


Estimated Placental Volume (EPV)



Harvey J. Kliman, M.D., Ph.D.
Yale University School of Medicine

MM

- 25 yo at 36+4 weeks. 142/83: hypertension precautions



MM

- 25 yo at 36+4 weeks. 142/83: hypertension precautions
- 37+2 135/98, c/o headaches, visual spots, edema for 1 day
 - L&D: 121/63, trace protein, non-stress test (NST).



MM

- 25 yo at 36+4 weeks. 142/83: hypertension precautions
- 37+2 135/98, c/o headaches, visual spots, edema for 1 day
 - L&D: 121/63, trace protein, non-stress test (NST). Normal. Sent home.

MM


- 25 yo at 36+4 weeks. 142/83: hypertension precautions
- 37+2 135/98, c/o headaches, visual spots, edema for 1 day
 - L&D: 121/63, trace protein, non stress test (NST) normal. Sent home.
- 38+3: c/o decreased fetal movement; NST normal. Sent home.

MM

- 25 yo at 36+4 weeks. 142/83: hypertension precautions
- 37+2 135/98, c/o headaches, visual spots, edema for 1 day
 - L&D: 121/63, trace protein, non stress test (NST) normal. Sent home.
- 38+3: c/o decreased fetal movement; NST normal. Sent home.
- 39+3: NST normal.....

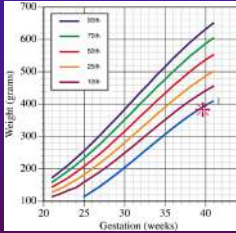
MM

- 25 yo at 36+4 weeks. 142/83: hypertension precautions
- 37+2 135/98, c/o headaches, visual spots, edema for 1 day
 - L&D: 121/63, trace protein, non stress test (NST) normal. Sent home.
- 38+3: c/o decreased fetal movement; NST normal. Sent home.
- 39+3: NST normal.....
- 39+4: Intrauterine fetal demise (IUFD)



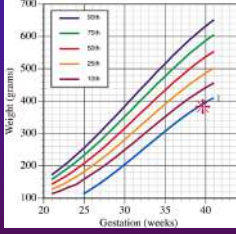
MM

- Weight < 1st %ile



MM

- Weight < 1st %ile
- Why didn't the Ob know the placenta was so small?




Current State of Clinical Practice

- Focus is on the fetus




Current State of Clinical Practice

- Focus is on the fetus
- Not knowing the size of the placenta is like not having a gas gauge in your car



IUFD

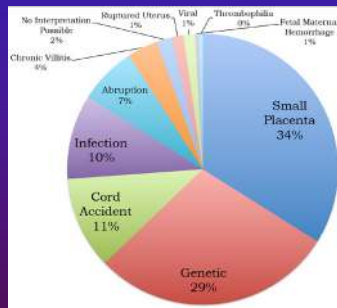
Fetal Status



The graph illustrates the relationship between Placenta (X-axis) and Fetal Status (Y-axis). The curve shows a rapid increase in fetal status as the placenta value increases, eventually leveling off near 100% fetal status for placenta values above 20. A yellow star is placed at the end of the curve near (100, 100).

Placenta	Fetal Status
0	0
10	90
20	100
40	100
60	100
80	100
100	100

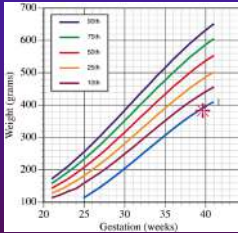
- IUFD: ≥ 20 w
- 25,000/yr (6.2/1000)
- Causes (218 cases)
 - Small placenta
 - Genetic (+TIs)
 - Cord accident
 - Infection
 - Abruptio



CONCLUSION: The most useful tests were placental pathology and fetal autopsy followed by genetic testing and testing for antiphospholipid antibodies.
(Obstet Gynecol 2017;0:1-8)

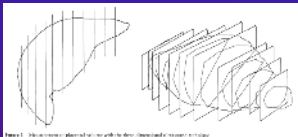
MM

- Weight < 1st %ile
- Why didn't the Ob know the placenta was so small?
- Can we measure the size of the placenta before delivery?



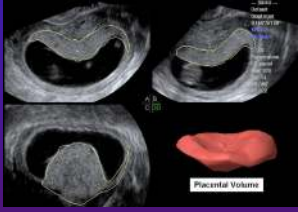
Prior Technologies

- Hafner et al., Ult Ob Gyn 12:97-102, 1998
- Used sums of serial sections
- Method not confirmed with comparison to actual placental weights



Prior Technologies

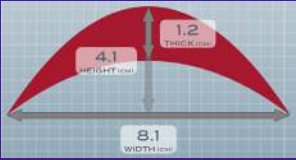
- Falcon et al., Ult Ob Gyn 25:546-550, 2005
- VOCAL: Virtual Organ Computer-aided AnaLysis
- Six sections rotated by 30° with manual image reconstruction
- Time consuming and operator limited



Courtesy of Nadav Schwartz, MD, Univ Penn

Is There a Better Way?

