ORIGINAL ARTICLE

Ann Acad Med Singap 2021;50:5-15
https://doi.org/10.47102/annals-acadmedsg.2020319

Risk factors and outcomes of uterine rupture in Singapore: Emerging trends

Shu Qi Tan, [1]*MBBS, MRCOG*, Li Houng Chen, [2]*MBBS*, Dhilshad Bte Muhd Abdul Qadir, [1]*MBBS, MRCS*, Bernard SM Chern, [1]*MBBS, FRCOG (UK), MRANZCOG*, George SH Yeo, [1]*MBBS, FRCOG, FAMS*

ABSTRACT

Introduction: Uterine rupture is uncommon but has catastrophic implications on the pregnancy. A scarred uterus and abnormal placentation are known contributory factors. The aim of our study was to review the contributing factors, clinical presentation, complications and management of uterine rupture in our population in light of the changing nature of modern obstetric practices.

Methods: A retrospective observational study was conducted at KK Women's and Children's Hospital by studying proven cases of uterine rupture in the period between January 2003 and December 2014. These cases were analysed according to their past history, clinical presentation, complications, management and outcome.

Results: A total of 48 cases of proven uterine rupture were identified. The incidence of uterine rupture was 1 in 3,062 deliveries. The ratio of scarred uterus rupture to unscarred uterus rupture was approximately 3:1. The most common factor was previous lower segment caesarean section for the scarred group, followed by a history of laparoscopic myomectomy. Abdominal pain was the common clinical presentation in the antenatal period, while abnormal cardiotocography findings were the most common presentation in intrapartum rupture.

Conclusion: There is a notable shift in the trend of uterine rupture cases given the increasing use of laparoscopic myomectomy and elective caesarean sections. While ruptures from these cases were few, their presentation in the antenatal period calls for diligent monitoring with informed patient involvement in their pregnancy care.

Ann Acad Med Singap 2021;50:5-15

Keywords: Antenatal, laparoscopic myomectomy, birth after caesarean, rupture, VBAC

INTRODUCTION

Uterine rupture is a catastrophic life-threatening complication of pregnancy with associated high maternal and neonatal morbidity and mortality. The incidence of uterine rupture varies with geographical location and obstetric practice. With the changes in obstetric practice over the years, caesarean section rates have increased in our population with undesirable consequences. The increasing numbers of caesarean sections for maternal requests, the decline of vaginal breech deliveries, and the increasing use of laparoscopic surgeries, especially laparoscopic myomectomies are contributory factors. The consequence of uterine rupture can be catastrophic. It is important to review the contributing factors, clinical presentation, complications and management of uterine rupture.

METHODS

A retrospective observational study of uterine rupture case records from January 2003 to December 2014 was performed at the KK Women's and Children's Hospital, the largest maternity hospital in Singapore. The operating theatre record books of the desired period were reviewed to trace the uterine rupture cases. The list of patients with the International Classification of Disease coding for uterine ruptures was also generated from our information system department, and the 2 lists were compiled. Obstetric records of these cases were traced from the Medical Records Office. Only cases of proven uterine rupture were included in the study. Cases of suspected or impending rupture and dehiscence were excluded. This study was reviewed and granted ethical approval by the SingHealth Centralised Institutional Review Board prior to its commencement.

[1] Division of Obstetrics and Gynaecology, KK Women's and Children's Hospital, Singapore
[2] Yong Loo Lin School of Medicine, National University of Singapore, Singapore
Correspondence: Dr Shu Qi Tan, Division of Obstetrics and Gynaecology, KK Women's and Children's Hospital, 100 Bukit Timah Road, Singapore 229899.
Email: tan.shu.qi@singhealth.com.sg

RESULTS

During this 12-year period, there were 147,003 deliveries and 48 cases of uterine rupture at our centre. The overall incidence of uterine rupture was 1 in 3,062 deliveries. The overall ratio of scarred to unscarred uteri was approximately 3:1.

The majority of cases occurred in women less than 35 years old (72.9%) and 79.2% of these mothers were multiparous. There was 1 case of twin pregnancy in our case series in the scarred group. All other pregnancies were singleton pregnancies.

The most common reason for a scarred uterus was 1 previous caesarean section (65.8%). Laparoscopic myomectomy and 2 previous caesarean sections were the next most common reasons for a scarred uterus at 13.2% each, followed by 3 previous caesarean sections (5.3%) and previous uterine rupture (2.6%). There was 1 case of recurrence of uterine rupture in the scarred uteri group from previous right cornual interstitial pregnancy at 18 weeks.

The mean duration from the previous pregnancy was 3.3 years. Only 1 patient had a short interpregnancy interval of less than a year. All patients with previous laparoscopic myomectomies and previous uterine rupture had an interval of more than 12 months between the operation and uterine rupture episode.

The majority of the uterine ruptures occurred during the third trimester (83.3%). However, a larger proportion of the unscarred uteri group experienced the rupture during the second trimester (33.3%) compared to the scarred uteri group (11.1%). There were no cases of uterine rupture in the first trimester. This could be due to the classification of cases as part of this retrospective study. Ruptures in the first trimester may have been classified as ruptured ectopic pregnancies.

