“Ultrasound” in Labor and Delivery: Is the future already here?

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Kaplan Medical Center, Rehovot
I will try to convince you to use ultrasound in L&D!

Do we need intra-partial US?
  - why, when, what

Assessment of fetal head position

Assessment of fetal head station

Prediction of the mode of delivery
Do we need “intrapartum ultrasound”?
Clinical Assessment in Obstetrics and Gynecology is Subjective !!!

- “Gynecologists stopped relating the size of ovarian cysts to various fruits years ago, when ultrasound replaced hands and fingers to determine the size and structure of adnexal masses.”

Eggebo TM, UOG 2012

THE LENGTH OF THE CERVIX AND THE RISK OF SPONTANEOUS PREMATURE DELIVERY


NEJM 1996;334:567
How accurate are we in determining fetal head station/engagement by digital examination?
Birth simulator: Reliability of transvaginal assessment of fetal head station as defined by the American College of Obstetricians and Gynecologists classification

Olivier Dupuis, MD, a,b,* Ruimark Silveira, MS, b Adrien Zentner, MS, b André Dittmar, PhD, b Pascal Gaucherand, MD, c Michel Cucherat, MD, d Tanneguy Redarce, PhD, b René-Charles Rudigoz, MD a

- 32 Residents
  (2.2 average years of experience)
- 25 Attending physicians
  (9.4 average years of experience)
- Fetal head mannequin:
  - 11 possible stations in a random order (−5 to +5)
  - “high”, “mid”, “low”, “outlet”
  - “engaged”, “non engaged”

Accuracy of determination of fetal head station and engagement by digital examination

<table>
<thead>
<tr>
<th></th>
<th>“Numerical” errors</th>
<th>“Group” errors</th>
<th>Undiagnosed high station</th>
<th>“Engagement” errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residents</td>
<td>50-88% of cases</td>
<td>30%</td>
<td>22.4% of errors</td>
<td>12%</td>
</tr>
<tr>
<td>Attendings</td>
<td>36-80% of cases</td>
<td>34%</td>
<td>16% of errors</td>
<td>12%</td>
</tr>
</tbody>
</table>

“transvaginal assessment of fetal head station is poorly reliable”

In real life…

Reversal of the decision for caesarean section in the second stage of labour on the basis of consultant vaginal assessment

K. S. OLÁH

• 32 cases
• Complete agreement 19% (n=6)
• Different head position 44% (n=14)
  – 12 OP diagnosed as OA, 2 OA diagnosed ad OP
• Different head station 81% (n=26)
  – by 1 cm in 19% (n=6)
  – by 2 cm in 25% (n=8)
  – by 3 cm in 38% (n-12) all initially estimated as higher in the pelvis
• 20 of 32 cases (62.5%) => Vaginal delivery

Olah KS. J Obstet Gynecol 2005;25:115-6
# EFFECT OF MODE OF DELIVERY IN NULLIPAROUS WOMEN ON NEONATAL INTRACRANIAL INJURY

Dena Towner, M.D., Mary Ames Castro, M.D., Elaine Eby-Wilkens, B.S., and William M. Gilbert, M.D.

<table>
<thead>
<tr>
<th></th>
<th>CS no labor</th>
<th>SVD</th>
<th>CS during labor*</th>
<th>VE</th>
<th>Forceps</th>
<th>CS after failed VE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intracranial hemorrhage</td>
<td>1/2750</td>
<td>1/1900</td>
<td>1/954</td>
<td>1/860</td>
<td>1/664</td>
<td>1/334</td>
</tr>
</tbody>
</table>

* No attempt at operative vaginal delivery

* * N Engl J Med. 1999;341:1709-14 *
Rising rates of caesarean deliveries at full cervical dilatation: a concerning trend

J. Unterscheider *, M. McMenamin 1, F. Cullinane 2

Department of Obstetrics and Gynaecology, University Hospital Galway, Newcastle Road, Galway, Ireland
Failure to progress in the second stage of labor: what to do?

- Should we try an **instrumental delivery**?
  - Failed vacuum can have serious consequences
- Should we go directly for a **CS**?
  - CS at prolonged second stage when the head is low may have serious consequences to mother and fetus
- Should we just **wait** for a spontaneous vaginal delivery?

