massive enlargement of only one lung. This condition may mimic more commonly encountered unilateral fetal lung abnormalities, particularly microcystic CPAM or pulmonary sequestration.

Keywords: bronchial obstruction

Image contest-11

방 안에 방이 또 있군요.

김호연*, 전혜진, 송관흡

Department of Obstetrics and Gynecology, Korea University School of Medicine

Image contest case reports

G3P2 (previous csec) 임신 35주2일에 coarctation of aorta가 의심된다고 개인병원에서 내원한 분으로 좌심방과 좌심실이 우측에 비해 작아져 있고 Aortic annulus 직경이 0.56cm으로 (35주 2.5%tile 0.58cm)작아져 있고 aortic arch narrowing과 aortic isthmus 가 좁아진 소견이 보이고 Color Doppler에서 aortic arch 의 retrograde blood flow가 관찰되어 CoA로 의심하였음. 임신 37주에 시행한 초음파에서 cardiomegaly 악화되고 cardiac effusion 증가 및 aortic annulus 0.36cm으로 더 좁아진 소견으로 emergency csec시행하였음. 남아 3.59kg Apgar score 2-3점으로 NICU에서 Echocardiography시행 결과 atrial septal aneurysm있으며 CoA는 보이지 않고 Pulmonary hypertension과 RV dysfunction있어 5일동안 dopamine투여 하였으며 7일동안 phosphodieterase투여후 stop. aneurysm 크기 점점 감소하고 퇴원후 건강하게 자라고 있음.

Keywords: narrow ascending aorta, chamber discordance, cardiomegaly, atrial septal aneurysm

Image contest-12

정상인 듯 정상 아닌 정상 같은 너~ ♬

Ji-Hyun Kim, Mi-Young Lee*, Jae Yi Jeong, Jihye Koh, Jin Hoon Chung, Hye-Sung Won

Department of Obstetrics and Gynecology, University of Ulsan College of Medicine, Asan Medical Center

Image contest case report

A 34-year-old woman was referred at 21.5 weeks of gestation for suspected dextro-transposition of the great arteries (d-TGA). Fetal echocardiography revealed a normal atrioventricular connection but abnormal ventriculoarterial connections, consistent with d-TGA. Typically, in d-TGA, the aorta (Ao) is located anterior to the pulmonary artery (PA), leading to an abnormal arrangement of the great arteries (GAs) in the 3-vessel view (3VV). However, in this case, the PA was positioned anteriorly and the Ao posteriorly, leading to a normal 3VV appearance. The diagnosis was confirmed as d-TGA with a posterior Ao, and a ventricular septal defect (VSD) was also noted. At 38 weeks, a male neonate weighing 3,050 g was delivered. Postnatal findings confirmed the prenatal diagnosis, and surgical correction was successfully performed on the 9th day after birth. The infant was discharged in good condition.

We present a rare variant of d-TGA with a posterior Ao. This case highlights that, in rare instances of d-TGA, the 3VV can appear normal. Therefore, when evaluating the fetal heart, it is essential to assess all cardiac views sequentially, including but not limited to the 4-chamber view (4CV) and 3VV.

Keywords: transposition of the great arteries with posterior aorta

Image contest-13

An unexpected little guest in my heart!

Seo-Yeon Park, Mi-Young Lee*, Jae Yi Jeong, Jihye Koh, Jin Hoon Chung, Hye-Sung Won

Department of Obstetrics and Gynecology, University of Ulsan College of Medicine, Asan Medical Center

Image contest case report

A 36-year-old woman was referred at 27 weeks of gestation for evaluation of a suspected dysplastic mitral valve (MV) with mitral regurgitation (MR). Ultrasonography revealed a 20 x 14 mm abnormally dilated, pouch-like lesion adjacent to the left ventricle (LV), with minimal blood flow into the pouch, and associated severe MR. LV aneurysm or diverticulum was suspected. No signs of fetal hydrops were observed. Despite the pouch gradually enlarging as gestation progressed, the fetus remained stable. At 39.5 weeks of gestation, a cesarean section was performed, delivering a female infant weighing 3,750 g. Postnatal echocardiography and cardiac computed tomography confirmed a diagnosis of LV diverticulum with an MV anomaly. The diverticulum extended from the base of the LV to approximately two-thirds of its length. The baby is stable and awaiting corrective surgery.

Keywords: LV diverticulum

Image contest-14

Fetal goiter due to congenital hypothyroidism

이유리[1], 함수지[1], 성지희[1], 최석주[1], 오수영[1], 노정래[1*]

[1] *성균관대학교 의과대학 삼성서병원 산부인과*

임신 25주 4일 초임부로 태아의 goiter를 진단받고 본원으로 전원되었다. 환자 는 임신 전 및 임신 중 특이병력이 없는 자로, 타원에서 임신 20주경 시행한 정밀 초음파에서 태아의 목부위에 덩이를 진단받았다. 이 덩이는 기도를 중심으로 좌우 대칭을 이루고 있으며 경계가 명확하고 내부의 음영이 균일하여 갑상선 goiter로 추정되었다. 임신 25주 4일 본원 전원되어 시행한 초음파에서도 동일한 덩이가 태아의 목부위에서 관찰되었으며, 덩이의 크기는 2.6 X 1.5 cm, 2.4 X 1.5 cm으로 관찰되었고 내부에 혈류가 관찰되었다. 산모의 갑상선 기능검사를 시행했으나 정상범위였고, 태아의 선천성 갑상선 기능저하증 여부를 확인하기 위해 임신 26주 1일 제대 천자를 통한 태아의 혈액검사를 시행했고, TSH 269.000 ㎍IU/㎖, Free T4 ▼0.28 ng/㎗, T3 ▼77.90 ng/㎗, Thyroglobulin Ab ▲209.7 U/m 로 태아의 선천성 갑상선 기능 저하증이 진단되었다. 태아의 goiter는 출생시 기도 압박의 위험이 있어 산전에 양수내로 T4 주사제를 투여하여 goiter 크기의 감소시키는 것이 치료방법이나, 현재 국내에서는 양수내로 주입가능한 T4주사제가 없어, 산모에게 경구로 T4 투약을 시작하고 외래 추적관찰 중에 있다.

