



بسم الله الرحمن الرحيم

∞∞∞∞

تم رفع هذه الرسالة بواسطة / حسام الدين محمد مغربي

بقسم التوثيق الإلكتروني بمركز الشبكات وتكنولوجيا المعلومات دون أدنى

مسئولية عن محتوى هذه الرسالة.

ملاحظات : لا يوجد





Prediction of morbidly adherent placenta using Two-dimensional versus Three-dimensional Ultrasound Using Crystal Vue®: Diagnostic Test Accuracy Study

Thesis

*Submitted for partial fulfillment of Master Degree in
Obstetrics and Gynecology*

By

Manival Usama Mostafa Ibrahim

M.B., B.Ch. Cairo University (2012)

Under supervision of

Prof. Dr. Mohamed Hassan Nasr Eldeen

*Professor of Obstetrics and Gynecology
Faculty of Medicine, Ain Shams University*

Dr. Mohamed Hamed Salama

*Assistant Professor of Obstetrics and Gynecology
Faculty of Medicine, Ain Shams University*

*Faculty of Medicine
Ain Shams University
2021*

Acknowledgment

*First and foremost, I feel always indebted to **ALLAH**,
the Most Kind and Most Merciful.*

*I'd like to express my respectful thanks and profound
gratitude to **Prof. Dr. Mohamed Hassan Nasr Eldeen**,
Professor of Obstetrics and Gynecology, Faculty of Medicine, Ain
Shams University for his keen guidance, kind supervision,
valuable advice and continuous encouragement, which made
possible the completion of this work.*

*I am also delighted to express my deepest gratitude and
thanks to **Dr. Mohamed Hamed Salama**, Assistant
Professor of Obstetrics and Gynecology, Faculty of Medicine, Ain
Shams University, for his kind care, continuous supervision,
valuable instructions, constant help and great assistance
throughout this work.*

Manival Usama

List of Contents

Title	Page No.
List of Abbreviations.....	i
List of Tables	iii
List of Figures	iv
Introduction	1
Aim of the Work.....	5
Review of Literature	
The Normal Placenta.....	6
Placenta Previa.....	18
Placenta Accreta Spectrum	33
Ultrasound in Obstetrics	65
Patients and Methods.....	81
Results	100
Discussion	113
Summary	121
Conclusion	123
Recommendations	124
References	125
Arabic Summary	—

List of Abbreviations

Abb.	Full term
2D	Two-Dimensional
3D	Three-Dimensional
3DUS	3D ultrasound
4D	Four-dimensional
AC	Abdominal circumference
ACOG	American College of Obstetricians and Gynecologists
AIP.....	Abnormally invasive placenta
BMI.....	Body mass index
BPD	Biparietal diameter
BPMF	Basal plate myometrial fibers
CCT.....	Controlled cord traction
CDI	Colour Doppler imaging
CI	Confidence interval
CNS	Central nervous system
CS	Cesarean section
DA.....	Diagnostic accuracy
DR82.....	Dynamic range 82
EFW.....	Estimated fetal weight
EVT.....	Extravillous trophoblast
FIGO.....	The International Federation of Gynecology and Obstetrics
G58	Gain rate at 58
HC.....	Head circumference
HGF	Hepatocyte growth factor

List of Abbreviations Cont...

Abb.	Full term
IGF2.....	Insulin-like growth factor 2
ISUOG.....	International Society of Ultrasound in Obstetrics and Gynecology
LR.....	Diagnostic odd ratio
LR-.....	Negative likelihood ratio
LR+.....	Positive likelihood ratio
MAP.....	Morbidly adherent placenta
MMPs.....	Matrix metalloproteinases
MRI.....	Magnetic resonance imaging
MROP.....	Manual removal of placenta
NPV.....	Negative Predictive value
OR.....	Odds ratio
PAS.....	Placenta accreta spectrum
PH.....	Primary hysterectomy
PPV.....	Positive Predictive value
RCOG.....	Royal College of Obstetricians and Gynaecologists
RR.....	Relative risk
SMFM.....	Society for Maternal-Fetal Medicine
TGF- β	Transforming growth factor- β
TIMPs.....	Tissue inhibitors of metalloproteinases
TVUS.....	Transvaginal ultrasound
US.....	Ultrasonography
VEGF.....	Vascular endothelial growth factor
VRU.....	Volume rendering ultrasound
YI.....	Youden's index

