THE ACCURACY OF ULTRASONOGRAPHY IN THE ANTENATAL DIAGNOSIS OF PLACENTA ACCRETA IN HOSPITAL UNIVERSITI SAINS MALAYSIA

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~ Dr. Mazlin Jamal Abdul Nasir

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LIST OF ABBREVIATIONS

ACOG	American College of Obstetricians and Gynecologists
BMI	Body Mass Index
D&C	Dilatation and Curettage
DIC	Disseminated intravascular coagulopathy
FN	False negative
FP	False positive
Hospital USM	Hospital Universiti Sains Malaysia
ICU	Intensive Care Unit
LSCS	Lower Segment Caesarean Section
MRI	Magnetic Resonance Imaging
MRP	Manual Removal of Placenta
NICU	Neonatal Intensive Care Unit
NPV	Negative predictive value
PPV	Positive predictive value

RCOG	Royal College of Obstetricians and Gynaecologists
TN	True negative
TP	True positive

ABSTRAK

Objektif:

Kajian ini bertujuan untuk menentukan ketepatan penggunaan ultrasound di dalam membuat diagnose “placenta accreta" di kalangan pesakit yang mengalami “placenta praevia" dan pernah menjalani pembedahan rahim sebelumnya. Kajian ini juga dijalankan bagi menganalisa kadar morbiditi pesakit yang mengalami “placenta accreta" dibandingkan dengan pesakit yang tidak mengalaminya.

Kaedah Kajian:

Kajian ini merupakan kajian retrospektif yang merangkumi para pesakit yang mengalami keadaan “placenta praevia" dan pernah menjalani pembedahan melibatkan rahim seperti pembedahan Caesarean, prosedur berkaitan keguguran, pembedahan fibroid atau prosedur penyingkiran manual plasenta yang melahirkan bayi di Hospital Universiti Sains Malaysia, di antara Januari 2005 hingga Disember 2015. Sistem rekod hospital telah disemak dan diteliti untuk mengenal pasti pesakit dengan diagnosis “placenta praevia" selepas usia kandungan 28 minggu dan pernah menjalani pembedahan rahim. Sensitiviti, kekhususan, nilai ramalan positif (PPV) dan nilai ramalan negatif (NPV) ultrasound dalam diagnosis “placenta accreta" telah dianalisis.

Keputusan:

Daripada 80 pesakit dimasukkan dalam kajian ini, 15 orang daripada mereka (18.75%) telah disahkan menghidap “placenta accreta”. Sensitiviti dan kekhususan ultrasound dalam diagnosis “placenta accreta” masing-masing adalah 84.62% dan 94.03%. Nilai ramalan positif (PPV) untuk ultrasound adalah 73.33% dan nilai ramalan negatif (NPV) adalah 96.92%. Dari segi morbiditi, pesakit dengan “placenta accreta" mengalami lebih banyak kehilangan darah, lebih kadar histerektomi dan kadar kemasukan ke ICU, lebih tinggi bilangan transfusi darah utuh dan produk darah, serta lebih lama memerlukan rawatan di wad hospital. Lebih ramai bayi dalam kumpulan accreta telah dimasukkan ke NICU.

Kesimpulan:

Placenta accreta dikaitkan dengan morbiditi yang tinggi berbanding “placenta praevia” sahaja. Ultrasound adalah alat diagnostik yang baik di dalam membuat diagnosis “placenta accreta”. Penemuan ini adalah konsisten dengan kajian lain.

ABSTRACT

Objectives

The aim of this study is to determine the sensitivity and specificity of ultrasonography in the antenatal diagnosis of placenta accreta in patients with placenta praevia and previous uterine surgery and to compare the morbidity associated with placenta accreta to that of placenta praevia alone.

Methodology:

This was a retrospective cohort study with the study population consisted of women with diagnosis of placenta praevia with previous uterine surgery, such as Caesarean section(s), dilatation and curettage (D&C), myomectomy or retained placenta who delivered at Hospital Universiti Sains Malaysia between January 2005 and December 2015. The hospital records system was used to identify all patients with the diagnosis of placenta praevia with previous uterine surgery, diagnosed after 28 weeks of gestation. Hospital charts were then traced and reviewed for data collection. The sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of ultrasound in the diagnosis of placenta accreta were calculated.