Uterine rupture occurred most frequently during the intrapartum period (62.5%). For women with 1 previous caesarean section, 84% presented in the intrapartum period. Among these cases with 1 previous caesarean that ruptured in the intrapartum period, 3 cases used prostaglandin in labour, and 2 cases used oxytocin.

In contrast, women with scarred uteri of other aetiologies (including 2 or more previous caesarean sections, and previous uterine rupture) presented mainly with scar rupture in the antenatal period. Of note, all 5 patients with a previous laparoscopic myomectomy had the scar rupture antenatally. Two of these patients' scars ruptured in the second trimester, and the remaining 3 ruptured in the third trimester. The details of uterine rupture in relation to labour are summarised in Table 1.

The mean duration of labour with intrapartum uterine ruptures was 9.2 hours. Six cases (21.4%) of intrapartum ruptures had prolonged active labour of 12 hours or more.

Maternal presentation

Abdominal pain was the most common presenting complaint for women with antenatal uterine rupture. For women in labour, the most common presentation was

Table 1. Number of patients with uterine rupture from scarred and unscarred uterus with or without use of prostaglandins and/or oxytocin

		Antenatal uterine rupture (n=20)	Intrapartum uterine rupture (n=28)				Total (n=48)
			Use of prostaglandin only	Use of oxytocin only	Use of both prostaglandin and ocytocin	No use of prostaglandin or oxytocin	
Scarred uterus, no.	1 previous caesarean section	4	3	2	0	16	25
	2 previous caesarean sections	4	0	0	0	0	4
	3 previous caesarean sections	1	0	0	0	0	1
	Previous laparoscopic myomectomy	5	0	0	0	0	5
	Previous uterine injury e.g. rupture/surgery	1	0	0	0	0	1
Unscarred uterus, no.		5	0	1	2	4	12
Total no.		20	3	3	2	20	48

an abnormal cardiotocogram (89.3%). Multiple presentations may be present simultaneously for each case. The different maternal presentations are summarised in Table 2.

Operative procedures

Caesarean section with uterine repair sufficed for 89.6% of the uterine rupture cases. However, 5 cases had severe haemorrhage, necessitating a hysterectomy to secure haemostasis. All of these cases were in the scarred uteri group. One of the patients presented with appendicitis at 17 weeks gestation with an incidental finding of haemoperitoneum due to uterine rupture at laparotomy.

Location of rupture

The most common location of the rupture was the anterior lower uterine segment (54.2%), followed by the fundus (22.9%).

For those with scarred uteri, 88.9% of the location of rupture corresponded to the previous scar sites. For women with previous caesarean deliveries, 86.7% of ruptures occurred at the caesarean site. For women with previous laparoscopic myomectomies, all myomectomies were performed at other centres. As no surgical details were available, it was not known if the rupture site corresponded to the site of the previous myomectomy. All cases of women with previous laparoscopic myomectomy had ruptures at the fundus.

The most common location for the unscarred group was the fundus (41.7%), followed by the posterior uterine wall (33.3%).

Maternal mortality and morbidity

There were no maternal deaths in this series of 48 cases. Haemoperitoneum was noted in half of the cases (50%). Notably, the patients with previous laparoscopic myomectomy had more severe maternal bleeding and adverse consequences from the rupture. All cases had significant haemoperitoneum, and one suffered from end organ damage secondary to hypovolaemic shock. More than half of the cases of rupture from a previous caesarean scar had no serious maternal complications (Table 3).

Fetal outcomes

Of the 48 cases, 12 cases resulted in stillbirth and neonatal death (25.0%). Six stillborns belonged to the scarred uteri group. The 4 stillbirths in the unscarred group occurred before 26 weeks gestation. More newborns in the scarred uteri group required stay in the neonatal intensive care unit (NICU) and resuscitation at birth compared to the unscarred uteri group. The average birth weight of life baby at birth in the scarred and unscarred group was 2,760g and 2,803g respectively (Table 4).

Table 2. Maternal presentation of uterine rupture

Antenatal uterine rupture (n=20)			
Presentation	**Scarred uterus (n=15)**	**Unscarred uterus (n=5)**	**Total by each presentation, no. (%)**
Abdominal pain	13	4	17 (85.0)
Antepartum hemorrhage	2	1	3 (15.0)
Reduced fetal movements	2	0	2 (10.0)
Maternal shock	3	1	4 (20.0)
Bloatedness	1	0	1 (5.0)
Intrapartum uterine rupture (n=28)			
Presentation	**Scarred uterus, 1 previous caesarean section (n=21)**	**Unscarred uterus (n=7)**	**Total by each presentation, no. (%)**
Abnormal CTG	19	6	25 (89.3)
Signs of CPD	4	4	8 (28.6)
Loss of station	1	0	1 (3.6)
Puerperal pyrexia	1	0	1 (3.6)
Scar tenderness	1		1 (3.6)
Abdominal pain	1	1	2 (7.1)

CPD: cephalopelvic disproportion; CTG: cardiotocograph

Up to half of the antenatal ruptures resulted in stillbirths. There were no stillbirths in the intrapartum group. However, there were 2 subsequent neonatal deaths due to hypoxic ischaemic encephalopathy. NICU admission rates and the need for resuscitation are similar for both groups. Within the scarred group, there was a higher proportion of stillbirths in the laparoscopic myomectomy group (40.0%) compared to the caesarean section group (13.3%). Both stillbirths from the laparoscopic myomectomy group ruptured in the second trimester. All live births from the laparoscopic myomectomy group were admitted to the NICU. Table 5 compares fetal outcomes between antepartum and intrapartum ruptures.