List of Tables

Table No.	Title	Page No.
Table (1):	RCOG criteria of diagnosing morbidly adherent placenta (MAP).	86
Table (2):	Demographic characteristics of the studied cases	101
Table (3):	Parity of the studied cases	101
Table (4):	Types of Morbidly adherent placenta among the studied cases	102
Table (5):	Correlation of placental findings, according to intraoperative diagnosis, to the demographic characteristics.....	103
Table (6):	Agreement between 2D& 3D ultrasonography and intraoperative placental findings.	105
Table (7):	Agreement between 2D & 3D Ultrasonography and intraoperative findings in differentiating placenta percreta/ increta from accreta spectrum.	106
Table (8):	Diagnostic characteristics of 2D and 3D ultrasonography in differentiating placenta percreta/increta from accreta spectrum.....	107
Table (9):	Agreement between 2D& 3D ultrasonography and intraoperative findings in differentiating placenta percreta from increta/accreta:	109
Table (10):	Diagnostic characteristics of 2D and 3D ultrasonography in differentiating placenta percreta from increta/accrete.	110
Table (11):	Complications among the studied cases	112

List of Figures

Fig. No.	Title	Page No.
Figure (1):	Placental Development: Fertilization to Full Term.	7
Figure (2):	New categorization of abnormal placental implantation sites, where placenta previa represents covering of Internal OS by placental tissue	18
Figure (3):	Placenta cover internal os and extend over it by under 2 cm, this type will often migrate by term and allow vaginal delivery	27
Figure (4):	Gray scale transvaginal	28
Figure (5):	Placenta Percreta. Coronal single-shot fast spin-echo of a 38-year old female at 35 weeks gestation demonstrates a lateral bulge (arrows) in the placenta (P) and lack of identifiable subjacent myometrium at the site of prior resection of a right-sided rudimentary uterine horn.....	30
Figure (6):	Anterior placenta (P) previa on cesarean scar and different grades of P previa accreta	34
Figure (7):	Uterus with placenta percreta visible at the time of laparotomy	34
Figure (8):	Transabdominal ultrasound longitudinal views of placenta (P) previa accreta at 36 weeks	41
Figure (9):	Transvaginal ultrasound views of placenta (P) previa increta at 20 weeks	42
Figure (10):	Myometrial thinning secondary to uterine thinning at scar defect	43
Figure (11):	Sound waves pathway from transducer through tissue layers and back to it.....	66

List of Figures Cont...

Fig. No.	Title	Page No.
Figure (12):	Basic processes in 3D U.S.....	74
Figure (13):	Samsung WS80A Elite US scanner with 3D/4D VRU software.	80
Figure (14):	Fetal biometric assessment to evaluate fetal wellbeing.....	84
Figure (15):	Placenta previa centralis with signs of adhesion detected by transvaginal ultrasound of Ws80A ultrasound in special care unit of fetus Ain shams university.	86
Figure (16):	Hypervascularity and bridging of PAS detected by transabdominal probe of ws80A ultrasound in fetal care unit Ain Shams University.....	88
Figure (17):	Flow chart of the studied cases.	100
Figure (18):	Morbidly adherent placenta according to intraoperative findings.....	102
Figure (19):	Comparison between placental findings according to intraoperative diagnosis regarding previous CS.....	103
Figure (20):	Diagnostic characteristics of 2D and 3D ultrasonography in differentiating placenta percreta/increta from accreta.....	108
Figure (21):	Diagnositic characterisitcs of 2D and 3D ultrasonography in differentiating placenta percreta from increta/accreta.....	111
Figure (22):	Complications among the studied cases.....	112