Results:

Out of 80 patients included in the study, 15 (18.75%) of them were confirmed to have placenta accreta. The sensitivity and specificity of ultrasound in the diagnosis of placenta accreta were 84.62% and 94.03%, respectively. The positive predictive value (PPV) for ultrasound was 73.33% and the negative predictive value (NPV) was 96.92%. In terms of morbidity, patients with placenta accreta had significant intraoperative blood loss, hysterectomy rate, ICU admission rate, number of packed cells and DIC regime transfusions and longer hospital stay. More neonates in the accreta group required NICU admission.

Conclusions:

Placenta accreta is associated with significant morbidity compared to placenta praevia alone. Ultrasound is a good diagnostic tool in the diagnosis of placenta accreta. This finding is consistent with other studies.

CHAPTER 1: INTRODUCTION

The incidence of placenta accreta is on the rise, owing to the increasing number of Caesarean sections. The incidence of placenta accreta has steadily increased in recent decades, from 1 in 2510 pregnancies in the early 1980s to 1 in 533 pregnancies in the period 1982–2002 (Esakoff, 2015). It is a potential life threatening condition, and associated with significant morbidity and mortality to the patients. Multidisciplinary approach is fundamental when it comes to strategies to minimise the complications (Eller *et al.*, 2011).

Placenta accreta is a general term used to describe the clinical condition when the entire placenta or part of it is adherent to the uterine wall without easy separation (Obstetricians and Gynecologists, 2012). The term placenta increta is used when the chorionic villi invade only the myometrium. Placenta percreta occurs when the invasion of placenta goes through the myometrium and serosa, and may sometimes invade to the adjacent organs, such as the urinary bladder. The diagnosis can be made by grey scale, colour or power Doppler sonography with or without magnetic resonance imaging (MRI), and is confirmed by evidence of gross placental invasion during surgery or histopathological examination.

It is important to make an accurate diagnosis to facilitate appropriate perioperative preparations, to reduce the morbidity to the patients. Studies have shown that ultrasonography is a good and inexpensive diagnostic tool to diagnosis placenta accreta. However, the fact that it is operator dependent may be a factor which affects its effectiveness. Therefore, this study was performed to evaluate the effectiveness of the

usage of ultrasound to diagnose placenta accreta among patients with placenta praevia with previous uterine surgery in Hospital Universiti Sains Malaysia (Hospital USM), which is one of the two tertiary centers in the state of Kelantan. Should it as effective as what was found in previous studies, it could be used as a reliable tool for such diagnosis thus facilitate in the counseling of the patients and extensive preparation for the operation to reduce the patients' morbidity.

CHAPTER 2: LITERATURE REVIEW

2.1 THE PLACENTA

Historically, the early Egyptians had already recognised and venerated the placenta. The term “Placenta” was first introduced by Realdus Columbus in 1559 during the Renaissance, which was derived from a Latin word meaning a “flat cake.” A Greek physician called Diogenes of Apollonia (ca. 480 BC) was the first person who described the function of fetal nutrition to the organs. Prior to that, Aristotle (384322 BC) had proposed that the fetus is fully enclosed within the chorion membranes (Edmonds, 2011).

The placenta is a discoid organ that weighs an average of 470 grams in which it is proportional to the fetus weight (Frank and Kaufmann, 2006). At term, the fetal to placental ratio is seven when determined by weight. The placenta is formed from the merger of the chorion and the allantois during early pregnancy and after the third stage of labour, it is called the “chorioallantoic placenta.” The decidua is the endometrium of pregnancy, arising as a result of a progesterone effect. The attachment site of the chorioallantoic placenta onto the uterus is at the decidua basalis, or basal plate, or also known as the maternal surface. The placenta exhibits about 10-40 irregularly shaped indentations called “cotyledons”, and each cotyledon is supplied by the major branches of the umbilical circulation (Rampersad *et al.*, 2011).

2.2 THE DEVELOPMENT OF PLACENTA

The development of placenta comprises a complex system. It begins when the fertilised ovum reaches the uterine cavity as morula, which rapidly converts into a blastocyst.

Following attachment to the endometrium, the outer layer of the blastocyst proliferates to form the trophoblastic cell mass which subsequently infiltrates the endometrial epithelium, causing the latter to degenerate and the trophoblast thus comes into direct contact with the endometrial stroma. In the seventh day, the trophoblast differentiates into two layers, an inner layer of mononuclear cytotrophoblastic cells in which mitotic figures are seen, and an outer layer of multinucleated syncytiotrophoblast. The multinucleated syncytiotrophoblast is in direct contact with maternal tissues, while the mononucleated cytotrophoblast as the stem cell layer of the trophoblast is directed towards the embryo. All of the differentiation and developmental stages of the placenta described so far occur before fluid-filled spaces within the syncytiotrophoblast can be detected. This stage is termed *prelacunar stage*.