Table 6 gives a summary of all 48 rupture cases to illustrate the type of scar, gestation of rupture, timing of rupture, intrapartum events and neonatal outcomes.

Table 3. Maternal outcomes from scarred and unscarred uterine ruptures (total n=48)

Outcome	Scarred (n=36)			Unscarred (n=12)	Total by each outcome, no. (%)
	Previous caesarean section (n=30)	Laparoscopic myomectomy (n=5)	Previous uterine rupture (n=1)		
Death	0	0	0	0	0
Significant haemoperitoneum	11	5	0	8	24 (50.0)
Disseminated intravascular coagulation	1	1	0	1	3 (6.3)
Hypovolaemic shock with end organ damage	0	1	0	0	1 (2.1)
Bladder injury	1	0	0	0	1 (2.1)
Uterine atony	1	0	0	0	1 (2.1)

Table 4. Fetal outcomes from scarred and unscarred uterine ruptures (total n=48)

Outcome	Scarred (n=36)			Unscarred (n=12)	Total by each outcome, no. (%)
	Previous caesarean section (n=30)	Previous laparoscopic myomectomy (n=5)	Previous uterine rupture (n=1)		
Live birth	26	3	1	8	38 (75)
Stillbirth	4	2	0	4	10 (20.8)
Subsequent neonatal death	2	0	0	0	2 (4.2)
NICU stay	11	3	1	2	17 (35.4)
Resuscitation[a]	11	3	1	2	17 (35.4)
Apgar score ≤6 at 1 min[b]	14	2	0	2	18 (37.5)
Apgar score ≤6 at 5 min	5	0	0	2	7 (14.6)

[a] Resuscitative measures include: oxygen, nasal continuous positive airway pressure, positive pressure ventilation, endotracheal tube, chest compressions, epinephrine use
[b] Apgar 7–10 is excellent, 4–6 is moderately depressed, 0–3 is severely depressed

Table 5. Comparison of fetal outcomes in antenatal and intrapartum uterine ruptures (total n=48)

Outcome, no. (%)	Antenatal (n=20)	Intrapartum (n=28)
Live birth	10 (50.0)	28 (100.0)
Stillbirth	10 (50.0)	0
Subsequent neonatal death	0	2 (7.14)
NICU stay	8 (40.0)	9 (32.1)
Resuscitation	8 (40.0)	9 (32.1)

Table 6. Summary of 48 uterine rupture cases

Case	Scarred uterus?	Scarred operation at our hospital	Timing of scar to rupture (months)	GA	Timing of rupture	Symptoms	Duration of labour	Prostaglandin use	Oxytocin	Site of rupture	Type of operation	Neonatal outcome	Birth weight (g)	NICU	Resuscitation
1[a]	1 CS	No	24m	39+6	Intrapartum	Trial of VBAC; NRFS	11 hours	No	No	LUS	CS	Live birth	3760	Yes	Yes
2[a]	1 CS	Yes	14m	39+4	Intrapartum	Trial of VBAC; NRFS	1 hour	No	No	LUS	Crash CS	Live birth	3390	Yes	Yes
3[a]	1 CS	Yes	12m	39+1	Intrapartum	Trial of VBAC; NRFS	6 hours	No	No	LUS	Crash CS	Live birth	3810	Yes	Yes
4[a]	1 CS	Yes	11m	37+0	Intrapartum	Trial of VBAC; NRFS	2 hours	No	No	LUS	CS	Live birth	2470	No	No
5[a]	1 CS	No	36m	40+1	Intrapartum	Abdominal pain with NRFS	1 hour	No	No	LUS	CS	Live birth	3845	No	No
6[a]	1 CS	No	48m	40+1	Intrapartum	Trial of VBAC; NRFS	11 hours	Yes	No	LUS	Crash CS	Live birth	3888	Yes	Yes
7[a]	1 CS	Yes	23m	40+3	Intrapartum	Trial of VBAC; NRFS	10 hours	No	No	LUS	CS	Live birth	3490	No	No
8[a]	1 CS	Yes	17m	37+4	Intrapartum	Trial of VBAC; NRFS	19 hours	No	Yes	Left	CS	Live birth	2922	No	No
9[a]	1 CS	No	108m	40+1	Intrapartum	Trial of VBAC; NRFS	10 hours	No	No	LUS	CS + TH	Live birth	2895	No	No
10[a]	1 CS	No	72m	39+6	Intrapartum	Trial of VBAC; NRFS + CPD	7 hours	No	No	LUS	Crash CS	Live birth	3160	No	No
11[a]	1 CS	Yes	13m	40+2	Intrapartum	Trial of VBAC; NRFS + Puerperal pyrexia	17 hours	No	No	LUS	CS	Live birth	3780	No	No
12[a]	1 CS	Yes	22m	39+3	Intrapartum	Trial of VBAC; NRFS + CPD	13 hours	No	No	Posterior	CS + TH	Live birth	3130	No	No
13[a]	1 CS	No	60m	40+0	Intrapartum	Trial of VBAC; NRFS	5 hours	No	No	LUS	Crash CS	Live birth	3555	No	No