Keywords: fetal goiter, congenital hypothyroidism, fetal neck mass

Image contest-15

Right sided congenital diaphragmatic hernia

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Image contest case reports

Congenital diaphragmatic hernia is not difficult to diagnose, but when it occurs on the right side, its diagnosis may be delayed because the stomach is identified in the abdominal cavity. We aimed to report a case of right-sided diaphragmatic hernia diagnosed due to abnormal cardiac axis and position

Keywords: congenital diaphragmatic hernia, right-sided

Image contest-16

Conjoined twins

Rina Kim[1*]

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Image contest case reports

A 44-year-old multigravida woman visited Jeju National University Hospital at 10.2 weeks of pregnancy because of old age. She had a history of autoimmune thyroiditis on medication.

The initial ultrasonography showed weird extremities of the fetus. After that, the clinician diagnosed a conjoined twin with hydrops: one head, one heart, one liver, four arms, and four legs.

After a thorough consultation with the patient and her husband, we decided to terminate the pregnancy.

Gross examination of the abortus revealed the top of the head down to the belly button, facing each other (cephalopagus).

Keywords: Conjoined twins, Cephalopagus

Image contest-17

A case of fetal adrenal hemorrhage

Se Jin Lee, Heejoo Hong, Sunghun Na*

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Image contest case reports

This case is a 41-year-old primiparous mother who first visited our hospital for delivery at 24 weeks and 3 days of pregnancy. At the time of the visit, an approximately 1.59 cm x 1.31 cm hypoechoic cyst in the abdominal cavity was found near the right kidney in the lower abdomen by ultrasound. The cyst did not show vascularity on Doppler, but its size was observed to gradually increase. At 32 weeks and 6 days of pregnancy, it was observed to be approximately 2.44*1.77cm, and at 35 weeks and 6 days of pregnancy, the echogenicity inside the cyst increased, but vascularity was not observed. In the ultrasound performed on 38 weeks and 1 day of pregnancy before delivery, the size increased further to 3.5*2.2cm.

She had a cesarean section at 39 weeks of pregnancy. And the adrenal hemorrhage was suspected on neonatal abdominal ultrasound after delivery, and during subsequent follow-up observations, the size gradually decreased to the point where it was barely visible on recent ultrasound. The patient is currently under observation.

Keywords: Fetal abdominal mass, adrenal hemorrhage

Image contest-18

Narrowly escaped death

Byung Soo Kang[1], Gisoo Um[1], Hyun Sun Ko[1*]

[1]*Department of Obstetrics and Gynecology, Seoul St. Mary's hospital, The Catholic University of Korea*

Image contest case reports

A 33-year-old woman, diagnosed with placenta previa, visited a local clinic at 32 weeks and 5 days' gestation due to diarrhea and abdominal pain. Fetal gastroschisis was suspected via ultrasonography. Due to uterine contractions, she received tocolytics with IV hydration. She was then transferred to a tertiary hospital at 33 weeks' gestation due to vaginal spotting. A 6.3 × 3.9 cm extra-abdominal mass was observed on fetal ultrasonography. An emergency cesarean section was planned due to a non-reassuring fetal heart rate.

Keywords: previa, extra-abdominal mass, emergency

Image contest-19

Everyone told me to give up…
(모두가 제게 포기하라고 했습니다.)

Gi-Soo Um [1], Byung-Soo Kang[1], Yun-Sung Jo[2], Hyun-Sun Ko[1*]

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Image contest case reports

A 36-year-old woman, diagnosed with fetal myelomeningocele (mmc), visited outpatient clinic at 24 weeks and 0 days' gestation. She said that everyone told me to give up the baby. Chiari II malformation was suspected on ultrasonography and fetal MRI. However, sac size was small and fetal leg movements were active. A multidisciplinary counselling was performed. Although mmc of the fetus had been progressed slowly after 30 weeks' gestation and mother received cesarean section at 35 weeks' gestation due to preterm labor, the neonate received immediate postnatal operation for mmc. The condition of the baby has been tolerable without additional treatment, until 45 days after birth.

Keywords: Myelomeningocele

Image contest-20

PortraitVue™를 이용한 fetal 3D ultrasonography의 가상 복원

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Image contest case reports

중기 정밀초음파는 태아의 구조적 이상을 확인하기 위해 필수적으로 하는 초음파로, 이미 대부분의 병원에서는 routine examination로 적용하고 있는 부분입니다. 그에 반해 fetal 3D 또는 4D ultrasonography는 필수적인 검사가 아니어서 일반적으로 하는 검사는 아니며, 태아의 position 및 다른 신체 부위와의 관계성으로 인해 태아의 자세에 따라 확인하기 어렵고 꽤 긴 시간이 소요되는 검사에 속합니다.

산모와 보호자들은 중기 정밀초음파의 대부분의 내용에 대해서는 필요성을 알고 있지만, 오히려 이 fetal 3D 에 대해서 더 큰 요구도가 있습니다. 또한 fetal 3D 초음파의 사진을 통해 산모와 보호자가 출산 전부터 태아와의 애착을 강화하는 하나의 기회가 될 수 있습니다.

삼성메디슨에서 새롭게 보여주는 PortraitVue™의 경우, 비록 진단적인 이득은 없지만 앞서 말씀드린 이유로 fetal 3D의 부족함을 채워줄 뿐 아니라 환자의 만족도 상승을 저도 느꼈습니다.

그런 이유로 이에 대한 짧지만 저의 경험을 함께 나누고 싶어, 큰 학문적인 내용이 아니더라도 저의 경험을 공유하고자 합니다.

Keywords: PorturateView, fetal 3D ultrasonography, fetal 4D sonography

제27차 대한산부인과초음파학회

추계학술대회

Poster presentation

좌장 : 김영한 (연세의대), **오수영** (성균관의대)
오관영 (을지의대), **권한성** (건국의대)

Korean Society of Ultrasound
in Obstetrics and Gynecology

Poster-01

Intravaginal Misoprostol for Missed Abortion: Factors Related to Successful Expulsion of Conceptus

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Objective: The objective of this study was to evaluate the predictive factors associated with the success of medical expulsion of the conceptus in missed abortions using vaginal misoprostol monotherapy in the first trimester of pregnancy.