PROTOCOL OF A THESIS FOR PARTIAL FULFILMENT OF
MASTER DEGREE IN OBSTETRICS AND
GYNECOLOGY

**Title of study: Prediction of morbidly adherent placenta
using Two-dimensional versus Three-dimensional
Ultrasound Using Crystal Vue®: Diagnostic Test
Accuracy Study**

Postgraduate Student: Manival Usama Mostafa Ibrahim

Degree: M.B., B.Ch. Cairo University (2012)

DIRECTOR: Mohamed Hassan Nasr Eldeen

Academic Position: Professor.

Department: Obstetrics and gynecology.

Co-DIRECTOR: Mohamed Hamed Salama

Academic Position: Assistant professor.

Department: Obstetrics and Gynecology.

1. INTRODUCTION/REVIEW

Placenta is an organ responsible for nutritive, respiratory, and excretory functions of the fetus during pregnancy (*Lebovitz et al., 2018*).

The incidence of morbidly adherent placenta has increased dramatically over the last three decades, in concern with the increase in the caesarean section rate (*Bartels et al., 2018*).

Previous cesarean delivery increases this risk to 3% for the first delivery, and to 40% and 67% for the third and fifth deliveries, respectively (*Cahill et al., 2018*).

An abnormal placentation into the uterine wall could present a risk of maternal and fetal morbidity (morbidly adherent placenta, MAP) and mortality, so it should be identified and defined early on (*De Vita et al., 2019*).

In abnormal implantation, placental delivery fails, which can result in severe postpartum hemorrhage with possible multiple organ failure and damage to the nearby organs such as bladder, bowel, and ureters (*Kocher et al., 2017*).

In these cases, emergency hysterectomy is usually required. One-third to one-half of all emergency postpartum hysterectomies are performed as a result of adhesive placental disorders (*Bartels et al., 2018*).

MAP is classified on the basis of depth of infiltration into the myometrium: in placenta accreta, there is direct contact between chorionic villi and myometrium without decidua basalis; in placenta increta, chorionic villi invade the myometrium without reaching the serous layer; in placenta percreta, villi invade through the myometrium to reach or extend beyond the serosa into the surrounding tissues (*Moser et al., 2018*).

The risk of placental abnormalities increases in the presence of uterine scars due to cesarean delivery or gynecologic procedures such as curettage, myomectomy, and hysteroplasty (when placenta implants are on the scar area), and also in women with maternal age greater than 35 years and multiparity (*Cali et al., 2020*).

The site of placental implantation is a risk factor as well. Placenta

previa is a pathologic condition in which the placenta is inserted in the lower uterine segment contributing to postpartum hemorrhage (*Fan et al., 2017*).

Prenatal ultrasonography (US) represents the first-line method for diagnosing antepartum placental abnormalities, with high sensitivity and specificity rates reported at 85.7% and 88.6%, respectively (*Abd El-Gaber et al., 2017*).

Second and third trimester gray-scale sonographic characteristics include loss of continuity of the uterine wall, multiple vascular lacunae (irregular vascular spaces) within placenta, giving “Swiss cheese” appearance adjacent to the placental implantation site, lack of a hypoechoic border (myometrial zone) between the placenta and the myometrium, bulging of the placental/myometrial site into the bladder, and increased vasculature evident on color Doppler sonography (*Zaidi et al., 2016*).

When a placenta accreta occurs on the posterior or lateral walls of the uterus, it may be difficult to detect by ultrasound. Visualization of lacunae has the highest sensitivity in the diagnosis of PA, allowing identification in 78%-93% of cases after 15 weeks gestation, with a specificity of 78.6% (*Baughman et al., 2018*).