- Simple, free
- Can be performed using standard ultrasound equipment
- Equation can be incorporated into devices for convenient real-time calculation




Estimated Placental Volume (EPV)

Arpura et al., AJP, 27:151-55, 2010

EPV is Simple


- Normal patient at 18 weeks



Arpura et al., AJP, 27:151-55, 2010

EPV is Simple

- Normal patient at 18 weeks
- Width



Arpura et al., AJP, 27:151-55, 2010

EPV is Simple

- Normal patient at 18 weeks
- Width
- Height

PR 28Hz
R0
2D
C 50
P Med
Hites

+ Diet 10.9 cm
H Diet 2.60 cm
D Diet 4.50 cm

Arpura et al., AJP, 27:151-55, 2010

EPV is Simple

- Normal patient at 18 weeks
- Width
- Height
- Thickness

PR 28Hz
R0
2D
C 50
P Med
Hites

+ Diet 10.9 cm
H Diet 2.60 cm
D Diet 4.50 cm

Arpura et al., AJP, 27:151-55, 2010

EPV is Simple

- Normal patient at 18 weeks
- Width
- Height
- Thickness
- Estimated Placental Volume (EPV) = 251 cc

PR 28Hz
R0
2D
C 50
P Med
Hites

+ Diet 10.9 cm
H Diet 2.60 cm
D Diet 4.50 cm

Arpura et al., AJP, 27:151-55, 2010

Validation Study

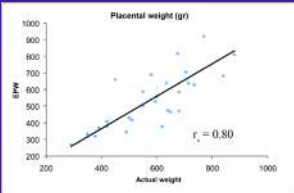
Determination of Placental Weight Using Two-dimensional Sonography and Volumetric Mathematic Modeling

Humberto Azpurua, M.D.,¹ Edmund F. Funai, M.D.,¹ Luisa M. Coraluzzi,¹ Leo F. Doherty, M.D.,¹ Isaac E. Sasson, M.D.,¹ Merwin Kliman, M.S.E.E.,² and Harvey J. Kliman, M.D., Ph.D.¹

Azpurua et al., AJP, 27:151-55, 2010

Validation Study

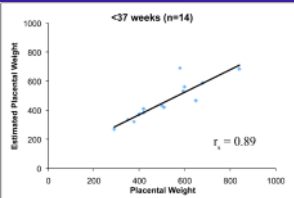
- 29 patients
- Median gestational age 37 w (29-41)
- Spearman's rho (r_s) = 0.80, $p < 0.001$



Azpurua et al., AJP, 27:151-55, 2010

Preterm Cases

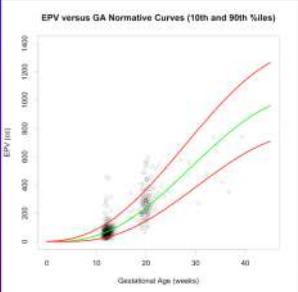
- 14 patients
- Spearman's rho (r_s) = 0.89, $p < 0.001$



Azpurua et al., AJP, 27:151-55, 2010

Cornell Normative Data

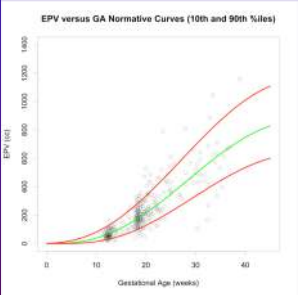
- 446 patients 9.7 – 39.3 w
- 12.5 ± 1.5 w (n=444):
 73 ± 47 cc
- 20 ± 2 w (n=151):
 276 ± 106 cc
- $EPV = (0.384GA - 0.00366GA^2)^3$, parabolic fit
- 10th and 90th are $\pm 1.28SE$



Arleo et al, Am J Perinatology, 31 683-688, 2013

Yale EPV Study

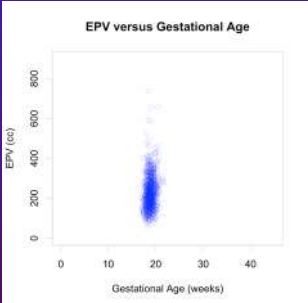
- 366 patients 11.0 – 38.9 w
- 12 ± 1 w (n=78): 63 ± 27 cc
- 20 ± 1 w (n=69):
 238 ± 103 cc
- $EPV = (0.372GA - 0.00364GA^2)^3$, parabolic fit
- 10th and 90th are $\pm 1.28 SE$