Methods: This retrospective cohort study included 673 women diagnosed with miscarriage during the first trimester of pregnancy. The medical records of patients with miscarriage up to 14 weeks of gestation, who underwent medical treatment with intravaginal misoprostol monotherapy were reviewed. A successful abortion was defined as complete expulsion of the conceptus without the need for surgical intervention. The primary outcome was failure to spontaneously pass the gestational sac within 18 hours of misoprostol administration

Results: Among the 673 women who continued the medical abortion process for 18 hours, 622 (92.4%) experienced a successful abortion. Multivariate logistic regression showed that a previous cesarean section was significantly associated with failed medical abortion within 18 hours (odds ratio, 2.354; 95% confidence interval (CI), 1.134-4.887; P = 0.022). Twin pregnancy was also a risk factor for failed medical abortion within 18 hours. (odds ratio, 3.193; 95% confidence interval (CI), 1.119-9.115; P = 0.030). Previous vaginal delivery appeared to be associated with successful abortion within 18 hours in univariate analysis (P = 0.054), but the association was lost in multivariate analysis. The most common side effects were abdominal pain, followed by fever, with mild nausea and diarrhea also observed.

Conclusion: Intravaginal misoprostol monotherapy is an effective treatment for first trimester miscarriages. However, women with a history of previous cesarean section or those with twin pregnancies are less likely to achieve successful expulsion of the conceptus within 18 hours of misoprostol administration. These factors should be considered when choosing expulsion **methods** for women experiencing miscarriages.

Keywords: Previous cesarean section, Twin pregnancy, Misoprostol, Miscarriage, First trimester of the pregnancy, Missed abortion

Poster-02

The clinical use of sFlt-1/PlGF in addition to umbilical artery Doppler for managing fetal growth restriction

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Objectives: We explored whether the sFlt-1/PlGF could be used in the management of fetal growth restriction in addition to conventional umbilical artery Doppler.

Materials and methods: We retrospectively investigated the sFlt-1/PlGF and umbilical artery Doppler in pregnant women with less than the 10^{th} percentile of estimated fetal weight and completed their deliveries from January 2024 to September 2024. We divided our study group into low and high-risk groups according to the results of the sFlt-1/PlGF and compared the maternal characteristics including umbilical artery Doppler and perinatal outcomes.

Results: A total of 43 pregnant women were enrolled during the study period, of whom 26 were in the low-risk group and 17 were in the high-risk group. There were no differences in maternal age, gestational age at enrollment or the rate of hypertensive disorders between the two groups, however the rate of abnormal Umbilical artery Doppler flow was significant higher in the high-risk group [1 (3.85%) vs. 7 (41.2), $p < 0.01$]. Also, in terms of perinatal outcomes, the high-risk group women showed earlier gestational age at delivery [36.3 (35.2-37.1) vs. 34.1 (33.2-36.1), $p < 0.01$] and lower birth weight [2.16 (1.92-2.33) vs. 1.68 (1.48-1.90, $p < 0.01$). Interestingly, 9 out of 10 women with normal Doppler results and who were in the high-risk group gave birth prematurely, while 1 woman with abnormal Doppler results and who was in the low-risk group gave birth at term. Meanwhile, there were 22 mothers who underwent sFlt-1/PlGF testing more than twice, with 3 mothers in the low-risk group and 2 in the high-risk group showing changes. Two mothers who transitioned from high risk to low-risk group showed normal Umbilical artery Doppler and normal placental pathology, although they delivered preterm before 34 weeks of gestation due to severe adenomyosis and pre-eclampsia, respectively.

Conclusion: Our results suggest the Flt-1/PlGF could be used in the management of fetal growth restriction in addition to conventional umbilical artery Doppler

Poster-03

Prelabor intrapartum ultrasound assessment in prediction of a successful vaginal delivery

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목적(Objective): To assess whether prelabor intrapartum ultrasound measurement can assist in predicting a successful vaginal birth in primiparous women with singleton pregnancy

방법(Methods): A prospective observational cohort study was performed in a single tertiary center including women at third trimester. Transperineal and transvaginal ultrasound was used to measure angle of progression(AoP), head to perineal distance(HPD), head to symphysis pubis distance(HSD), cervical length, posterior cervical angle(PCA) and head station before the onset of labor. Clinical data and delivery outcome were retrieved from medical records. The ultrasound measurement was carried out once again by expert who was blinded about the delivery outcome. The primary outcome was a successful vaginal delivery.

결과(Results): Of the 141 women, 69(48.9%) women underwent a successful vaginal delivery. The mean Aop was wider(97°±17.9 vs 88.7°±12.6, p=0.003), and head station was lower(1cm(-0.2-1.8) vs 0cm(-1.1-0.8), p< 0.001) in vaginal delivery group. The median HSD and cervical length were shorter(p=0.002) in vaginal delivery group. There were no differences in HPD, PCA and bishop score before the onset of labor. Multivariable regression analysis demonstrated sonographic head station was a marker to predict successful vaginal birth after adjustment for maternal age, BMI and birthweight(aOR 1.35 95%CI 1.01-1.85).

결론(Conclusion): Prelabor sonographic head station using ultrasound measurement may be a useful sonographic tool for predicting a successful vaginal birth.

Keywords: vaginal delivery, head station, intrapartum ultrasound, prelabor

Poster-04

대한민국 전치태반 및 하위태반 산모의 분만 및 예후

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목적(Objective): 본 연구는 국내 대학병원에서 치료한 전치태반 및 하위태반 환자의 수술 계획 주수에 따른 산모와 신생아 예후를 확인하고자 하였다.

방법(Methods): 이 연구는 전치태반과 하위태반이 있는 단태임신 여성들을 대상으로 한 다기관 후향적 코호트 연구로서, 수술을 계획한 주수, 분만 주수, 응급 제왕절개 분만율 및 산모, 신생아 이환율을 분석하였다. 또한, 수술을 계획한 주수가 37주인 경우와 38주인 경우의 응급 제왕절개율과 모성 및 신생아 이환율의 차이를 확인하였다. 산모의 불량한 예후로는 대량 출혈, 바크리 풍선 삽입, 자궁 동맥 색전술, 자궁 적출술 및 중환자실 입원이 포함되었고, 신생아의 불량한 예후로는 호흡곤란증후군, 기관지폐이형성증, 괴사성 장염, 패혈증, 발작 및 두개내 출혈이 포함되었다.