Can we continue to rely on subjective and unreliable assessments to take the most important decision during labor (and probably the one with the most significant potential adverse outcomes to the mother and/or fetus)?
Intrapartum ultrasound - potential advantages over digital examination

- Objective
- Easy to perform
- More accurate
- More reproducible
- Shorter learning curve
- No patient discomfort
- Less invasive examinations (less infections)
- Objective documentation (liability advantage)
Intrapartum Ultrasound

Transabdominal

Fetal head position

Prediction of mode of delivery

Transperineal

Fetal head station
Intrapartal US – What do we need?

Voluson E10
Intrapartal US – What do we need?

- Ultrasound unit
  - mobile, compact, fast and simple to operate
- Technique
  - easy and fast to perform
  - easy and fast to interpret
  - reproducible
- Proof of improved outcome
Assessment of fetal head position
Intrapartum sonography to determine fetal head position

S. Akmal¹, E. Tsoi¹, N. Kametas¹, R. Howard² and K. H. Nicolaides¹

¹Harris Birthright Research Centre for Fetal Medicine, King’s College Hospital, Denmark Hill, London, UK
²Department of Obstetrics and Gynaecology, King George’s Hospital, Ilford, Essex, UK

Suprapubic transabdominal ultrasound

ocципut-posterior position
ocципut-anterior position
ocципut-transverse position

Intrapartum fetal head position I: comparison between transvaginal digital examination and transabdominal ultrasound assessment during the active stage of labor

D. M. SHERER*, M. MIODOVNIK*, K. S. BRADLEY* and O. LANGER*

*Division of Maternal-Fetal Medicine, Department of Obstetrics and Gynecology, St Luke’s Roosevelt Hospital Center, Columbia University College of Physicians and Surgeons, New York, NY, USA

- Transvaginal digital examinations consistent with ultrasound assessments - 24% (24/102)

“Intrapartum ultrasound increases the accuracy of fetal head position assessment during active labor and may serve as an educational tool for physicians in training”

- Attendings (58%) had a higher success rate than residents (33%) in depicting correct fetal head position by physical examination in the ±45°

Sherer DM et al. Ultrasound Obstet Gynecol 2002;19:258-63
Digital examination failed to define the correct fetal head position in 27% of patients (in 70% of errors the difference was ≥ 90°)

“Consequently, ultrasound scanning for accurate determination of fetal head position should be performed routinely before instrumental delivery”
Comparison of the learning curves of digital examination and transabdominal sonography for the determination of fetal head position during labor

P. ROZENBERG*, R. PORCHER†, L. J. SALOMON*, F. BOIROT*, C. MORIN* and Y. VILLE*

…learning and accuracy of the determination of fetal head position in labor were easier and higher, respectively, with transabdominal sonography than with digital examination

This should encourage physicians to introduce clinical ultrasound examination into their practice
How to perform ultrasound in labor: assessment of fetal occiput position

A. YOUSSEF, T. GHI and G. PILU

Department of Obstetrics and Gynecology, Sant’Orsola Malpighi University Hospital, University of Bologna, Bologna, Italy
Assessment of fetal head station
Methods to assess fetal head station by US

Measuring engagement of the fetal head: validity and reproducibility of the ultrasonographic method.

A new method to assess fetal head descent in labor with transperineal ultrasonography.

Ultrasound assessment of fetal head–perineum distance before induction of labor.

Comparison between ultrasound parameters and clinical examination to assess fetal head station in labor.

Head progression distance in prolonged second stage of labor: relationship with mode of delivery and the second stage of labor with intrapartum transabdominal ultrasound.

Diagnosis of station and rotation of the fetal head in prolonged second stage of labor: clinical significance.

Pubic arch angle in prolonged second stage of labor: clinical significance.

Fetal head–symphysis distance: a simple and reliable ultrasound index of fetal head station in labor.

Transperineal ultrasound imaging in prolonged second stage of labor with occipitoanterior presenting fetuses: how well do it work?

Intrapartum translabial ultrasound (ITU): sonographic landmarks and correlation with successful vacuum extraction.