APH: antepartum haemorrhage; CPD: cephalo-pelvic disproportion; CS: caesarean section; GA: gestational age; HIE: hypoxic ischaemic encephalopathy; LUS: lower uterine segment; NA: not applicable; NICU: neonatal intensive care unit; NRFS: non-reassuring fetal status; TH: total hysterectomy; VBAC: vaginal birth after caesarean

[a] Multiparous womenn

Table 6. Summary of 48 uterine rupture cases (Cont'd)

Case	Scarred uterus?	Scarred operation at our hospital	Timing of scar to rupture (months)	GA	Timing of rupture	Symptoms	Duration of labour	Prostaglandin use	Oxytocin	Site of rupture	Type of operation	Neonatal outcome	Birth weight (g)	NICU	Resuscitation
14[a]	1 CS	Yes	37m	38+1	Intrapartum	Trial of VBAC; NRFS	9 hours	Yes	No	LUS	CS	Live birth	2359	No	No
15[a]	1 CS	Yes	15m	39+2	Intrapartum	Trial of VBAC; NRFS	5 hours	Yes	No	LUS	Crash CS	Live birth NN death from HIE	3202	Yes	Yes
16[a]	1 CS	Yes	16m	39+2	Intrapartum	Trial of VBAC; NRFS + CPD + loss of station	11 hours	No	No	LUS	Crash CS	Live birth	3234	No	No
17[a]	1 CS	No	48m	39+1	Intrapartum	Trial of VBAC; NRFS	10 hours	No	No	LUS	Crash CS	Live birth	3200	Yes	Yes
18[a]	1 CS	No	72m	40+2	Intrapartum	Failed VBAC	10 hours	No	No	Fundus	CS	Live birth	3090	No	No
19[a]	1 CS	No; history of classical CS	48m	40+4	Intrapartum	Trial of VBAC; NRFS	12 hours	No	No	Previous anterior CS scar	Crash CS	Live birth	3530	Yes	Yes
20[a]	1 CS	Yes	30m	40+1	Intrapartum	Trial of VBAC; NRFS	11 hours	No	No	LUS	Crash CS + TH	Live birth NN death from HIE	2955	Yes	Yes
21[a]	1 CS	Yes	46m	39+4	Intrapartum	Trial of VBAC; scar tenderness	20 hours	No	Yes	LUS	CS	Live birth	2765	No	No
22[a]	1 CS	No	84m	17+4	Antenatal	Abdominal pain	NA	NA	NA	LUS	Appendicectomy + CS + sub-TH	Stillbirth	NA	NA	NA
23[a]	1 CS	Yes	19m	37+2	Antenatal	APH	NA	NA	NA	LUS	CS	Live birth	3365	No	No
24[a]	1 CS	No	13m	29+5	Antenatal	Abdominal pain with acute abdomen and NRFS	NA	NA	NA	Posterior	Crash CS	Live birth	1125	Yes	Yes

APH: antepartum haemorrhage; CPD: cephalo-pelvic disproportion; CS: caesarean section; GA: gestational age; HIE: hypoxic ischaemic encephalopathy; LUS: lower uterine segment; m: months; NA: not applicable; NICU: neonatal intensive care unit; NN: neonatal; NRFS: non-reassuring fetal status; TH: total hysterectomy; VBAC: vaginal birth after caesarean

[a] Multiparous women

Table 6. Summary of 48 uterine rupture cases (Cont'd)

Case	Scarred uterus?	Scarred operation at our hospital	Timing of scar to rupture (months)	GA	Timing of rupture	Symptoms	Duration of labour	Prostaglandin use	Oxytocin	Site of rupture	Type of operation	Neonatal outcome	Birth weight (g)	NICU	Resuscitation
25[a]	1 CS	Yes	38m	37+1	Antenatal	Reduced FM + abdominal pain + giddiness	NA	NA	NA	LUS	CS	Stillbirth	2324	NA	NA
26[a]	2 CS	Yes	17m	37+2	Antenatal	Abdominal pain with NRFS	NA	NA	NA	LUS	Crash CS	Stillbirth	3068	NA	NA
27[a]	2 CS	No	Unknown	20+6	Antenatal	Abdominal pain with maternal shock	NA	NA	NA	LUS; placenta accreta	CS + TH	Stillbirth	NA	NA	NA
28[a]	2 CS	No	72m	33+2	Antenatal	Abdominal pain with acute abdomen and NRFS	NA	NA	NA	LUS	Crash CS	Live birth	2060	Yes	Yes
29[a]	2 CS	Yes	13m	35+5, DCDA	Antenatal	Abdominal pain with acute abdomen	NA	NA	NA	LUS	CS	Live birth	2100; 2280	No	No
30[a]	3 CS	Yes	35m	30+3	Antenatal	Abdominal pain with APH	NA	NA	NA	LUS	Crash CS	Live birth	1450	Yes	Yes
31[a]	Laparoscopic myomectomy	No	24m	28+6	Antenatal	No fetal movement with maternal shock	NA	NA	NA	Fundus	Peri-mortem CS	Stillbirth	1225	NA	NA
32	Laparoscopic myomectomy	No	24m	34+4	Antenatal	Abdominal pain and NRFS	NA	NA	NA	Fundus	CS	Live birth	2170	Yes	Yes
33	Laparoscopic myomectomy	No	30m	32+0	Antenatal	Abdominal pain and NRFS	NA	NA	NA	Fundus	Crash CS	Live birth	1975	Yes	Yes