결과(Results): 총 1,081명의 환자가 포함되었으며, 이 중 242명(22.4%)은 하위태반, 372명(33.4%)은 부분 전치태반, 467명(43.2%)은 완전 전치태반이었다. 하위태반과 부분 전치태반에서 수술을 계획한 주수는 평균 38주였고, 완전 전치태반은 37주였다. 응급 제왕절개율은 완전 전치태반에서 50%로, 산모의 불량한 예후 빈도는 42.6%로 나타났으며, 이는 부분 전치태반과 하위태반보다 유의하게 높았다(모두 $p<0.001$). 완전 전치태반에서 수술을 38주에 계획한 경우 37주에 계획한 경우보다 모성 합병증이 더 많았다(48.3% vs. 33.3%, $p=0.031$). 하위태반의 경우, 37주에 수술을 계획한 경우보다 38주에 계획한 경우 신생아 합병증이 더 적었다(4.9% vs. 17.1%, $p=0.042$).

결론(Conclusion): 대한민국에서 하위태반 및 부분 전치태반은 대체로 38주에, 완전 전치태반은 37주에 분만을 계획하며, 이 주수에 수술을 계획하는 것이 산모와 신생아의 합병증을 감소시키는 데 기여한다.

Keywords: 전치태반, 하위태반

Poster-05

Birth weights according to the birth order of siblings

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목적(Objective): The aim of this study was to evaluate whether birth weights is different according to the birth order of siblings.

방법(Methods): This retrospective nationwide study included women who had their first delivery and a subsequent delivery between 2015-2021. Comparisons between first and second siblings were carried out using linear mixed models. All models included family identification number as a random factor, to account for the clustering of siblings. Random intercepts for subjects nested within each family were used to correct for repeated measurements per subject's respective family.

결과(Results): In this study, 194,354 women and their 388,708 siblings were included. The comparison of siblings within families showed an increase in birth weight (52.7%) in second sibling compared to first sibling. On linear mixed models, adjusted birth weight was higher in second sibling (3.265, 3.263-3.266 kg) compared to first sibling (3.163, 3.162-3.165 kg)($p<0.05$) after adjustment for maternal age, sibling sex and gestational age at delivery.

결론(Conclusion): Our results demonstrate a strong positive association between increasing birth order and birth weight. Further studies are required to understand the mechanisms underlying this phenomenon

Keywords: birth order, birth weight, sibling,

Poster-06

Cervical Elastography and the Risk of Preterm Birth in Pregnant Women with a Cervical Length of 25–29 mm in Mid-trimester

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목적(Objective): To investigate the differences in cervical elastographic parameters in pregnant women with or without preterm birth (PTB) who were diagnosed with a cervical length (CL) of 25-29mm between in mid-trimester.

방법(Methods): This was a secondary analysis of a multicenter prospective observational study for asymptomatic pregnant women by the Korean Research Group of Cervical Elastography involving 7 referral hospitals. Among asymptomatic pregnant women who were scheduled for fetal anomaly scan between 18 and 24 weeks of gestation, singleton pregnancies diagnosed with a CL of 25-29 mm were enrolled. Cervical elastographic parameterswere measured using E-Cervix™ (WS80A, Samsung Medison, Seoul, Republic of Korea). Women with progesterone use, and cerclage before or after cervical elastography were excluded. PTB was defined asdelivery 〈 37 weeks of gestation. CL and elastographic parameters were compared between term and PTB groups. The area under the curve (AUC) analyses were performed.

결과(Results): A total of 101 patients were included in the analysis. Seven women (6.9%) had spontaneous PTB. The mean gestational age at cervical elastography measurements was 21.1 weeks. Mean gestational age at delivery was 38.49 and 35.43 weeks in term and PTB groups, respectively. Although CL was not significantly different between the groups, IOS strain, EOS strain, ECI, and Hardness ratio were different between the two groups. (Table 1) The AUCs for CL, EOS strain, ECI, strain mean, and Hardness ratio were 0.407, 0.767, 0.793, 0.778, and 0.888, respectively..

결론(Conclusion): There were differences in cervical elastographic parameters using E-Cervix™ in singleton pregnancies with and without PTB complicating with a CL of 25-29 mm in mid-trimester,

which may help in predicting PTB (This research was supported by Korea Health Technology R&D project through the Korea Health Industry Development Institute (KHIDI), Grant number : HI18C1696)

Table 1. Cervical length and E-Cervix elastographic parameters between term and preterm birth groups

	Term birth (n=95)	PTB (n=7)	p-value
CL, mm	28.078 (27.00-29.000)	27.299 (26.799-29.000)	0.449
IOS strain	0.197 (0.159-0.232)	0.259 (0.209-0.310)	0.017
EOS strain	0.230 (0.189-0.392)	0.370 (0.230-0.490)	<0.001
IOS/EOS ratio	0.819 (0.670-1.044)	0.860 (0.560-0.910)	0.595
ECI	2.665 (2.135-3.349)	4.239 (3.019-4.670)	0.004
Hardness ratio	79.125 (72.219-86.300)	58.470 (42.040-66.980)	<0.001

CL, cervical length; PTB, preterm birth

Keywords: Cervical length, mid-trimester, E-cervix, cervical elastography

Poster-07

Pregnancy outcomes according to placental location with placenta previa.

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목적(Objective): Placenta previa (PP) usually manifests as antepartum bleeding, neonatal morbidity and mortality are also common and result primarily from premature birth. Although there has been extensive research into abnormal placentation (placenta accreta) and low placental implantation, only a few studies have evaluated the other aspects of placental position and the impact they may have on pregnancy and neonatal outcomes. Therefore, the aim of this study was to evaluate pregnancy outcomes according to placental location in women with PP.

방법(Methods): This retrospective cohort study included cases wherein cesarean deliveries were performed because of PP at three university hospitals between May 1999 and February 2020. The study included women who have diagnosed with PP. The patients were categorized into two groups (anterior and posterior placenta groups). The adverse obstetric outcomes associated with placenta location were evaluated using a multivariate logistic analysis.