W. HENRICH*, J. DUDENHAUSEN*, I. FUCHS*, A. KÄMENA† and B. TUTSCHEK‡

Departments of *Obstetrics and Radiology, Charité Virchow Clinic, Berlin and †Heinrich-Heine-University, Düsseldorf, Germany
Transperineal US

Distances and angles

Symphysis
Fetal head
Transducer
Vagina
bladder
Cervix
Fetal head
Vagina
Cervix

radiologykey.com

radiologykey.com

radiologykey.com
1. “Head progression distance”
The shortest distance between the perineal skin and fetal head (skull)

"firm pressure, but without creating any discomfort for the woman"

The distance between the inferior edge of the symphysis and the closest point of fetal head on the perpendicular to the symphysis
4. “Head direction”
4. “Head direction”

- “Head up” - the line points ventrally at an angle of $\geq 30^\circ$
- “Head down” - line $< 0^\circ$
- “Head horizontal” - all other angles

5. “Angle of progression”

Formed by the line parallel to the long axis of the symphysis and the line tangential to the fetal head

- Intra-observer variability 2.9°
- Inter-observer error estimate 1.2°

6. “Pubic arch angle”

Transducer position on perineum is transverse, with 45° inclination relative to the long axis of the pubic symphysis.

Gilboa Y et al. Ultrasound Obstet Gynecol 2013;41:442-6
More things that can be objectively seen and measured…
Caput and Molding

Caput succedaneum

molding
Fetal head asynclitism

Intrapartum sonographic imaging of fetal head asynclitism

T. GHI*, A. YOUSSEF*, G. PILU*, A. MALVASI† and A. RAGUSA‡

*Department of Obstetrics and Gynecology, S. Orsola Malpighi University Hospital, University of Bologna, Bologna, Italy; †Department of Obstetrics and Gynecology, Santa Maria Hospital, Bari, Italy; ‡Department of Obstetrics and Gynecology, Sesto San Giovanni Hospital, Milan, Italy

Ultrasound Obstet Gynecol 2012;39:234-240

Intrapartum sonography for fetal head asynclitism and transverse position: sonographic signs and comparison of diagnostic performance between transvaginal and digital examination

Antonio Malvasi1, Michael Stark2,3, Tullio Ghi4, Dan Farine5, Marcello Guido6 & Andrea Tinelli7

1Department of Obstetrics and Gynaecology, Santa Maria Hospital, Bari, Italy, 2The New European Surgical Academy (NESA), Berlin, Germany, 3The USP Hospital, Mallorca, Spain, 4Department of Obstetrics and Gynecology, S. Orsola Malpighi University Hospital, University of Bologna, Bologna, Italy, 5Department of Obstetrics and Gynaecology, University of Toronto, Mount Sinai Hospital, Toronto, Canada, 6Institute of Hygiene and Epidemiology, University of Salento, Lecce, Italy, and 7Department of Obstetrics and Gynaecology, Vito Fazzi Hospital, Lecce, Italy


Intrapartum sonographic diagnosis of posterior asynclitism by two-dimensional transperineal ultrasound.

Ghi T1, Dall’Asta A2, Kiener A1, Volpe N1, Suprani A1, Frusca T1.
Cervical dilatation

Agreement between transperineal ultrasound measurements and digital examinations of cervical dilatation during labor

Sigurlaug Benediktsdottir¹, Torbjørn M. Eggebø²,³ and Kjell Å. Salvesen¹,³

BMC Pregnancy and Childbirth 2015;15:273
Which parameter is better?

- Easy and fast to perform
- Reproducible and reliable
- Easy and fast to interpret
- Not confounded by other variables
- Improve outcome
Important, but hard…

- Most studies aimed to predict mode of delivery in women with prolonged second stage of labor
- However, the earlier during the labor process an accurate prediction can be achieved, the better will be the maternal and fetal outcome
Intrapartum translabial ultrasound (ITU): sonographic landmarks and correlation with successful vacuum extraction

W. HENRICH*, J. DUDENHAUSEN*, I. FUCHS*, A. KÄMENA† and B. TUTSCHEK‡

Departments of *Obstetrics and †Radiology, Charité Virchow Clinic, Berlin and ‡Heinrich-Heine-University, Düsseldorf, Germany

- 20 women with clinical indication for vacuum extraction
- Translabial US immediately before operative vaginal delivery
- Head direction during pushing

Results

- **Occiput anterior** position (n=17)
  - **Head-up sign** (65%, 11/17) – all simple (5/11) or only moderately difficult (6/11) VE
  - **Head horizontal or down** (35%, 6/17) - only one simple VE
    - one fetus with head down sign - failed VE
- **Occiput posterior** position (n=3)
  - All head direction was horizontal - 2 difficult and one moderately difficult VE

*Head-up sign appears to be a predictor for successful VE*

Failed compared to simple vacuum extraction

Transperineal ultrasound imaging in prolonged second stage of labor with occipitoanterior presenting fetuses: how well does the ‘angle of progression’ predict the mode of delivery?