The *lacunar stage* begins at day eight to nine post-conception, when the syncytiotrophoblast generates a number of fluid-filled spaces within the mass. These spaces flow together to form larger lacunae and are finally separated by parts of the syncytiotropoblast called *trabeculae* that cross the syncytial mass from the embryonic to the maternal side. These trabecular columns are not true villi but serve as the framework from which villi will then develop. The trabeculae are therefore best termed „primary villous stems” (Boyd and Hamilton, 1970)

The lacunar system divides the placenta into three compartments. The first compartment is the *chorionic plate*, in which the embryonic part of the trophoblast will develop into. The second compartment is the *intervillous space, anchoring villi* and *floating villi*, formed by the lacunae, trabeculae and the growing braches, respectively. The third compartment is the *basal plate*, formed by the maternally oriented part of the

trophoblast. At the end of this stage, the implantation process is completed at day twelve post-conception. The developing embryo is totally embedded in the endometrium and the syncytiotrophoblast surrounds the whole surface of the conceptus (Boyd and Hamilton, 1970).

Following this stage, the primary, secondary and finally, the tertiary villi were formed. Only later, the connection to the fetal vessel system will be established. The villi are organized in villous trees that cluster together into a series of spherical units known as lobules or placentones. Each placentone originates from the chorionic plate by a thick villous trunk stemming from a trabecula. Continuous branching of the main trunk results in daughter villi mostly freely ending in the intervillous space.

2.3 ABNORMAL IMPLANTATION AND ITS SEQUELAE

Normally, the human blastocyst implants in the upper portion of the uterus. Nonetheless, abnormal implantation is common and can lead to pregnancy complications such as placenta praevia, which is often associated with placenta accreta. The term “placenta praevia” refers to the location of placenta over the internal os. It is the principal cause of life-threatening bleeding during the third trimester which often warrants an emergency Caesarean section. Many authors concluded that previous Caesarean section predisposes to placenta praevia and antenatal haemorrhage. Other contributing factors are previous termination of pregnancy by uterine curettage, advanced maternal age, multiparity and cigarette smoking (Laughon *et al.*, 2005).

Placenta accreta was first defined by as the abnormal adherence, either in whole or in part, of the afterbirth to the underlying uterine wall" (Irving and Hertig, 1937). The pathological basis is that the villous tissue had not been attached to the decidua, but it had grown onto the myometrium without intervening decidua. There is evidence that placenta accreta is due to the failure of normal decidua to form, usually because the endometrium is deficient and cannot transform (Irving and Hertig, 1937).

There are several subdivisions of this condition. If the placenta villi are attached to the myometrium but do not invade the muscle it is classified as “placenta accreta vera”. “Placenta increta" occurs when the villi invade the muscle, whereas if the villi penetrate through the full thickness of the myometrium, it is termed “placenta percreta”. In this study, all of these varieties will be termed as “placenta accreta".

2.4 RISK FACTORS AND COMPLICATIONS OF PLACENTA ACCRETA

Placenta accreta is a rare condition that can lead to significant maternal morbidity and mortality. Among the identified risk factors are previous Caesarean section, placenta praevia, previous dilatation and curettage (D&C), previous myomectomy, high gravidity and parity as well as age (Chou MM, 2000; Comstock CH, 2013). The consequences are often Caesarean hysterectomy, end of fertility, massive obstetric haemorrhage, coagulopathy, injury to surrounding organs and ICU admission. Esakoff et al reported that women with placenta accreta had higher estimated blood loss, increased need for blood transfusion and longer hospital stay (Esakoff TF, 2011). These complications are devastating to the patients and may also lead to other complications such as transfusion reaction, infections and deep venous thrombosis.

2.5 INCIDENCE OF PLACENTA ACCRETA

The incidence of placenta accreta is on the rise. It affects approximately 1 in 588 women (Meng XY, 2013). Owing to the increasing rate of Caesarean delivery, the incidence of both placenta praevia and placenta accreta is steadily increasing in frequency. The incidence of placenta accreta in the presence of placenta praevia increases from 24% after one Caesarean section, up to 47%, 40% and 67% after two, three and four Caesarean sections respectively (Kean L, 2010).