APH: antepartum haemorrhage; CPD: cephalo-pelvic disproportion; CS: caesarean section; DCDA: dichorionic diamniotic twins; FM: fetal movement; GA: gestational age; LUS: lower uterine segment; m: months; NA: not applicable; NICU: neonatal intensive care unit; NRFS: non-reassuring fetal status; TH: total hysterectomy; VBAC: vaginal birth after caesarean

[a] Multiparous women

Table 6. Summary of 48 uterine rupture cases (Cont'd)

Case	Scarred uterus?	Scarred operation at our hospital	Timing of scar to rupture (months)	GA	Timing of rupture	Symptoms	Duration of labour	Prostaglandin use	Oxytocin	Site of rupture	Type of operation	Neonatal outcome	Birth weight (g)	NICU	Resuscitation
34	Laparoscopic myomectomy	No	15m	25+0	Antenatal	Abdomnal pain, bloatedness, maternal shock	NA	NA	NA	Fundus	CS	Stillbirth	Unknown	NA	NA
35	Laparoscopic myomectomy	No	35m	26+3	Antenatal	Abdominal pain	NA	NA	NA	Fundus	Crash CS	Live birth	1075	Yes	Yes
36[a]	Previous uterine rupture from cornual ectopic	Yes	24m	34+2	Antenatal	Abdominal pain	NA	NA	NA	Fundus	Crash CS	Live birth	1190	Yes	Yes
37[a]	No	NA	NA	39+4	Intrapartum	NRFS; CPD	8 hours	No	No	Left	CS	Live birth	3470	Yes	Yes
38	No	NA	NA	40+1	Intrapartum	NRFS; CPD	9 hours	Yes	Yes	Posterior	CS	Live birth	3840	No	No
39[a]	No	NA	NA	39+5	Intrapartum	NRFS; CPD	7 hours	No	Yes	Posterior	Crash CS	Live birth	3435	No	No
40[a]	No	NA	NA	39+5	Intrapartum	NRFS	3 hours	No	No	Posterior	Crash CS	Live birth	3180	No	No
41	No	NA	NA	35+6	Intrapartum	NRFS, APH	3 hours	No	No	Right	CS	Live birth	2840	No	No
42	No	NA	NA	35+0	Intrapartum	Abdominal pain + NRFS	5 hours	No	No	Posterior	Crash CS	Live birth	2700	No	No
43[a]	No	NA	NA	39+2	Intrapartum	CPD	22 hours	Yes	Yes	Left	CS	Live birth	3320	No	No
44[a]	No	NA	NA	31+6	Antenatal	Abdominal pain + NRFS	NA	NA	NA	Fundus	CS	Live birth	1780	Yes	Yes
45	No	NA	NA	26+1	Antenatal	Fall with secondary abruption	NA	NA	NA	Fundus	CS	Stillbirth	660	NA	NA
46[a]	No	NA	NA	18+0	Antenatal	Abdominal pain	NA	NA	NA	Fundus	CS	Stillbirth	Unknown	NA	NA
47	No	NA	NA	22+2	Antenatal	Abdominal pain	NA	NA	NA	Fundus	CS	Stillbirth	Unknown	NA	NA
48	No	NA	NA	18+3	Antenatal	Abdominal pain with maternal shock	NA	NA	NA	Fundus; histo: placenta accreta	CS	Stillbirth	Unknown	NA	NA

APH: antepartum haemorrhage; CPD: cephalo-pelvic disproportion; CS: caesarean section; GA: gestational age; LUS: lower uterine segment; m: months; NA: not applicable; NICU: neonatal intensive care unit; NRFS: non-reassuring fetal status; TH: total hysterectomy; VBAC: vaginal birth after caesarean

[a] Multiparous women

DISCUSSION

With the shift in obstetric practices towards an increasing trend of caesarean section, the incidence of uterine rupture in our case series has grown in this decade to 1 in 3,062. In the previous series at our same institution between 1972 and 1982, the incidence was 1 in 3,869.[1] Between 1983 and 1992, the incidence was 1 in 6,331.[2] This is comparable to rupture rates of other developed countries after year 2000, such as Saudi Arabia, Taiwan and France.[1-8]

Previous uterine scars are known risk factors for uterine rupture.[9] A history of previous caesarean sections is the most common reason for a scarred uterus. There is a global trend moving towards caesarean sections. Caesarean section incidence has been increasing, rising from 12% of live births in 2000 to 21% in 2015. In North America, Western Europe and Latin America, caesarean section rates rose by around 2% a year between 2000 and 2015 to 32%, 27% and 44%, respectively. In more than 15 countries, caesarean section rates have surpassed 40%.[10] In Singapore, caesarean section rates have been steadily increasing from 17.8% in 1999 to 34% in 2009, and 37.4% in 2014.[11,12] The main indication for caesarean section in 1999 was cephalopelvic disproportion but a decade later, history of 1 previous caesarean section became the most common indication.[11] While the procedure can reduce mortality and morbidity in suitable cases, indiscrete use can inflict unnecessary complications and risk for mothers, especially in future births.