결과(Results): There was a higher rate of admission bleeding in the anterior PP group (45.5% (anterior group) vs. 36.7% (posterior group); $p = 0.027$). The emergency cesarean section rate was significantly higher in the anterior PP group ($p = 0.015$). Anterior PP significantly increased the risk of transfusion (OR = 2.23; 95% CI: 1.50–3.33; $p < 0.001$) and placenta accreta (OR = 2.16; 95% CI: 1.21–3.97; $p = 0.009$)

결론(Conclusion): We found that anterior PP was an independent risk factor for PAS and need for transfusion.

Therefore, if placenta previa is diagnosed, it is important to prepare for massive bleeding in the anterior group

Keywords: placenta previa, obstetric outcomes

Poster-08

Assessment of the fetal right myocardial performance index in diabetic pregnancy in the third trimester

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목적(Objective): To assess the modified myocardial performance index (Mod-MPI) of fetal left and right heart in pregnant women with diabetes mellitus and compare it with the Mod-MPI in the control group

방법(Methods): This was a multicenter prospective cross-sectional study to assess the Mod-MPI of the fetal heart for singleton pregnant women with diabetes mellitus in the third trimester. Mod-MPI was measured using an automated measurement system for the left heart and a semi-automated system for the right fetal heart (MPI+, Samsung Medison, Seoul, Korea). Singleton pregnant women with pre-gestational diabetes or gestational diabetes beyond 28 weeks of gestation were included in the diabetes group, and uncomplicated pregnant women were included in the control group.

결과(Results): A total of 120 measurements (67 diabetes, 53 controls) were included in this study. The mean gestational age of measurement was 32.7±2.4 weeks in the control group and 34.1±3.4 weeks in the diabetes group. There was no significant difference for Mod-MPI of the left fetal heart between the diabetes and the control group (0.52 [0.47-0.57] vs. 0.50 [0.45-0.53], p=0.067). Mod-MPI of the right heart was significantly higher in the diabetes group (0.57 [0.50-0.62]) compared to the control group (0.52 [0.47-0.57], p=0.0070). However, there was no significant difference in Mod-MPI of the fetal right or left heart between pregestational diabetes and gestational diabetes group.

결론(Conclusion): Mod-MPI of the right fetal heart is significantly higher in the diabetes group and might have a predictive value of fetal cardiac function associated with the adverse perinatal outcome of diabetic pregnancy

Keywords: diabetes, fetal cardiac function, myocardial performance index, third trimester

Poster-09

Assessing the feasibility of 3D auto segmentation-based standard plane detection for fetal brain malformations: a preliminary study

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목적(Objective): Standard plane detection in three-dimensional (3D) fetal neurosonography was essential in assessing the fetal brain. Our proposed algorithm, standard axial plane detection based on 3D autosegmentation and anatomical knowledge-based plane navigation, demonstrated higher performance than conventional software in detecting the standard axial planes of the fetal normal central nervous system. However, research on algorithms accurately detecting standard planes in fetal brain malformations was limited. This study aimed to evaluate the performance of the proposed standard plane detection algorithm in fetal brain malformations.

방법(Methods): We used 34 3D volumes of the fetal head obtained from fetal brain malformation. The volumes wereacquired using a HERA W10 ultrasound system (Samsung Medison, Seoul, Korea) with a 1-8 MHz transabdominal probe. Two independent experts audited the output standard axial plane (transventricular (TV), transthalamic (TT), and transcerebellar (TC) plane) images to confirm diagnostic plane accuracy.

결과(Results): The experimental results showed that our method achieved a success rate of 79.3% for 3D auto-segmentation and accuracy of 79.4%, 70.6%, and 70.6% for TV, TT, and TC plane detection, respectively.

In cases of mild fetal brain anomalies such as ventriculomegaly and cerebellar hypoplasia, the accuracy rate reached 81.3%. In cases of corpus callosal dysgenesis, the detection rates for the TV, TT, and TC planes were 75%, 62.5%, and 62.5%, respectively. However, severe ventriculomegaly, characterized by unclear internal structures, rendered plane detection impossible.

결론(Conclusion): Our proposed algorithm demonstrated good performance in fetal brain anomalies, excluding severe ventriculomegaly. Techniques that can acquire standard planes even in malformations where the brain's internal structure is complicated to distinguish are needed.

Keywords: fetal anomalies, brain, autosegmentation

Poster-10

Uterine rupture with prior adenomyomectomy which can be mistaken as ovarian cyst : a case report at 27 weeks gestation

최세경

가톨릭의대 산부인과

A 36-year-old primigravida at 27 weeks and 5 days of gestation presented to the emergency room with persistent abdominal distension. She had a history of adenomyomectomy performed 2 years ago at another hospital, with an unremarkable prenatal course in the current pregnancy.
On admission, she had mild vaginal bleeding, no uterine contractions, and a reassuring fetal status. However, ultrasound revealed a near-absent amniotic fluid volume and a new cystic mass approximately 10cm above the uterus.
The cystic mass was suspected to be a uterine rupture related to the prior adenomyomectomy, rather than an ovarian cyst-associated amnion rupture.
The surgical findings also revealed that the amniotic sac protruded like a cystic lesion due to uterine fundus rupture following a previous adenomyomectomy.

This case highlights the importance of considering uterine structural abnormalities in pregnant women with a history of uterine surgery, and the need for careful monitoring and intervention in such cases to ensure optimal maternal and fetal outcomes.
With the increasing maternal age in recent years, the occurrence of uterine myomas or adenomyosis before pregnancy has become quite common. However, it is important to note that undergoing surgery for these conditions before pregnancy is actually considered very risky. It is advisable to manage these conditions conservatively with careful monitoring during pregnancy.

