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Epidemiology of pregnant patients with major trauma in Victoria

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Competing interests

None declared

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Ethics approval statement

The Victorian State Trauma Registry has ethical approval from the Department of Health and Human Services Human Research Ethics Committee (HREC), 138 trauma-receiving hospitals in Victoria, and the Monash University HREC.

ABSTRACT

Objective: Trauma is one of the most common contributors to maternal and foetal morbidity and mortality. The aim of this study was to describe the characteristics and outcomes of major trauma in pregnant patients using a population-based registry.

Methods: Registry based study using data from the Victorian State Trauma Registry (VSTR), a population-based database of all hospitalized major trauma (death due to injury, ISS > or =12, admission to an ICU for more than 24 hours and requiring mechanical ventilation for at least part of their ICU stay or urgent surgery) in Victoria, Australia from July 1 2007 to June 30 2019. Pregnant patients with major trauma were identified on the VSTR. We summarised patient data using descriptive statistics.

Results: Over the 12-year study period, there were 63 pregnant major trauma patients. 52 patients (82.5%) sustained injuries resulting from road transport collisions. The maternal survival rate was 98.4% and the foetal survival rate was 88.9%. Thoracic injury was the most common injury (25/63), followed by abdominal injury (23/63). Eighty six percent of the third trimester patients (19/22) were transported directly to a major trauma service with capacity for definitive care of the pregnancy.

Conclusion: This study demonstrated road transport injury was the most common mechanism of injury and both maternal survival rates and foetal survival rates were high. This information is essential for trauma care system planning, and public health initiatives to improve the clinical management and outcomes of pregnant women with major trauma.

Keywords: Descriptive study, Major trauma, Population-based, Pregnancy

Introduction

Trauma is one of the most common contributors to maternal and foetal morbidity and mortality[1-3]. In previous studies, 1-2% of female patients of child bearing age who sustain trauma were pregnant[3-6]. Motor vehicle collisions, falls, and domestic or intimate partner violence have been found to be the leading cause in pregnant trauma patients[3,5-7].

The incidence and outcomes of trauma in pregnancy depend on cultural context and health care systems[5,6,8,9]. In the United Kingdom, national trauma registry data shows that vehicle collision was the most common mechanism of injury (55.5%), followed by high fall (17.9%)[6]. By contrast, pregnant patients in the United States as per the National Trauma Data Bank (NTDB), were most likely to be injured in motor vehicle crashes (70.4%), followed by interpersonal violence (11.6%)[3]. The maternal survival rate was 98.8% in pregnant women who sustain trauma in the United States, while it was 94.9% in the United Kingdom[4,6]. However, little is known about the mechanism of injury, population types and outcome of hospitalized major trauma in pregnant patients from Australia using a population-based trauma registry.

The aim of this study is to describe the mechanism of injury, population types and outcomes of major trauma in pregnant females using a population-based registry in Victoria, Australia.

Methods

Study design and participants

This study included all pregnant patients with major trauma in Victoria, on the Victorian State Trauma Registry (VSTR), with a date of injury from 1 July 2007 to 30 June 2019. Pregnant patients were defined as any of the International Classification of Diseases

10th Revision-Australian Modification (ICD-10-AM) diagnosis codes Z32 to 38.8, O09.0 to O09.9, or free text search “pregnant”, “gestation”, “placenta” from VSTR.

Setting

The state of Victoria, Australia, has a population of 6.6 million people[10]. The Victorian State Trauma System (VSTS) was implemented between 2000 and 2003[11]. The VSTS is a centrally coordinated trauma network with two adult (the Alfred Hospital and the Royal Melbourne Hospital) and one paediatric hospital (the Royal Children’s Hospital Melbourne) as major trauma services. The Royal Melbourne Hospital (RMH) has been designated to care for Victorian obstetric trauma patients due to its co-location with the Royal Women’s Hospital. Prehospital guidelines recommend all women greater than 24 weeks pregnant or with a suspicion of uterine trauma be preferentially transferred to the RMH. The trauma system for the whole region is tightly monitored and all obstetric patients are directed to RMH with a statewide guidance at https://trauma.reach.vic.gov.au/guidelines/obstetric-trauma/early-management.

Victorian State Trauma Registry

The VSTR is a population-based registry that collects data about all hospitalized major trauma patients in Victoria[12]. A patient is classified as major trauma in the VSTR if any of the following criteria are met: death due to injury; an injury severity score (ISS) > or = 12 as determined by the Abbreviated Injury Scale (AIS) (2005 version 2008 update) (This changed in 2010 ISS > 15 to ISS > or = 12); admission to an intensive care unit (ICU) for more than 24 hours and requiring mechanical ventilation for at least part of their ICU stay; and urgent surgery. The VSTR has ethical approval from the Department of Health and

Human Services (DHHS) Human Research Ethics Committee (HREC), 138 trauma-receiving hospitals in Victoria, and the Monash University HREC.