2.6 DIAGNOSIS OF PLACENTA ACCRETA

Placenta accreta is often diagnosed after the delivery of baby, when placenta fails to be delivered (Kayem G, 2013). Attempt to force the delivery may result in severe postpartum haemorrhage which warrants emergency hysterectomy. Some may result in maternal death. Therefore, it is of paramount importance that accurate diagnosis to be established antenatally to minimise the complications. Tikkanen et al reported that women with antenatal diagnosis of placenta accreta had a lower estimated blood loss and required fewer units of packed red blood cells (Tikkanen M, 2011).

According to many previous studies, the antenatal diagnosis of placenta accreta can be accurately made by ultrasound (Chalubinski KM, 2013). Many studies had evaluated the accuracy of ultrasound using the grey-scale, colour Doppler and even three-dimensional (3D) sonography. The grey-scale sonography criteria suggestive of placenta praevia accreta include a loss of the normally visible retroplacental hypoechoeic zone, the presence of multiple lakes that represent dilated vessels extending from the placenta through the myometrium (“Swiss cheese” appearance of the placenta), thinning or focal

disruption of the uterine serosa-bladder wall complex and focal mass-like elevation of tissue with the same echogenicity of the placenta beyond the uterine serosa (Japaraj *et al.*, 2007). The colour Doppler and power Doppler criteria suggestive of placenta praevia accreta are dilated vascular channels with diffuse lacunar flow, interphase hypervascularity with abnormal vessels linking the placenta to the bladder and dilated peripheral subplacental vascular channel with pulsatile venous type flow over the uterine cervix (Japaraj *et al.*, 2007).

Previous studies reported the ultrasound sensitivity of 77-93%, specificity of 71-97%, positive predictive value (PPV) of 65-88% and negative predictive value (NPV) of 92-98% in the diagnosis of placenta accreta (Esakoff TF, 2011). In a study comparing 3D power Doppler with grey-scale and colour Doppler ultrasonography, the sensitivity of 3D power Doppler was reported to be 97% with specificity of 92%.(Shih JC, 2009) This was based on best single criterion characterised by “numerous coherent vessels” visualised by 3D power Doppler (Shih JC, 2009).

Nonetheless, the use of ultrasound is operator dependent and its accuracy has not been tested at local setting. It is important to make a prompt and accurate diagnosis of placenta accreta as patients can be exposed to potential morbidity and mortality. Hence, this study is performed.

Magnetic resonance imaging (MRI) is another imaging modality to diagnose placenta accreta but it is more expensive. In a meta-analysis comparing the value of ultrasound and MRI, it was found that there is no significant difference between the two modalities in the diagnosis of placenta accreta (Meng XY, 2013). At present, the role of MRI is to

complement, rather than replace, information obtained via standard sonographic imaging (Japaraj *et al.*, 2007).

CHAPTER 3: OBJECTIVES

3.1 OBJECTIVES

The objectives of this study are:

1. To determine the incidence of placenta accreta among patients with placenta praevia with previous uterine surgery in Hospital USM between January 2005 and December 2014.

2. To determine the sensitivity and specificity of ultrasound findings as compared to intraoperative findings in the diagnosis of placenta accreta.

3.2 RESEARCH QUESTIONS

1. How accurate is the ultrasonography in diagnosing placenta accreta?

2. What is the morbidity of placenta accreta as compared to placenta praevia without accreta?

3.3 RESEARCH HYPOTHESIS

Antenatal ultrasound which is performed in Hospital USM is an accurate diagnostic tool to diagnose placenta accreta among patients with placenta praevia with previous uterine surgery.

CHAPTER 4: METHODOLOGY

4.1 STUDY DESIGN, SETTING AND DURATION

This study was a retrospective study with the aim to determine the accuracy of ultrasonography in the antenatal diagnosis of placenta accreta. This study was conducted in Hospital USM for 18 months' duration, from 1st January 2015 till 1st of June 2016. A total of 80 patients were included in the study.

4.2 STUDY POPULATION

The study population consisted of women with a diagnosis of placenta praevia with previous uterine surgery including previous Caesarean section(s), D&C, myomectomy or retained placenta who delivered at Hospital USM, from 1st January 2005 until 31st December 2015.