Poster-11

Placenta percreta with vaginal bleeding in early pregnancy: A case report

Kyung-Eun Lee[1], Jae-Eun Shin[1*]

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A 32-year-old woman, who was 4th multigravida, was referred to our hospital at 8weeks 1day (estimated) of gestation with vaginal bleeding by car. The pregnant woman had undergone eclampsia and pre-eclampsia before pregnancy and delivered babies by cesarean section.
When the patient came to our hospital, her vital signs were unstable due to massive vaginal bleeding. We performed transvaginal and transabdominal sonography. The fetal heartbeat was not checked and the g-sac was located on the c/sec scar. We diagnosed c/sec scar pregnancy or cervical pregnancy. Therefore, we decided to perform emergency dilatation and curettage under general anesthesia.
Despite the use of uterotonics, vaginal bleeding became worse and uncontrolled during surgery. We converted the surgery to abdominal hysterectomy. After surgery, the patient was admitted to the intensive care unit for closed monitoring.
Gross and pathohistologic findings revealed placental percreta.
On postoperative day 5, the patient recovered her condition and laboratory results and was discharged.

Keywords: cesarean sections, placenta accreta, hysterectomy, dilatation and curettage

Poster-12

Effectiveness of vaginal progesterone in preventing preterm birth in women with short cervix after 28 weeks: A propensity score matching study

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Introduction: To investigate the efficacy of progesterone in preventing preterm birth (PTB) in singleton pregnancies who exhibit a short cervix in the early third trimester.

Methods: We included women who delivered at Seoul St. Mary's Hospital between 2009 and 2019, with cervical length measurement taken at least once in both the second trimester (16+0 weeks to 27+6weeks) and the early third trimester (28+0 weeks to 33+6weeks). Exclusion criteria comprised cases with a short cervix detected before 28 weeks, cerclage placement, iatrogenic preterm birth, and progesterone use before 28 weeks. The participants were divided into two groups: the progesterone use group and the non-progesterone use group. We compared the rates of PTB between the two groups using propensity score matching analysis.

Results: A total of 683 women were included in the study, with 73 women in the progesterone group and 610 women in the non-progesterone group. The preterm birth rate was lower in the progesterone group (5.5%) compared to the non-progesterone group (9.5%), but the difference was not statistically significant. Even after 1:1 matching using propensity scores, there was no significant difference in the risk of preterm birth between the two groups (5.5% in the progesterone group vs. 8.2% in the non-progesterone group, p = 0.512).

Conclusion: In asymptomatic singleton pregnancies with a short cervix detected after 28 weeks of gestation, the administration of vaginal progesterone does not appear to effectively prevent preterm birth. Further prospective studies may be needed.

Keywords: Cervical length, third trimester, preterm birth, progesterone

Poster-13

Prenatally Diagnosed Congenital Medulloblastoma by Ultrasound and MRI

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소뇌모세포종(Medulloblastoma)은 소아의 가장 흔한 악성 뇌종양이다. 그러나 선천적 소뇌모세포종은 매우 드물며 대부분 출생 후에 진단된다. 이에 본 저자들은 태아의 소뇌모세포종이 산전 초음파 검사와 MRI를 통해 진단된 사례를 발표하고자 한다.

35세의 경산부가 산전 진료 위해 내원하였고 첫 아이 임신했을 때 23주경 심장 기형이 있었고 사산된 과거력 및 이번 임신이 시험관 임신 외에는 특이소견 없었다. 임신 11주 0일에 시행된 비침습적 태아 검사 결과는 낮은 위험군이었고, 임신 23주 5일에 시행된 정밀 초음파 검사에서는 구조적 기형이 확인되지 않았으며, 임신성 당뇨 검사도 특이 소견 없었다. 임신 31주 0일에 정기 검진 중 시행한 초음파 검사에서는 특별한 소견이 없었으나 측뇌실 크기가 0.88cm으로 관찰되었다. 임신 33주 4일에 시행된 초음파 검사에서는 편측의 수두증이 1.26cm으로 증가되고, 색 Doppler를 통해 소뇌 종양이 (3.14 * 1.95) cm^2로 확인되어 MRI 검사를 하였다. MRI 소견에서는 제4뇌실과 소뇌를 포함하는 종양 병변이 나타났으며, 수두증과 뇌실 확장을 유발하였고, 감별 진단으로는 선천적 소뇌모세포종이나 뇌실내종양이었다. 임신 34주 4일의 초음파 검사에서는 수두증이 1.46cm로 더욱 증가하였고, 종양 크기도 (3.98 * 2.88) cm^2, 임신 35주 2일에는 수두증이 2.04cm로 증가하고 종양 크기가 (4.01 * 2.98) cm^2, 임신 36주 0일에는 수두증이 2.58cm로 증가하고 종양 크기가 (4.13 * 3.34) cm^2로 지속적으로 증가하였다. 처음에는 편측 수두증과 소뇌 종양이 관찰되었으나 크기가 급격히 증가하고 양측 수두증이 발생하여 임신 36주 0일에 응급 제왕절개술을 하였다. 2420g의 체중을 가진 남자 아기가 태어났고, 1분 Apgar 점수는 8점, 5분 Apgar 점수는 9점이었다. 출생 후, 신생아는 뇌종양 절제를 받았으며, 병리학적 소견에서 소뇌모세포종으로 확인되었다.

이와 같은 사례를 바탕으로, 임신 관리 중 급속히 성장하는 태아의 뇌종양이 발견될 경우, 임상 의사들은 상세한 산전 초음파 및 MRI 검사를 시행하여 분만 시기를 결정하는 것이 중요하다.

Keywords: Congenital medulloblastoma, Prenatal ultrasound, MRI

Poster-14

Uterine artery embolization as an intervention for postpartum hemorrhage, and its potential complications.

Kyung-Eun Lee, Min-Jeong Kim*

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목적(Objective): The purpose of this study was evaluate the efficacy and adverse effects of uterine artery embolization (UAE) to treat postpartum hemorrhage (PPH) and the effects to subsequent pregnancies.

방법(Methods): In an 8-year period at two medical center, 138 patients underwent UAE for PPH. Their medical record were retrospectively reviewed to assess information about the mode of delivery, clinical outcomes, time from delivery to UAE, embolic agent, and successful conception after UAE.

결과(Results): The clinical UAE success rate was 99.1% and late complications were found in 11 patients. Among them, two patients were performed abdominal hysterectomy.and only three patients were successfully conceived. Early-onset and late-onset PPH were caused uterine atony and placenta associated problem. One of severe complication for UAE was uterine necrosis, because it can be caused long-term complication such as amenorrhea, arterio-venosus malformation, and abnormal placentation.