Isakov et al, Am J Perinatology, 2017

Oslo Data

- 1,006 patients
- Prospective, double-blinded



Staff, Laine, Lahmami, Gustafsson, Surbehan, Barbero, Kliman

Oslo Data

- 1,006 patients
- Prospective, double-blinded

EPV versus Gestational Age

40+4; 2,734g
(2740g); 428g
(1940g)

Staff, Laine, Lahmami, Gustafsson, Surbchan, Barbero, Kliman

Oslo Data

- 1,006 patients
- Prospective, double-blinded

EPV versus Gestational Age

40+0; 4,484g
(4480g); 1,200g
(5497g)

40+4; 2,734g
(2740g); 428g
(1940g)

Staff, Laine, Lahmami, Gustafsson, Surbchan, Barbero, Kliman

Oslo Data

- 1,006 patients
- Prospective, double-blinded

EPV versus Gestational Age

LGA

SGA
PE, HELLP

40+0; 4,484g
(4480g); 1,200g
(5497g)

40+4; 2,734g
(2740g); 428g
(1940g)

Staff, Laine, Lahmami, Gustafsson, Surbchan, Barbero, Kliman

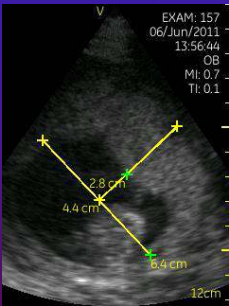
In Firmware



In Firmware



Vscan for EPV



P16.10. Vscan portable ultrasound scanner accurately measures estimated placental volume (EPV).

Anders, AM; Campbell, EH; Galarneau, F; Ye S, Kliman HJ. Yale University School of Medicine, New Haven, CT, USA

Introduction

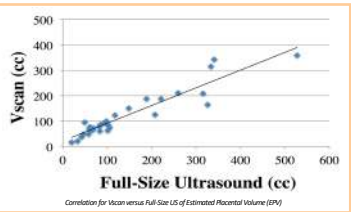
Estimated placental volume (EPV) measurements, a previously validated ultrasound method of calculating the placental volume (Apostola et al, 2010), can serve as a means to identify patients with abnormally small or large placentas. Our study aim was to validate the utility of the Vscan portable ultrasound scanner for measuring EPV in routine prenatal examinations.

Methods

Following IRB approval, pregnant patients with singleton pregnancies presenting for routine first trimester screenings or anatomical ultrasounds were consented. The placenta was imaged at maximal width, at which point width, height and thickness were measured using a GE Voluson E8 or Philips IU22 (full-size ultrasound machines) and the GE Vscan. EPV was calculated with both machines and compared using Pearson correlation coefficient (r).

Results

Thirty patients were scanned between 11+1 and 22+3 weeks. EPVs calculated using Vscan correlated very closely to the EPVs calculated using the full-sized ultrasound devices (r=0.94, p<0.0001) (Figure).



Conclusion

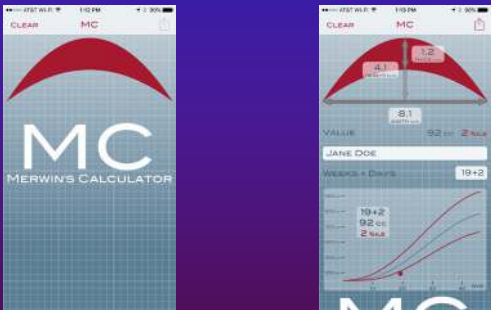
The Vscan can accurately assess EPV up to approximately 20 weeks. Beyond 20 weeks the Vscan's 75 degree field-of-view may not be able to fully image a placenta with a width greater than 10 cm. In spite of this limitation, the portability and affordability of the Vscan may enable healthcare providers greater access to ultrasound technology during routine prenatal care, increasing the chances of identifying cases of abnormal placental growth.

Lumify



Kane and Kliman (Senegal study)

iPhone app



Matt Harper, Harvey Kliman



Acknowledgments

Humberto Arzuaga
Merwin Kliman
Elizabeth Arflev
Kim Barker
John Emerson
Francis Gutierrez
Amber Anders
Katarina Lane
Anne Staff

Lee Segel, PhD
Lisa J. Fauci, PhD
Katarzyna A. Rejniak, PhD

Yulian Zhao, MD, PhD
Gail Stetten, PhD

Thank You

klimanlabs.yale.edu