Vaginal birth after caesarean section (VBAC) remains the most common cause for a scarred uterus rupture in our study. The highest rate of uterine rupture in these patients occur intrapartum. Ultrasound of scar thickness has not shown to reliably predict rupture risk. Our institution does not offer trial of labour after 2 previous sections. Mothers who are keen for trial of labour after more than 1 previous caesarean may seek a second opinion at an alternative institution. Compared to spontaneous VBAC labour, induced and/or augmented labour had a 2- to 3-fold increased risk of uterine rupture and around 1.5-fold increased risk of caesarean delivery.[13] Prostaglandins used for cervical ripening and induction of labour have been associated with increased risk of rupture when used in patients with previous cesarean sections.[14] A study by Lydon-Rochelle[14] found that the incidence of rupture when oxytocin was used during a VBAC was 7.7 per 1,000. In our case series, prostaglandin was used in 3 out of 20 cases of VBAC, while 2 cases had oxytocin use. This is much lower than that reported in other studies in the US[15] and China,[16] where the rates of labour augmentation with oxytocin in VBAC cases quoted were 27.7% and 25.5%, respectively. Cautious use of these agents is essential to minimise risk of uterine rupture.

There are no guidelines to recommend duration for trial of labour after VBAC. Up to 1 in 5 cases had prolonged active labour duration of more than 12 hours in our case series. Timely review of VBAC patients to assess feasibility of success of labour by a senior obstetrician is recommended.

One of the most important risk factors in uterine rupture is a history of laparoscopic myomectomy.[17] The second most common cause of scarred uteri in our case series is a previous history of laparoscopic myomectomy. All cases of rupture had laparoscopic approach for their previous myomectomy. There were no cases of rupture from a history of open myomectomy. The rupture rates after laparoscopic myomectomy are variable, as high as 10%.[18-22] The technique of repair with laparoscopic suturing following myomectomy could be a contributing factor to the integrity of the scar subjected to a trial of labour.

Bernadi[21] suggested a few factors that increase the incidence of uterine rupture after myomectomy. This included short duration between myomectomy and conception (less than 12 months), opening of endometrial cavity, and patients with large myomas more than 4cm. The extensive use of electro-surgery leads to poor vascularisation and necrosis of the myometrium.[18,21,23] This decreases scar strength and predisposes to uterine rupture. Appropriate use of electro-surgery and multilayered closure of the myometrium are essential for the prevention of uterine rupture after a laparoscopic myomectomy.[24] Avoidance of entry into the endometrial cavity and prevention of haematoma formation are also extra precautions. The use of Morphological Uterus Sonographic Assessment (MUSA) classification to better classify myomas and predict the risk of uterine rupture in subsequent pregnancies is a plausible idea.[25] Further studies need to be performed to validate the effectiveness of the MUSA classification.

In our study, the majority of ruptures in women with a previous laparoscopic myomectomy occurred in the third trimester. A recent meta-analysis supports that up to 80% of uterine ruptures after laparoscopy myomectomy occur between 28 and 36 weeks of gestation.[26] However, some case series have shown early preterm uterine ruptures, as early as 10 weeks of gestation after laparoscopic myomectomy. Makino[4] suggested that uterine rupture occurred earliest in patients after adenomyomectomy, followed by myomectomies in those with caesarean section. Obstetricians should exercise extra caution antenatally with this subgroup, even in the first trimester.

Of note, patients with previous laparoscopic myomectomy presented almost exclusively antenatally. All our patients in this subgroup ruptured antenatally in our case series, with 1 case complicated by end organ damage from hypovolaemic shock. Consequently, fetal loss rate appears to be higher in this subgroup of women compared to women with scarred uteri from previous caesarean sections. Claeys[27] examined 29 cases, with 1 case of rupture intrapartum, and 28 cases of rupture before the onset of labour. These women may also have atypical presentations of pain mimicking appendicitis and abruption, which warranted a high index of suspicion. Careful counselling of young women of reproductive age following a laparoscopic myomectomy regarding pain in the third trimester appears to be useful.

Pregnancy after laparoscopic myomectomies, however, can be uncomplicated. A case series by Kumakiri[28] of 111 patients who conceived following laparoscopic myomectomy had successful term deliveries with no cases of ruptures. Of these patients, 52 had caesarean sections and 59 underwent successful vaginal deliveries.