The Three-dimensional ultrasound (Semi-Automated detection system):

In conventional two-dimensional ultrasound, the sonographer must manipulate accordingly to locate an appropriate plane for fitting measurements. The 2D ultrasound is also burdensome as sonographers must meet with patients directly to conduct a lengthy examination. Furthermore, the accuracy of diagnosis and construction of images mainly depend on the degree of the sonographer’s experience and expertise (*hur et al., 2015*).

To compensate for these weakness, semi-automated detection system, 3D ultrasound was made available to streamline the process of reconstructing the multiple views of the examined organ (*Thienphrapa et al., 2014*).

Three-dimensional workflow refers to semi-automated identification of specific diagnostic image planes and measurements from a volume data set. Examples include the 3D LB (fetal long-bone) and 3D NT (nuchal translucency) features (*Meiburger et al., 2018*).

Clinical applications of this new technology include:

1. The Three-Dimensional Ultrasound Heart which is designed to simultaneously display nine standard fetal cardiac views by applying intelligent navigation technology to volume datasets of fetal heart.
2. 3D CNS which displays six measurements (BPD, HC, OFD, Cerebellum, Posterior Fossa, Atria lateral ventricle) from three transverse views generated from a single volume of the fetal brain to enhance measurement reproducibility and streamline workflow
3. 3D Follicle which Identifies and measures multiple ovarian follicles for rapid assessment of follicular size and status during gynecology examinations. (*Meiburger et al., 2018*)

2. AIM/OBJECTIVES

The present study aims to evaluate the diagnostic accuracy of the transvaginal 2D ultrasound versus abdominal 3D Ultrasound using semi-automated detection system with Crystal Vue® software in order to predict Morbidly Adherent Placenta according to the scoring system of RCOG.

Research question:

Is the Semi-automated system in 3D Ultrasound superior to transvaginal 2D Ultrasound in the diagnosis of morbidly adherent placenta??

Study Hypothesis:

Three-Dimensional Ultrasound with Crystal Vue® software is superior to Two-dimensional Ultrasound in diagnosis of morbidly adherent placenta

3. METHODOLOGY**Patients and Methods/ Subjects and Methods/ Material and Methods**

- ***Type of Study:*** Diagnostic Test Accuracy Study using Cross sectional study.
- ***Study Setting:*** The study will be conducted at Special care center of fetus, Ain Shams University Maternity Hospital, Cairo, Egypt
- ***Study Period:*** The study will be conducted from June 2019 till June 2020.
- ***Study Population:*** The study will include 185 patients diagnosed with morbidly adherent placenta

Inclusion Criteria:

- ✓ Patient aged 18-42 (child bearing period)
- ✓ Pregnant women above 28 weeks gestation diagnosed as adherent placenta by Standard 2D ultrasound examination.
- ✓ Patients who have done one or more than one caesarean section or previous hystrotomy.
- ✓ History of adherent placenta
- ✓ Placenta previa with its lower edge covering the scar of previous CS.

Exclusion Criteria:

- Patient who won't deliver at our hospital
- Refusal to give a consent
- Pregnancy with multiple gestations (placenta will not be accurately visualized)
- Chorioamnionitis (due to abnormal decidualization)
- Placental abnormalities (as accessory lobe, villamentous) (abnormal implantation couldn't be excluded)

-Study Procedures and Intervention:

Initial approach: patients fulfilling the inclusion and exclusion criteria will be approached in the antenatal clinic or the special care unit of the fetus where the study protocol and procedure will be explained in Arabic (form 2).

All caesarean sections and procedures will be done by supervisors and experts.

Upon agreement to participate in the study the patient will be asked to sign informed consent

Patient history will be reviewed

The study will include patients who will be selected from the outpatient and inpatient obstetric Ain Shams maternity hospital.

Ultrasound imaging:

In the special care unit of the fetus the patient will be subjected to

1. **2D ultrasound:** the safety of 2D ultrasound has been established in patients who undergo transvaginal examination (*Fatahi Asl et al., 2020*).