4.3 SAMPLE SIZE CALCULATION

The sample size was calculated using sample size calculator for sensitivity and specificity (MY, 2015), using the formula as below,

$$n_{sensitivity} = \frac{Z_{(1-\alpha/2)}^{\ 2}}{\Delta^2 P} * S_N(1 - S_N)$$

where;
$\alpha = Type\ I\ error$
$\Delta = precision\ of\ estimation$
$P = Prevalence$
$S_N = Sensitivity$

with:

- Expected sensitivity of 97% (Shih JC, 2009)
- Expected specificity of 92% (Shih JC, 2009)
- Prevalence of 23% (Shih JC, 2009)
- Desired precision: 0.09
- Confidence level: 95%

With that calculation, a total sample size of 77 was required. In this study, a total of 80 patients were recruited.

4.4 INCLUSION AND EXCLUSION CRITERIA

4.4.1 Inclusion Criteria

1. Patients diagnosed with placenta praevia after 28 weeks
2. Patients with previous history of uterine surgery

4.4.2 Exclusion criteria

Patients in whose files have inadequate data were excluded from the study.

4.5 STUDY METHODS

The study was approved by the Ethics Committee of Hospital USM, as in Appendix 1. The hospital electronic records were used to identify all patients with the diagnosis of placenta praevia diagnosed after 28 weeks with previous uterine surgery. Hospital charts were then traced and reviewed for data collection.

Placenta accreta was diagnosed antenatally using both greyscale and Doppler ultrasonography. The grey-scale features which were previously reported to diagnose placenta accreta (as shown below) were used to diagnose placenta accreta (Japaraj *et al.*, 2007):

1. A loss of the normally visible retroplacental echolucent zone
2. The presence of multiple lakes that represent dilated vessels extending from the placenta through the myometrium (“Swiss cheese” appearance of the placenta)
3. Thinning or focal disruption of the line between the uterus and the bladder
4. Focal mass-like elevation of tissue with the same echogenicity of the placenta beyond the uterine serosa

Patients with the suspicion of placenta accreta had colour Doppler ultrasound performed to confirm the diagnosis. The features of colour Doppler used to diagnose placenta accreta were as follows (Japaraj *et al., 2007*):

1. Dilated vascular channels with diffuse lacunar flow
2. Interphase hypervascularity with abnormal vessels linking the placenta to the bladder
3. Dilated peripheral subplacental vascular channel with pulsatile venous type flow over the uterine cervix

If the ultrasound findings remained inconclusive, patient were subjected for Magnetic Resonance Imaging (MRI). These patients were not included in this study.

If the ultrasound findings were inconclusive, patient were subjected for Magnetic Resonance Imaging (MRI).

The diagnosis by ultrasound was then confirmed with the intraoperative diagnosis of placenta accreta, which was considered as the gold standard diagnosis.

The medical records were also used to look at the morbidity of patients diagnosed with placenta praevia with accreta and those without accreta. The factors which were looked into were the need for Caesarean hysterectomy, the estimated blood loss and numbers of packed cells used, the need for disseminated intravascular coagulopathy (DIC) regime, the need for intensive care unit (ICU) admission, the timing of delivery (elective versus emergency delivery) and the urinary bladder involvement. The neonatal outcomes including the Apgar score at five minutes and neonatal ICU admissions were also analysed.

4.6 STATISTICAL ANALYSIS

Data that were obtained in the study were entered, cleaned and analysed using SPSS version 20 (IBM Armonk, New Jersey, US) and STATA Version 14. The sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were calculated using the formula below:

Presence of Placenta Accreta by Ultrasound	**Diagnosis of Placenta Accreta at operation**	
	Yes	**No**
Yes	True positive (TP)	False positive (FP)
No	False negative (FN)	True negative (TN)

Sensitivity = TP/(TP + FN) x 100%

Specificty = TN/(FP + TN) x 100%

PPV = TP/ (TP + FP) x 100%

NPV = TN/ (TN + FN) x 100%

The morbidity of placenta accreta was assessed based on a few variables. The independent t-test analysis was used to analyse the estimated blood loss, the number of packed cells used, and the length of hospital stay. The Chi square test was used to analyse Caesarean hysterectomy, admission to intensive care unit (ICU), disseminated intravascular coagulopathy (DIC) regime requirement, the timing of Caesarean section (elective versus emergency) and the intraoperative bladder involvement/injury.