Uterine rupture may also happen to women who have no previous uterine scars. While rare, we captured 12 such cases in our series. One in 4 of our patients who experienced uterine rupture had unscarred uteri. Of these 12 patients, 6 were primiparous. Of these 6 primiparous patients, 3 patients ruptured antenatally in their second trimester at the uterine fundus, and the histology of one of these cases returned as placenta accreta. This latter condition is unusual. The retrospective nature of this study limits our ability to obtain more details on these cases. Previous literature review by Lydon-Rochelle[14] found an incidence of 1 in 8,000 to 1 in 1,500. Zwart et al.[8] reported 25 cases of rupture in unscarred uteri, with an overall incidence of 0.7 in 10,000. Multiple factors are associated with rupture in the unscarred uteri. These include: a history of instrumental abortion or postpartum curettage, history of hysteroscopy, uterine anomalies, multiple gestations, macrosomia, oxytocin stimulation, prostaglandin use, undiagnosed malpresentation, forced manipulation of the birth canal such as cervical dilatation and breech extraction, and obstetric trauma.[8,9,29]

An interesting finding was that a high proportion of ruptures in the unscarred uteri group in our series occurred in the fundus. The fundus is the most common rupture site in unscarred uteri in the literature.[17] It has been postulated that a history of previous termination of pregnancies and other uterine procedures could be withheld from the clinician, which could be a contributory factor to this phenomenon.

There were no maternal deaths in our case series, and there was an overall rate of 10.4% for hysterectomies done after uterine rupture. Varying rates of hysterectomy from 6.7% up to 71.5% have been reported.[1,3,5,8,30] Hysterectomy, whether total or subtotal, is a common surgical procedure in cases of uterine rupture. Haemoperitoneum is a common finding, and early recognition is crucial to avert severe hypotension and possible end organ damage.

The incidence of fetal loss was 25.0% in our study. This could be related to the high incidence of antenatal rupture in our review (41.7%). Other studies have quoted fetal loss rates varying from 12.2–84.1%.[1,3,5,30] Although our study did not show significant differences in maternal and neonatal outcomes between the scarred and unscarred groups, severe maternal and neonatal morbidity and mortality were more often observed among women with an unscarred uterine rupture, as compared to uterine scar rupture in other studies. Zwart et al.[8] reported significantly higher maternal intensive care unit admissions, hysterectomy rates, major blood loss and peripartum fetal death in the unscarred uteri group. As discussed, it appears that ruptures in cases with previous laparoscopic myomectomy have worse fetal outcomes than those with a history of caesarean section. Makino[4] reviewed uterine rupture in 112 women with scarred uteri, and showed that neonatal death is most prevalent in those with previous adenomyomectomy, followed by laparoscopic myomectomy, and is the least in those with caesarean section. This is likely related to the timing of ruptures. Mothers with previous laparoscopic myomectomy tend to present antenatally, and earlier in the course of their pregnancy, when fetuses are premature. They may also present with signs mimicking acute abdomen or appendicitis, making diagnosis more difficult, and thus management can potentially be delayed. In contrast, those with previous caesarean section tend to present intrapartum, where they are on continuous fetal monitoring. Signs of rupture are likely to be observed earlier, leading to improved fetal outcomes.

The retrospective nature of this review would mean that the data was dependent on the accuracy of the diagnosis that was recorded. This possibly explains why there were no recorded uterine rupture cases in the first trimester, as these cases were likely classified as ruptured ectopic pregnancies. As the largest obstetric public institution in Singapore, our data is likely to reflect most acute cases sent by ambulance. The numerator data could be over-represented as evidenced by the fact that all the cases of uterine rupture after a laparoscopic myomectomy were performed at other centres. In addition, the ratio of deliveries in the public versus private sectors has changed over the past decade. This will affect the denominator

value as well. Therefore, our incidence of rupture could be subjected to such bias.

CONCLUSION

Compared to the previous series at the same institution, there is a notable change in the trend of uterine rupture cases in Singapore given the increasing use of laparoscopic myomectomy and elective caesarean sections. While rupture from these cases are few, their presentation in the antenatal period calls for diligent monitoring with informed patient involvement in their pregnancy care. Meticulous review of previous surgical documentation and photos, detailed counselling, close follow-up and early identification of these at-risk patients is crucial to optimise outcomes for uterine rupture cases. A high degree of vigilance should remain when patients with a scarred uterus undergo a trial of vaginal birth, and induction of labour for this group of patients should be done after careful counselling. Unscarred uteri can also rupture. Discreet enquires about previous uterine instrumentation at the booking visit could help identify some women at risk.

