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Motor vehicle accidents during pregnancy: a population-based study

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Abstract
This population-based cohort study of >600,000 Australian women describes the incidence of motor vehicle accidents (MVA) during pregnancy and the immediate and subsequent pregnancy outcomes. In this study, 3.5 women per 1000 maternities were admitted to hospital following an MVA. Immediate delivery was uncommon, including 0.4% <20 weeks and 3.5% ≥20 weeks. Outcomes for those giving birth immediately were poor with increased risk of antepartum haemorrhage, preterm birth, caesarean section and perinatal death. In contrast, women who remained undelivered following an MVA (96%) had similar pregnancy outcomes to women not involved in MVAs and can be reassured.

Keywords: pregnancy, pregnancy complications, motor vehicle accidents, population-based

Introduction

Worldwide, deaths and non-fatal injuries from traffic accidents continue to contribute to the global burden of disease, although a greater burden is experienced in low-middle income countries [1]. In 2002 WHO estimated that in Europe over 13,500 women of reproductive age died due to road traffic injuries and over 560,000 disability-adjusted life years were lost due to traffic injury morbidity [1, 2].

Motor vehicle accidents (MVA) are the most common cause of physical trauma during pregnancy, and an important incidental cause of maternal and perinatal mortality particularly in the developed world [3-5]. Due to concerns for the well-being of the fetus, presentations to hospital after a MVA are likely to be higher in pregnancy than outside of pregnancy. Immediate obstetric complications such as preterm birth and placental abruption are associated with MVA during pregnancy and can result in adverse perinatal outcomes [4, 6, 7]. Injury severity, associated abdominal and pelvic trauma and gestational age at MVA have been shown in part, to predict pregnancy outcomes after MVA [8]. However, evidence about the pregnancy outcomes more remote from the admission for an MVA during pregnancy is lacking. This is important information for women and care providers to guide subsequent management of pregnancy. Longitudinally linked population health data, including hospitalization records, allows follow-up of events such as MVAs which occur outside of the maternity services domain, and determination of pregnancy outcomes not only that occur at the time of MVA but also for those pregnancies that continue.

This population-based study aims to describe the incidence of MVA requiring admission to hospital during pregnancy and the immediate and subsequent pregnancy outcomes following MVA in pregnancy.

Methods

The study population included women who gave birth in New South Wales (NSW), Australia from 1 July 2000 to 30 June 2007 inclusive. NSW is the most populous state in Australia and accounts for one-third of all Australian births (>90,000 per annum). The data were obtained from two validated and linked NSW Department of Health population health databases. 'Hospital data' on all hospital admissions was obtained from the NSW Admitted Patients Data Collection. These records were searched for women with hospital admissions for a MVA (identified by the International Classification of Diseases Version 10 (ICD10) codes V01-V04, V06, V09-V79, V87, V89, V99, Y32 or Z04.1) [1], and additionally for any codes related to pregnancy and childbirth (O codes in ICD10). 'Birth data' were obtained from the NSW Midwives Data Collection, a statutory population-based surveillance system that includes information on all births of ≥20 weeks gestation or weighing at least 400g. Longitudinal linkage of hospital and birth data was used to identify miscarriages (<20 weeks) and births (≥20 weeks gestation) during or subsequent to the MVA hospitalisation, including hospital-to-hospital transfers. The NSW Department of Health provided anonymised, linked birth and hospital data. The use and linkage of the data were approved by the NSW Population and Health Services Research Ethics Committee.

The hospital data were used to identify MVA type (e.g. as an occupant of a car, a cyclist or pedestrian), the injuries sustained, hospital type (obstetric, non-obstetric, urban or rural), maternal age , socio-economic status, length of admission, intensive care unit admission, blood transfusion and pregnancy events (miscarriage, placental abruption, antepartum and postpartum haemorrhage). Maternal factors (age, parity, smoking) and birth outcomes (gestational age at birth, mode of delivery, perinatal death) were obtained from the birth data. Missing data were infrequent ranging from 0.02% for gestational age to 0.3% for smoking during pregnancy.

Analysis: We used frequency distributions and contingency table analyses to describe MVAs and the outcomes experienced by pregnant women. The relationship between MVA and maternal factors and pregnancy outcomes is reported as crude odds ratios (ORs) with 95% confidence intervals (95% CI).

Results

From 2000 to 2007, 604,380 women gave birth in NSW and 2147 pregnant women were admitted to hospital following a motor vehicle accident (MVA), giving a ratio of 3.5 per 1000 maternities. Compared with the entire maternity population, the pregnant women involved in MVAs were younger (mean age 27.7 years versus 30.2 years), more likely to be nulliparous (49.5% versus 41.7%) and in the most disadvantaged socioeconomic group (24.1% versus 22.1%).

Of the 2147 women involved in MVAs, the majority were occupants of a car or other vehicle (88.6%), 3.4% were pedestrians, 0.9% motor-cycle riders, 0.8% bicycle riders, and the type of MVA was not reported for 6.3% of women. Gestational age at the

time of MVA ranged from <6 to 42 weeks, with 20.7% prior to 20 weeks and 10.0% at term. Most women (2053, 95.6%) presented to a hospital with obstetric services, 504 (23.5%) presented to a rural hospital and 128 (6.0%) had more than one admission related to the MVA. Overall, most injuries were minor and 77.9% of the women were hospitalized for only one day. The overall rate of injuries to the back, abdomen or pelvis was 7.6% with 0.6% of women sustaining a pelvic fracture, and 4.9% were transferred to another hospital.