4.7 STUDY FLOW CHART

The study flow chart is as shown in Figure 4-1.

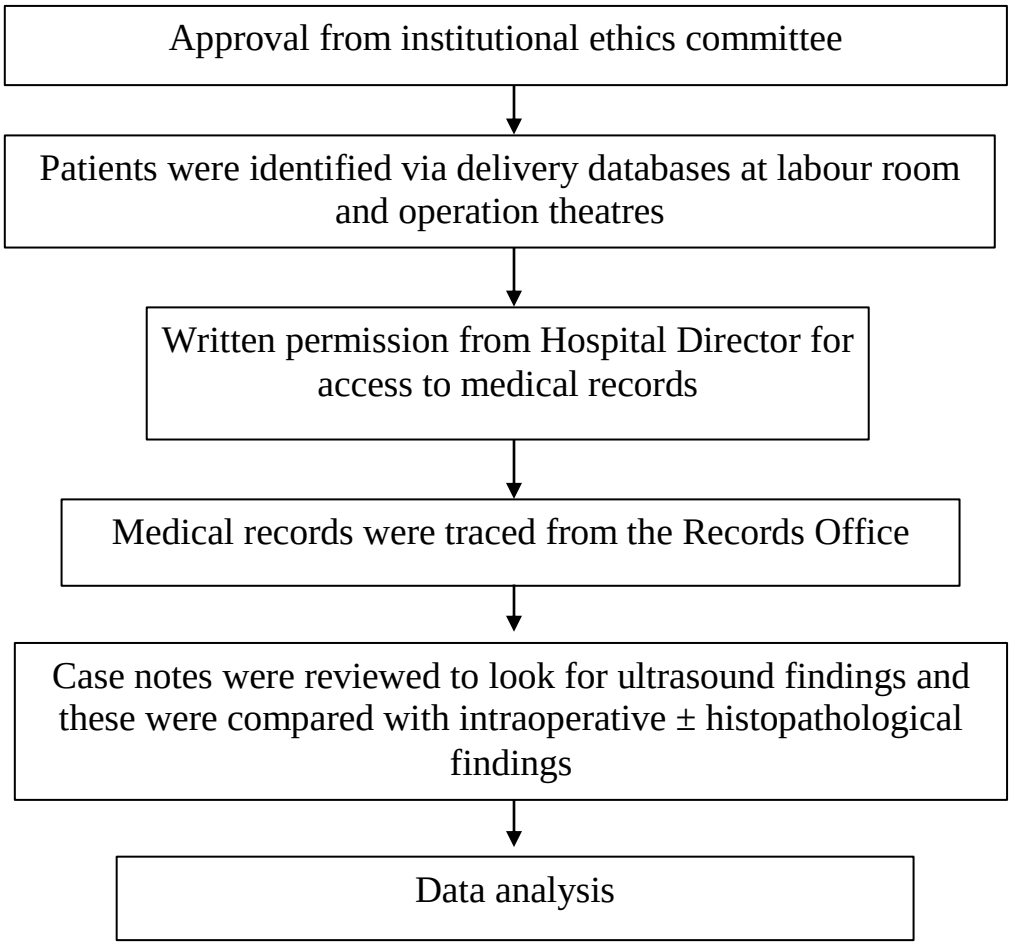

Figure 4-1: Study Flow Chart

CHAPTER 5: RESULTS

5.1 DEMOGRAPHIC DATA

A total of 80 patients diagnosed to have placenta praevia with previous uterine surgery were recruited into the study. Almost all the patients were Malays except one patient who was a Sikh (n=79; 98.8% and n=1; 1.2% respectively). The mean age of the patients was 35.45 ± 4.70 years. Most of the patients were overweight with the mean body mass index (BMI) was 27.71 ± 5.48kg/m^2.

Majority of the patients were Para 3 to 5, which was followed by Para 1 to 2. The mean parity of the patients was 2.83 ± 1.98. The mean gestational age when the diagnosis of placenta accreta was made was 33.86 ± 2.66 weeks, while the mean gestational age at delivery was 36.49 ± 2.12 weeks.

The demographic data of the patients is as summarized in Table 5.1.