결론(Conclusion): Although UAE is a safe way to manage for PPH, a long-term follow-up and preparation for subsequent pregnancies are needed to determine the complications of UAE and potential adverse pregnancy outcomes in future pregnancies.

Keywords: Uterine artery embolization; Postpartum hemorrhage; Uterine necrosis; Pregnancy complications (Italic; Times New Roman; 12 pt font)

Poster-15

Perinatal outcomes of cervical polyp in pregnancy

Hee-Sun Kim[1], Dong-Wook Kwak[2], GiSu Lee[3], HaYan Kwon[4], HyunSun Ko[5], HyunHwa Cha[6], Hyun-Joo Seol[7], RiNa Kim[8], JaeEun shin[9], Ji-Hee Sung[10], JinHa Chung[11], KyungA Lee[12], MiYoung Lee[13], Min-A Kim[14], SeJin Lee[15], SeungYeon Pyeon, Sul Lee[16] , Young Mi Jung[17], Jin-Gon Bae[3]

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Introduction: Endocervical and decidual types of cervical polyps are gynecological conditions found in approximately 2-5% of women of childbearing age, and they are mostly benign histologically. These polyps can sometimes cause recurrent vaginal bleeding in early pregnancy. While cervical polyps during pregnancy are generally benign, they may lead to atypical vaginal bleeding, increased vaginal discharge, and localized inflammation. Research on the effects of cervical polyps during pregnancy is limited, and there is still considerable debate regarding their treatment. This study aims to investigate the management of cervical polyps and their perinatal outcomes.

Materials and Methods:

A retrospective analysis was conducted on mothers diagnosed with cervical polyps who gave birth at 16 universities between January 1, 2011, and December 31, 2022. Cervical polyps were classified as either endocervical or decidual types, based on ultrasound findings or clinical presentation after

delivery. The treatment options analyzed included observation, polypectomy, cerclage, and polypectomy with cerclage. However, cases where only cerclage was performed were excluded from the analysis due to the small number of subjects.

Results: Among the 106 mothers, 97 had endocervical polyps and 19 had decidual polyps. The mean size of the cervical polyps, based on the long axis, was statistically significant, with endocervical polyps measuring 2.0 cm and decidual polyps measuring 3.0 cm ($p = 0.008$). The incidence of preterm labor was significantly higher in the endocervical polyp group at 83.3%, compared to 57.9% in the decidual polyp group ($p = 0.026$). Among those with endocervical polyps, 63 (70.8%) were managed with observation, 14 (15.7%) underwent polypectomy, and 10 (11.2%) received polypectomy with cerclage. In contrast, among those with decidual polyps, 6 (31.6%) were managed with observation, 5 (26.3%) underwent polypectomy, and 8 (42.1%) received polypectomy with cerclage ($p = 0.001$). There was no statistically significant difference in perinatal outcomes based on treatment modality.

Conclusions: It was confirmed that cervical polyps during pregnancy are associated with preterm labor, with a particularly strong correlation in cases of endocervical polyps. However, no differences in perinatal outcomes were observed based on treatment or polyp size. Further analysis with a larger study population may yield more clinically significant results.

Poster-16

Ultrasound Findings of Uterine Necrosis Following Uterine Artery Embolization for Postpartum Hemorrhage

Kyung Eun Lee, and Jae Eun Shin*

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목적(Objective): The objective of this study is to evaluate the ultrasound findings indicative of uterine necrosis following uterine artery embolization (UAE) performed to manage postpartum hemorrhage. By identifying specific ultrasound characteristics associated with necrotic tissue, we aim to enhance diagnostic accuracy and improve management strategies for patients experiencing complications after UAE.

방법(Methods): This study evaluated the ultrasound findings of the uterus one month post-uterine artery embolization (UAE) for postpartum hemorrhage, specifically comparing uterine size and the presence of hypoechoic areas and irregular uterine contours.

결과(Results): In total, 69 patients were analyzed, with 7 in the necrosis group and 62 in the non-necrosis group. The necrosis group demonstrated longer uterine length and width compared to the non-necrosis group. Additionally, the myometrium thickness was thinner in the necrosis group, while the endometrium was observed to be thicker. Necrosis group was more associated with presence of hypoechoic area and irregular endometrial contrours.

결론(Conclusion): These findings suggest distinct differences in uterine characteristics between the two groups one month following uterine artery embolization

Keywords: Uterine artery embolization, uterine necrosis, postpartum bleeding

Poster-17

Evaluation of fetal heart function in diabetic pregnancy using fetal speckle tracking echocardiography: Korean multicenter study

Seung-Woo Yang[1], Seong Yeon Hong[2], Jin Gon Bae[3], Seung Mi Lee[4], Young Nam Kim[5], So Yeon Kim[6], Gina Nam[7], Kyung A Lee[8], Yun Ji Jung[9], Mi Ju Kim[10], Ki Hoon Ahn[11*]

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Purpose: To compare cardiac functional parameters using speckle tracking echocardiography between diabetic and normal pregnancy

Method: Nineteen women with gestational diabetes and overt diabetes (diabetic group) and 28 women with a healthy pregnancy (control group) were included in this prospective observational cohort study. Each group was divided into the 2nd trimester (13 diabetics vs 25 control) and 3rd trimester (14 diabetics vs 34 control) groups. For all fetuses, estimated body weight (EFW) was calculated. Also, in the four-chamber view, speckle-tracking analysis was performed using the GE Automatic Fetal Heart Assessment Tool (fetal HQ) to measure the global sphericity index (GSI), global longitudinal strain (GLS), fractional area change (FAC), 24-segment sphericity index (SI), and 24-segment end-diastolic diameter of the left ventricle (LV) and right ventricle (RV).