Data collection

Demographic factors, cause of injury (road transport collision, low [≤ 1m] and high falls [> 1m], others), injury intent (intentional [self-harm or assault] or unintentional) and severity, and information about trimester at the time of injury were extracted from the registry.

Outcomes measures

Outcomes were foetal outcomes, hospital length of stay, ICU admission, in hospital maternal mortality and the extended Glasgow Outcome Scale (GOS-E) at 6 months after injury. The foetal outcome was extracted as ICD-10AM codes O021, O039, O060, or O364. The VSTR follows up all survivors to hospital discharge by telephone at 6, 12 and 24 months post-injury to collect patient-reported outcomes data[13]. The GOS-E categorises patient function into one of eight categories, with upper good recovery representing return to pre-injury function[14]. The GOS-E is recommended for use in trauma populations because of great responsiveness and low ceiling effect[15].

Continuous data with skewed distributions were summarised using the median and interquartile range (IQR). Categorical data were reported using frequencies and proportions.

Results

For the twelve-year period between 2007 and 2019, a total of 63 pregnant patients were recorded. The median age was 27 (interquartile range [IQR] 23-32). A record of their

pregnancy gestation was present in 48 (76%) cases - Sixteen patients were in their 1st trimester, 10 patients in their 2nd trimester and 22 in their 3rd trimester (Table 1). Of those in the 3rd trimester, there were 19 cases (86%) who transported directly from the scene to the Royal Melbourne Hospital, and 2 cases (9%) who were transferred from the primary hospital to the Royal Melbourne Hospital. Thus, 95% (21 cases) of the patients in the third trimester had definitive care at the appropriate centre. A road transport collision was the most common mechanism of injury (82.5%), followed by low and high falls (9.5%). Eight patients (12.7%) had intentional injuries – 3 patients had maltreatment. The median ISS was 17 (IQR 14-24).

The most common injury type was rib fractures (31.7%), followed by uterine injury (25.4%), pelvic fracture (14.3%) and lower extremity injury (14.3%) (Table 2). Among 16 patients with uterine injury, 13 patients were in their 3rd trimester. Among 9 patients with pelvic fracture, 6 patients were in 1st trimester.

Overall, maternal survival rates were 98.4% in pregnant patients with major trauma. Caesarean section was performed in 11 patients (18.6%), due to complications including 7 abruptions (Table 3). Of the 19 patients who had a primary transport to The Royal Melbourne Hospital in the 3rd trimester, 10 cases had caesarean section. The overall foetal survival was 83% with 52 survivor, 7 deaths and 4 unknown cases following maternal major trauma in this population. At 6 months after injury, 69.8% of pregnant patients with major trauma had completed a valid GOS-E. Of those who survived to hospital discharge, 38.6% had lower/upper good recovery and 43.2% had lower/upper moderate disability.

Discussion

We investigated characteristics and outcomes of major trauma in pregnancy using a population-based registry in Victoria, Australia. Road transport collisions accounted for more

than 80% of events. Both maternal survival rates and foetal survival rates were high. There was a low rate of documented intentional injury and interpersonal violence in this major trauma cohort, compared with international experience.

There was a high proportion of road transport collisions in our study. A retrospective cohort study in the UK showed that the incidence of vehicle collision was 55.5% in pregnant trauma patients, followed by high fall (17.9%), using the national trauma registry data[6]. An American retrospective cohort study from the NTDB demonstrated that the incidence of motor vehicle crashes was 70.4%, followed by interpersonal violence (11.6%)[3]. The increased percentage of road transport collisions in our study might be due to the major trauma criteria for inclusion in the VSTR, which selects a higher level of injury severity. High velocity motor vehicle trauma is more likely to result in multiple injuries and higher ISS.

Consistent with prior studies, we observed a high maternal survival rate that was comparable with prior studies from the US (98.8% - 99.9%) [3,4]. One retrospective cohort study in the UK showed that the maternal survival rate was 94.9%[6]. There are some possible explanations for observed higher survival rate relative to other trauma. Most victims were presumably young and relatively fit. Compared with older adults with major trauma, younger patients have lower mortality rates[11]. In addition, considering the rarity of presentation and need for multidisciplinary approach with multiple specialities, most of pregnant patients with major trauma may have been transported to major trauma services with the capability of care of the pregnancy in the countries.

Our study had a high foetal survival rate, compared with a foetal mortality rate of 44% in UK. Foetal outcomes were not collected in the NTDB and thus not comparable[3,4,6]. However, a retrospective cohort study of injured pregnant patients admitted in the US showed

17.5% lost the foetus and 30% had the pregnancy terminated[16]. A possible explanation of higher foetal survival rate in our study might be that more pregnant patients were in the third trimester, previous studies revealed gestational age below foetal viability was associated with foetal mortality[16,17]. Importantly, our study had few injuries with penetrating trauma[18]. In addition, most 3rd trimester patients with major trauma had a primary transport to a major trauma service with the capability of definitive care of the pregnancy. A previous study reported that severely injured pregnant women were at increased risk of additional morbidity including caesarean delivery, and their infants were at increased risk of preterm delivery, low birth weight, foetal distress, hypoxia, neonatal respiratory distress syndrome, and foetal death[2]. Pregnant women with major trauma would likely require immediate delivery to a facility with maternal and neonatal care capability to improve the chances of survival of the infant. Although prior studies suggested that adverse foetal outcomes are related to the severity of the injury[16,19,20], our study did have patients with a high ISS ranging from 14 to 50.