Table 5.1: Demographic data

Variables	Frequency (n)	Percentage (%)	Mean ± SD
Age (years)			35.45 ± 4.70
Ethnicity: Malay Sikh	 79 1	 98.8 1.2	
BMI (kg/m^2) 18.5- 24.9 25.0- 29.9 30.0- 34.9 35.0- 39.9 >39.9	 29 31 13 4 3	 36.3 38.8 16.3 5.0 3.8	27.71 ± 5.48
Parity Nulliparous Para 1-2 Para 3-5 Para 6 and above	 5 32 36 7	 6.3 40.0 45.0 8.8	2.83 ± 1.98
Gestational age at diagnosis of placenta accreta			33.86 ± 2.66
Gestational age at delivery			36.49 ± 2.12

5.2 INCIDENCE OF PLACENTA ACCRETA

Out of 80 patients, 15 patients (18.8%) were confirmed to have placenta accreta, as seen during the operation (Figure 5-1).

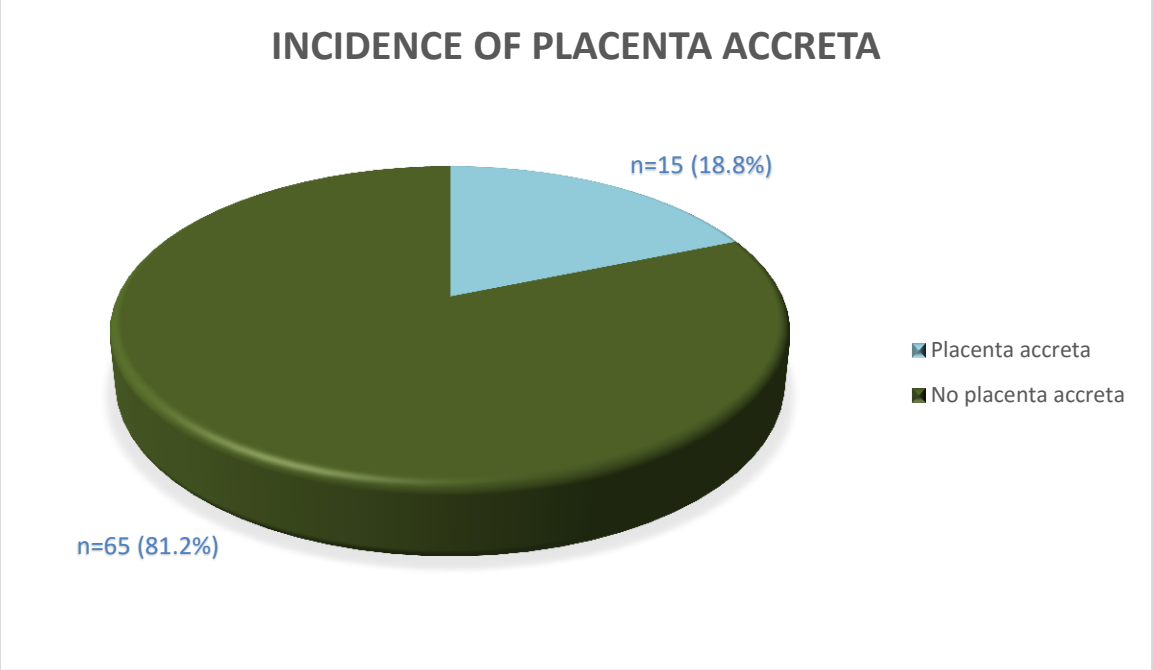

Figure 5-1: Incidence of placenta accreta

From this, one patient had previous history of MRP, four patients with one previous LSCS, four with two previous LSCS, two patients with three previous LSCS, one patient with four previous LSCS, one patient with one previous LSCS and two D&Cs, one with two previous LSCS and one D&C and one patient with two previous LSCS and one MRP. Table 5.1 shows the incidence of placenta accreta in relation to the number and type of uterine surgery the patients had undergone.

Table 5.2: Incidence of placenta accreta in relation to the number and type of uterine surgery

Number of previous uterine surgery	n	Percentage
D&C alone	0	0.0
MRP alone	1	6.7
1 previous LSCS	5	33.3
2 previous LSCS	6	40
3 previous LSCS	2	13.3
4 previous LSCS	1	6.7
LSCS + D&C	3	20
LSCS + MRP	1	6.7

The timing of operation, either emergency or elective operation was analysed. 10 patients had undergone emergency operation, while only 5 had undergone elective operation.

5.3 DIAGNOSIS OF PLACENTA ACCRETA BY ULTRASOUND

From the 80 patients who were recruited into the study, 13 patients were diagnosed to have placenta accreta by ultrasound during the antenatal period. Out of this, 11 patients were confirmed to have placenta accreta intraoperatively (Table 5.3).