Results: Maternal body mass index (BMI) [23.2 (19.1-34.8) vs 21.4 (18.3-27.5)] and birth weight [3340 (2810-3830) vs 3132 (2680-3680) is higher in the diabetic group than the control group. In fetal HQ analysis, the diabetic group showed a lower GSI value than the control group (1.05 ± 0.27 vs 1.23 ± 0.24, p = 0.016), meaning a more round-shaped heart. Other parameters showed no statistical difference between the two groups. Adjusted maternal age, BMI, and EFW, only GSI is statistically different between the two groups [0.115 (0.016-0.845), p= 0.034]. In correlation with maternal age, BMI, and EFW in all patients, LV FAC and RV-FAC showed a negative correlation with maternal age (-0.317, p=0.003) and BMI (-0.389, p=0.003)

Conclusion: Fetuses of women with diabetes showed a round shape than the than control group. Other parameters showed statistical differences, which is thought to be due to a small sample size measurement bias. This study showed the possibility that fetal HQ can be used to assess fetal cardiac morphology and function a necessity for further study.

Keywords: cardiac function, speckle tracking echocardiography, diabetic pregnancy

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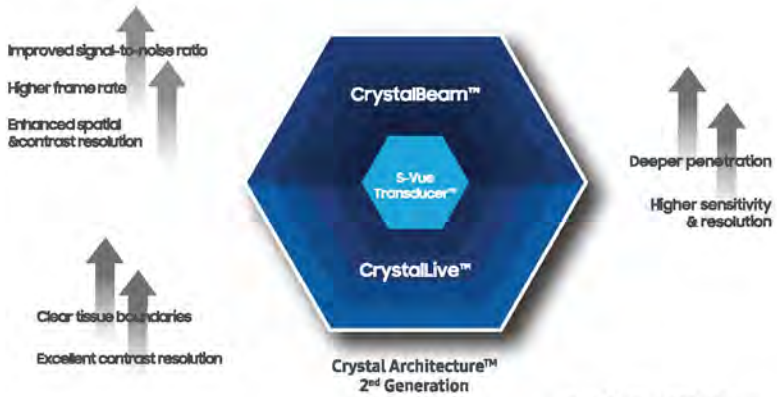

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일회용 의료기기 | 재멸균 금지 | 재사용 금지

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사용기간	제조일로부터 2년

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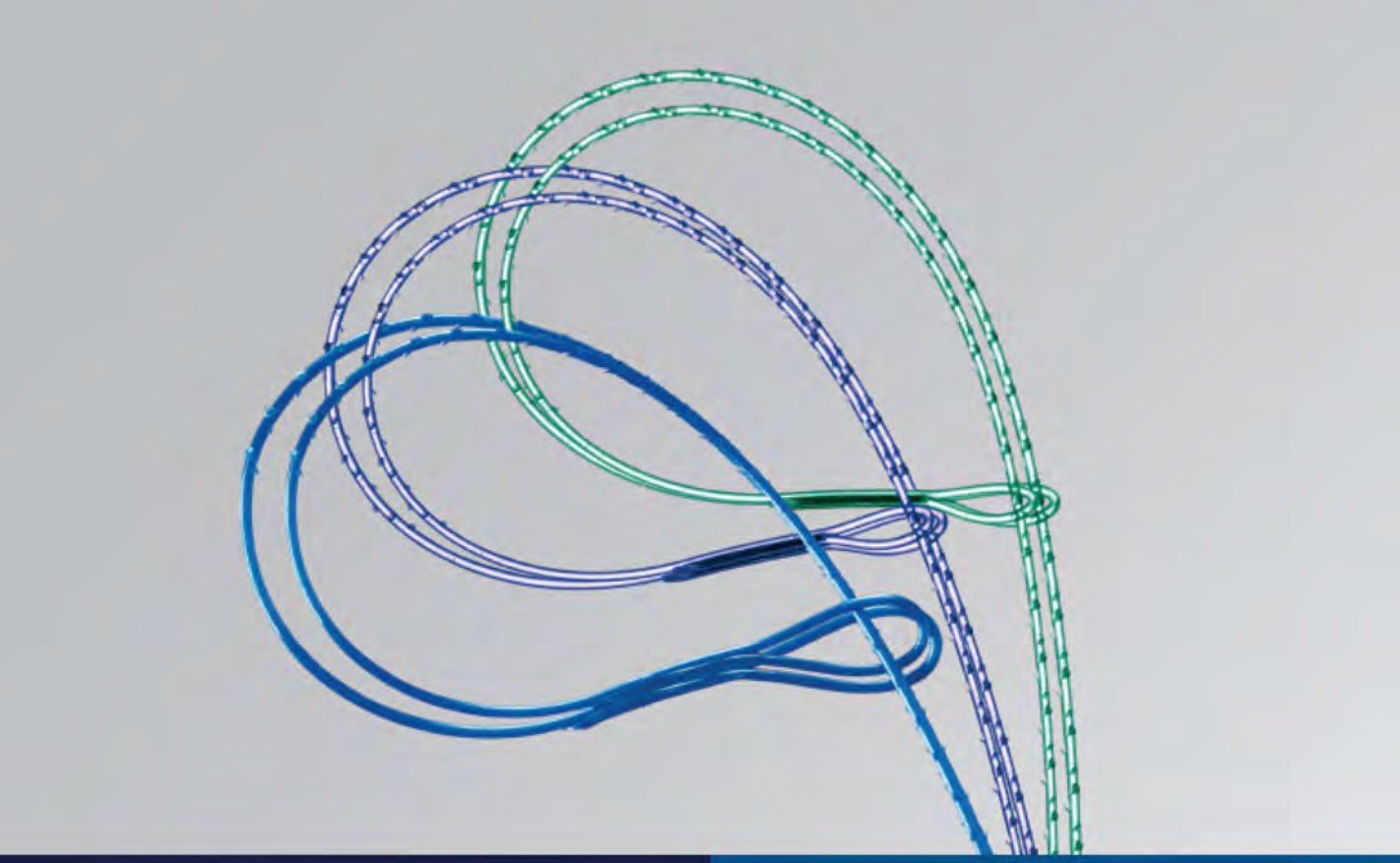
1. Floseal hemostatic matrix 국내 제품 설명서(식품의약품안전처 [https://nedrug.mfds.go.kr] 의약품등 제품정보창 참조)
2. Tackett, Scott M., et al. "Real-world outcomes of hemostatic matrices in cardiac surgery." Journal of cardiothoracic and vascular anesthesia 28.6 (2014): 1558-1565.



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