This study revealed that thoracic injury was the most common injury, followed by abdominal injury. The result was similar to a prior study, which showed severe chest injury (AIS>3) was the most common injury even though the mechanism was unknown[6]. There were 25.4% of patients with uterine injuries in our study, which included only one case of uterine rupture. Uterine rupture is rare even in a major trauma cohort[21].

This study demonstrated that road transport collision was the most common mechanism for pregnant patients with major trauma. Although we did not assess seat belt use, not wearing a seatbelt is associated with more severe injuries, higher frequency of surgical interventions, and adverse foetal outcome[22]. It is important that seat belts are properly applied to reduce injuries in pregnant women whilst driving[23]. In addition, we had a very low number of intentional injuries. Other studies have shown that intentional injuries were high risk for

mother and child and are an important group to focus on[5]. Prenatal and postpartum screening for violence and improved access to social work and mental health services are essential. Finally, our study revealed that nearly all patients in the third trimester had definitive care at the major trauma service dedicated to care for these patients, demonstrating high compliance of with our clinical pathways for these patients.

Limitation

Our study has several limitations. First, this was a small sample of injured patients (despite a large population over 12 years), therefore we did not undertake comparisons between subgroups. Additionally, we did not evaluate the relationship between contributing factors in our trauma system and outcomes. In the Australian context, this would need to be a national approach to collect a larger sample to understand the factors contributing to the positive outcomes in this study. Second, we did not include prehospital deaths. However, in our region, the absolute number of maternal trauma is low despite covering a population of more than 6 million people[10,24,25]. Third, we did not evaluate long term outcomes of the foetus. However, previous research reported that if a woman remained undelivered following a motor vehicle collision her pregnancy outcomes were unaffected[26]. Fourth, we did not have access to cause of maternal death and how the treating doctors diagnosed uterine rupture or placental abruption. Finally, although poor foetal outcomes are described even with non-severe trauma, this study focused solely on maternal morbidity[19]. Analysing major trauma only may lead to an underappreciation of the total injury burden as pregnant women with minor trauma can still suffer foetal loss.

Conclusion

This study showed very low numbers of presentations of pregnant patients with major trauma using a population-based registry. Both maternal survival rates and foetal survival rates were high. The majority of 3rd trimester pregnant women were triaged to the appropriate Trauma centre.

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Table 1. Characteristics of the study population (2007-18 major trauma) according to pregnancy

Variables	**All pregnant patients with major trauma**	
	n=63	**%**
Age		
20 and under	8	12.7
21-25	14	22.2
26-30	16	25.4
31-35	16	25.4
36 +	9	14.3
Trimester		
Trimester 1	16	25.4
Trimester 2	10	15.9
Trimester 3	22	34.9
Unknown	15	23.8
Cause of injury†		
Road transport collision	52	82.5
Low and high falls	6	9.5
Others	5	7.9
Intent		
Unintentional	55	87.3
Intentional (self-harm or assault)	8	12.7
ISS, median (IQR)	17 (14-24)	

ISS, injury severity scale; IQR, interquartile range;

† Percentages may not equal 100 due to rounding.

Table 2. Serious injury types (Abbreviated Injury Scale > 2) for pregnant patients

Variables	**All pregnant patients with major trauma**	
	n=63	**%**
Head injury	8	12.7
Spine injury	†	
Thoracic injury	25	39.7
Rib fractures	20	31.7
Hemopneumothorax	8	12.7
Lung contusion	5	7.9
Abdominal injury	23	36.5
Liver, Spleen, Kidney, Bowel injury	8	12.7
Uterine injury	16	25.4
Pelvic fracture	9	14.3
Lower extremity injury	9	14.3
Others	†	

† Reflects cell counts <5.

Table 3. Outcomes in hospitalized pregnant patients with major trauma

Variables	**All pregnant with major trauma**	
	n=63	**%**
LOS, median (IQR)	5.4 (1.0-12.2)	
ICU admission		
No	35	55.6
Yes	28	44.4
Pregnant outcome‡		
Caesarean section	11	18.6
Abruption	10	16.9
Preterm delivery	8	13.6
Foetal death	7	11.9
Others	†	
GOS-E at 6 months after injury without death in hospital§		
Dead/ Vegetative state	0	0.0
Lower/ Upper severe disability	8	18.2
Lower/ Upper moderate disability	19	43.2
Lower/ Upper good recovery	17	38.6

LOS, length of stay; IQR, interquartile range; ICU, intensive care unit; GOS-E, extended Glasgow Outcome Scale

†Reflects cell counts <5.

Missing data:

‡ n=4 (6.3%), § n=18 (28.6%)