Table 5.3: Diagnosis of placenta accreta by ultrasound

Intraoperative placenta accreta	Placenta accreta by ultrasound		Total
	Yes	**No**	
Yes	11	4	15
No	2	63	65
Total	13	67	80

The sensitivity of ultrasound to diagnose placenta accreta is therefore as follows:

$$\text{Sensitivity} = \frac{TP}{TP + FN} \times 100\%$$

$$= \frac{11}{11 + 3} \times 100\%$$

$$= \mathbf{85.0\%}$$

The specificity of ultrasound to diagnose placenta accreta is:

$$\text{Specificity} = \frac{TN}{FP + TN} \times 100\%$$

$$= \frac{63}{67} \times 100\%$$

$$= \mathbf{94.0\%}$$

PPV of ultrasound to diagnose placenta accreta:

$$\text{PPV} = \frac{TP}{TP + FP} \times 100\%$$

$$= \frac{11}{15} \times 100\%$$

$$= \mathbf{73.0\%}$$

NPV of ultrasound to diagnose placenta accreta:

$$\text{NPV} = \frac{TN}{TN + FN} \times 100\%$$

$$= \frac{63}{67} \times 100\%$$

$$= \mathbf{94.0\%}$$

5.4 THE MORBIDITY OF PLACENTA ACCRETA

Although the maternal and perinatal morbidity is not one of the objectives, it is interesting to know whether the timing of operation, either emergency or elective surgery, and the degree of placenta adherence affect the outcome of the mother and newborn. As seen in the summary provided in Table 5.4, the timing of operation did not associated with the estimated amount of blood loss, so as the degree of placenta adherence. Neither the timing of operation nor the degree of placenta adherence affects the outcome of the newborn as well. Most of the newborns had good Apgar score. Only 3 newborns were intubated for severe prematurity.

Table 5.4: Placenta accreta in association with maternal and neonatal morbidity

Case No	Prior surgery	Gestational age at diagnosis (weeks)	Presence of accreta by ultrasound	MRI findings	Gestational age at delivery (weeks)	Timing of Caesarean section	Intra-operative blood loss (ml)	Hysterectomy	Baby's outcomes (Apgar score at 5 minutes, NICU admission)	Histopathology
1	1 LSCS	36	No	No MRI	37	Emergency	3000	Yes	10, No	Accreta
2	1 LSCS	34	Yes	No MRI	38	Emergency	2000	Yes	10, No	Accreta
3	1 MRP	28	Yes	No accreta	29	Emergency	4000	Yes	Intubated for severe prematurity, Yes	Accreta
4	2 LSCS	34	No	No MRI	34	Emergency	2000	No, focal accreta was excised and sewn over	10, Yes	Tissue not sent
5	3 LSCS	33	Yes	No MRI	37	Elective	1000	Yes	10, No	Accreta
6	1 LSCS 2 D&C	32	Yes	No MRI	33	Emergency	2500	Yes	7, Yes	Percreta
7	1 LSCS	35	No	No MRI	36	Emergency	6000	Yes	9, No	Accreta
8	2 LSCS 2 D&C	31	Yes	No MRI	37	Emergency	4000	Yes	10, No	Percreta
9	2 LSCS 1 D&C	34	Yes	No MRI	38	Elective	3000	Yes	10, Yes	Increta
10	2 LSCS 1 MRP	28	No	No MRI	31	Emergency	3000	Yes	Intubated for severe prematurity, Yes	Accreta
11	2 LSCS	32	Yes	No MRI	37	Elective	4500	Yes	10, No	Accreta
12	3 LSCS	28	Yes	No MRI	38	Elective	2000	Yes, UAC done	9, No	Increta
13	1 LSCS	28	Yes	No MRI	31	Emergency	7000	Yes	Intubated for severe prematurity, Yes	Increta
14	4 LSCS	34	Yes	Yes	36	Elective	5000	Yes, UAC done	9, No	Percreta
15	2 LSCS	37	Yes	No MRI	37	Emergency	4000	Yes	10, Yes (hydro-chephalus)	Accreta

LSCS = lower segment Caesarean section; D&C = dilatation and curettage; MRP = manual removal of placenta; MRI: magnetic resonance imaging; NICU = neonatal intensive care unit; UAC = uterine artery catheterisation