REFERENCES

1. Chew SY. Uterine rupture in labour. A 10-year review. Singapore Med J 1984;25:24-9.
2. Chen LH, Tan KH, Yeo GS. A ten-year review of uterine rupture in modern obstetric practice. Ann Acad Med Singap 1995; 24:830-5.
3. You SH, Chang YL, Yen CF. Rupture of the scarred and unscarred gravid uterus: Outcomes and risk factors analysis. Taiwan J Obstet Gynecol 2018;57:248-54.
4. Makino S, Takeda S, Kondoh E, et al. National survey of uterine rupture in Japan: Annual report of Perinatology Committee, Japan Society of Obstetrics and Gynecology, 2018. J Obstet Gynaecol Res 2019;45:763-5.
5. Turgut A, Ozler A, Siddik Evsen M, et al. Uterine rupture revisited: Predisposing factors, clinical features, management and outcomes from a tertiary care center in Turkey. Pak J Med Sci 2013;29:753-7.
6. Sayed Ahmed WA, Habash YH, Hamdy MA, et al. Rupture of the pregnancy uterus - a 20-year review. J Matern Fetal Neonatal Med 2016;30:1488-93.
7. Markou GA, Muray JM, Poncelet C. Risk factors and symptoms associated with maternal and neonatal complications in women with uterine rupture. A 16 years multicentric experience. Eur J Obstet Gynecol Reprod Biol 2017;217:126-30.
8. Zwart JJ, Richters JM, Ory F, et al. Uterine rupture in The Netherlands: a nationwide population-based cohort study. BJOG 2009;116:1069-78.
9. Mazzone ME, Woolever J. Uterine rupture in a patient with an unscarred uterus: a case study. WMJ 2006;105:64-6.
10. Boerma T, Ronsmans C, Melesse DY, et al. Global epidemiology of use of and disparities in caesarean sections. Lancet 2018;392:1341-8.
11. Wang CCP, Tan WC, Kanagalingam D, et al. Why we do caesars: a comparison of the trends in caesarean section delivery over a decade. Ann Acad Med Singap 2013;42:408-12.
12. Chi C, Pang D, Aris IM, et al. Trends and predictors of cesarean birth in Singapore, 2005-2014: A population-based cohort study. Birth 2018;45:399-408.
13. RCOG Green Top Guidelines No.45, Birth after Previous Caesarean Birth, 1 October 2015.
14. Lydon-Rochelle M, Holt VL, Easterling TR, et al. Risk of uterine rupture during labor among women with a prior cesarean delivery. N Engl J Med 2001;345:3-8.
15. Abraham C, Adeyekun M, Demissie S, Patterns of Oxytocin Use in Those Undergoing Trial of Labor After Cesarean Delivery. Gynecol Obstet (Sunnyvale) 2017;129:S147.
16. Wu SW, Dian H, Zhang WY. Labor Onset, Oxytocin Use, and Epidural Anesthesia for Vaginal Birth after Cesarean Section and Associated Effects on Maternal and Neonatal Outcomes in a Tertiary Hospital in China: A Retrospective Study. Chin Med J (Engl) 2018;131:933-8.
17. Okada Y, Hasegawa J, Mimura T, et al. Uterine rupture at 10 weeks of gestation after laparoscopic myomectomy. J Med Ultrason (2011) 2016;43:133-6.
18. Dubuisson JB, Fauconnier A, Deffarges JV, et al. Pregnancy outcome and deliveries following laparoscopic myomectomy. Hum Reprod 2000;15:869-73.
19. Malzoni M, Sizzi O, Rossetti A, et al. Laparoscopic myomectomy: a report of 982 procedures. Surg Technol Int 2006;15:123-9.
20. Sizzi O, Rossetti A, Malzoni M, et al. Italian multicenter study on complications of laparoscopic myomectomy. J Minim Invasive Gynecol 2007;14:453-62.
21. Bernardi TS, Radosa MP, Weisheit A, et al. Laparoscopic myomectomy: a 6-year follow-up single-center cohort analysis of fertility and bstetric outcome measures. Arch Gynecol Obstet 2014;290:87-91.
22. Koo YJ, Lee JK, Lee YK, et al. Pregnancy Outcomes and Risk Factors for Uterine Rupture After Laparoscopic Myomectomy: A Single-Center Experience and Literature Review. J Minim Invasive Gynecol 2015;22:1022-8.
23. Yazawa H, Takiguchi K, Ito F. Uterine rupture at 33rd week of gestation after laparoscopic myomectomy with signs of fetal distress. A case report and review of literature. Taiwan J Obstet Gynecol 2018;57:304–10.
24. Parker WH, Einarsson J, Istre O, et al. Risk factors for uterine rupture after laparoscopic myomectomy. J Minim Invasive Gynecol 2010;17:551-4.
25. Vimercati A, Del Vecchio V, Chincoli A, et al. Uterine Rupture after Laparoscopic Myomectomy in Two Cases: Real Complication or Malpractice? Case Rep Obstet Gynecol 2017;2017:1404815.
26. Kim HS, Oh SY, Choi SJ, et al. Uterine rupture in pregnancies following myomectomy: A multicenter case series. Obstet Gynecol Sci 2016;59:454-62.
27. Claeys J, Hellendoorn I, Hamerlynck T, et al. The risk of uterine rupture after myomectomy: A systematic review of the literature and meta-analysis. Gynecological Surgery 2014;11:197-206.
28. Kumakiri J, Takeuchi H, Itoh S, et al. Prospective evaluation for the feasibility and safety of vaginal birth after laparoscopic myomectomy. J Minim Invasive Gynecol 2008;15:420-4.
29. Pearlman MD, Tintinalli JE, Lorenz RP. Blunt trauma during pregnancy. N Engl J Med 1990;323:1609-13.
30. Ahmed DM, Mengistu TS, Endalamaw AG. Incidence and factors associated with outcomes of uterine rupture among women delivered at Felegehiwot referral hospital, Bahir Dar, Ethiopia: cross sectional study. BMC Pregnancy Childbirth 2018;18:447.