Department of Obstetrics, Charité University Hospital, Campus Benjamin Franklin, Berlin, Germany

- N=26 (5 CS, 5 SVD, 16 VE)
- Nulli- and multiparas
- Prolonged 2\textsuperscript{nd} stage
- Only OA position
- AoP before vaginal examination

“…first report to document a strong relationship between an objective ultrasound marker (angle of progression) and the mode of delivery following prolonged second stage of labor”
Our study suggests a correlation between the PAA and mode of delivery in prolonged second stage of labor.

Gilboa Y et al. Ultrasound Obstet Gynecol 2013
Impact of intrapartal ultrasound to assess fetal head position and station on the type of obstetrical interventions at full cervical dilatation


Department of Obstetrics, Charité University Hospital—Berlin, Germany

All prolonged second stage during 1 year (n=121)

Intrapartum ultrasound

SVD: 7 (16%)
VE: 7 (16%)
CS: 29 (67%)
n=43

No ultrasound

SVD: 20 (26%)
VE: 58 (74%)
n=78

The routine use of intrapartum ultrasound in clinical making decisions during the second stage of labor - does it have any impact on delivery outcomes?


635 women, second stage of labor: 1) prolonged second stage; 2) arrest of descent; 3) suspected CPD; and 4) failed VE

Intrapartum ultrasound

- SVD: 20.2%
- VE: 61.1%
- CS: 18.2%

n=99

No ultrasound

- SVD: 27.8%
- VE: 65.1%
- CS: 7.1%

p=0.001

n=536

Failed VE

- 0 (0%)
- p=0.1

- 13 (3.6%)

Gynecologic and Obstetric Investigation. In press
...but why so late in the delivery process?

- Can’t we use ultrasound before the onset of labor or in its early stage to predict the mode of delivery?
Every pregnant woman in early spontaneous labor or due to undergo induction of labor wishes to know if she will deliver vaginally…"

"It would be ideal if, before the onset of labor or in its early stages, we could predict accurately who will deliver vaginally spontaneously without complications, and who will require an operative delivery (abdominal or assisted)."

"…would reduce morbidity, improve safety, optimize utilization of resources and improve satisfaction of women”
Can angle of progression in pregnant women before onset of labor predict mode of delivery?

R. LEVY, S. ZAKS, A. BEN-ARIE, S. PERLMAN, Z. HAGAY and E. VAISBUCH

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100 Nulliparous women

<table>
<thead>
<tr>
<th>Angle of progression (°)</th>
<th>Vaginal (n=91)</th>
<th>CS (n=9)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>104 (97-113)</td>
<td>90 (85.5-93.5)</td>
</tr>
</tbody>
</table>

p < 0.001

Ultrasound Obstet Gynecol 2012;40:332-7
A cutoff angle of 95° has:

- Sensitivity = 85%
- Specificity = 89%

for VD in nulliparous (n=100)

Transperineal sonographic assessment of the angle of progression as a predictor of a successful vaginal delivery following induction of labor.

Gillor M, Vaisbuch E, Zaks S, Barak O, Haçay Z, Levy R.

**Diagram:**

- **Mode of delivery**
  - **Vaginal** (n=110)
  - **CS** (n=40)

- **Angle of progression (°)**
  - **Vaginal**
    - Median: 98, (91-105)
  - **CS**
    - Median: 90, (84-94.5)

- **p = 0.001**
Do we need intrapartal US?

No if you believe in this:

Yes

But…

it is still not entirely evidence-based

there is much research to be done
• Digital examination to assess labor progress and fetal head position and station is subjective and not reliable
• There is need for objective parameters to assist in clinical decisions during labor and delivery
• Ultrasound during labor is a reliable way to determine fetal head position and station
• The most reliable US parameter to predict mode of delivery is yet to be determined
Currently, the use of US in labor and delivery to assess fetal head station for clinical decisions is still investigational and should be used as a complementary tool to clinical examination.

There is still a lot to study - e.g. the significance of caput, molding, occiput posterior, asynclitism.

Randomized, large scale clinical trials are urgently needed.
Thank You!

“TOMORROW BELONGS TO THOSE WHO CAN HEAR IT COMING.”
(David Bowie)

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