Pregnancy outcome data was available for 2044 (95.2%) of the women and unknown for 103 women following an MVA. Compared to the women with known pregnancy outcomes, the women with unknown outcomes were more likely to be younger (49.5% versus 31.9% <25 years old), have gestational age <20 weeks (31% versus 12%) if it was recorded at the time of the MVA, present to a non-obstetric hospital (11.7% versus 4.0%), be involved in an MVA as a pedestrian (9.7% versus 3.1%), and require transfer to another hospital (6.8% versus 4.8%).

Of the 2044 women whose pregnancy outcomes were known, 9 (0.4%) had a miscarriage (<20 weeks) recorded in the same admission as the MVA, 72 (3.5%) delivered ≥20 weeks during the MVA admission and 1963 (96.0%) remained undelivered at the time of discharge. Thirteen of the women (0.7%) who were discharged from hospital following MVA subsequently had a miscarriage and 1950 delivered ≥20 weeks.

Of the 72 women who delivered (at ≥20 weeks gestation) during the MVA admission 14 (19%) sustained bruising injuries to their abdomen, pelvis or lower back, 5 (7%)

sustained a pelvic fracture; 6 (8%) intra-abdominal injuries; 7 (10%) were admitted to intensive care; 8 (11%) received a blood transfusion; and three died. Of these women 32 (44%) initially presented to a rural hospital and the median duration of admission was 6 days (range 1-167 days). Compared with women with no record of an MVA, the women who delivered at the time of MVA had significantly higher rates of preterm birth and other adverse outcomes including antepartum haemorrhage, placental abruption and perinatal death (including 15 stillbirths), and almost two-thirds were delivered by caesarean section (Table 1).

If the MVA did not precipitate delivery, there was no increased rate of preterm birth or perinatal death (Table 1). There were increased crude risks for antepartum haemorrhage (cOR 1.52, 95% CI 1.22-1.88) and placental abruption (cOR 1.66, 95% CI 1.00-2.77). However these increased risks did not persist if the placental abruptions and APH recorded only at the time of the MVA (ie did not lead to immediate delivery) were excluded. Only 2 placental abruptions and 16 APH occurred after the MVA admission.

Discussion

In this study, 3.5 women per 1000 maternities were admitted to hospital following an MVA. The majority had no adverse outcomes during the MVA admission, were admitted for one day, and were discharged home undelivered. However, for those requiring delivery (>20 weeks) during the MVA admission, the rate of pregnancy complications was significantly higher than women who did not have an MVA during pregnancy. Over a quarter had a placental abruption, and over half delivered <37 weeks. Placental abruption and preterm labour are recognised complications of MVA

during pregnancy [4, 6, 7, 9] and therefore are likely to explain the high rate of deliveries prior to term in this study. The demonstrated association between need for delivery following MVA and severe maternal injuries such as pelvic fracture is supported by other studies [6, 8, 10].

The fetal/neonatal outcomes in those pregnancies which are delivered during the MVA admission, either spontaneously or in the context of a pregnancy complication such as a placental abruption, were poor. About a third ended in a perinatal death. While some of these perinatal deaths would have been as a result of spontaneous preterm birth, the high rate of caesarean section (62.7%) in the group who delivered during the MVA admission suggests a significant number underwent emergency delivery for maternal or fetal indications (e.g. placental abruption or abnormal fetal heart rate pattern on cardiotocograph). The low overall perinatal death rate of 1.1%, during the admission immediately following a MVA in pregnancy >20 weeks, is reassuring.

What is also reassuring is that for those women who did not require delivery during the MVA admission the rate of pregnancy and delivery complications as well as perinatal death were the same as for women who had not had an MVA during pregnancy. Over three-quarters of women were admitted for only one day following MVA. While the optimal length of time necessary to monitor women in hospital with minor or no obvious injuries following an MVA cannot be determined in this study it would suggest that one day is sufficient in most cases, without any adverse impact on complication rates.

The strength of the study is the use of large, validated population datasets that provide information on the experience of an entire birth population. Record linkage ensures that women, rather than hospital admissions, are counted. Linkage also allows identification of women who may not have an early pregnancy recorded (or recognised) at MVA but who subsequently link to a birth record. We believe the results are generalisable to high income countries with a wide range of safety measures including seat-belt use, vehicle crash protection, traffic-calming interventions and traffic law enforcement [1].

The limitations of this study lie in the difficulties of capturing the population of women who experience MVA during their pregnancies. Using hospitalizations following MVA may result in an over representation of serious accidents because women with minor accidents may never present to hospital; or under estimate the mortality rate as it does not capture those women who die at the scene and never make it to hospital. In addition, pregnancies that end in miscarriage during an admission following an MVA may be more likely to have the pregnancy recorded. On the other hand, women who miscarry subsequent to a MVA and are not admitted to hospital at the time of miscarriage would not be included. While these limitations make it difficult to draw firm conclusions about the rate of miscarriage following MVA <20 weeks, qualitatively it supports the idea that these women should be warned of the risks of miscarriage and offered an examination for fetal viability following an MVA in pregnancy.

Conclusions

Our study demonstrates that complications leading to delivery following MVA in pregnancy are associated with poor perinatal outcomes, but that if a woman remains undelivered following an MVA her pregnancy outcomes are unaffected. Therefore if we are to improve the perinatal outcomes following MVA, we need to target the detection and prompt management of pregnancy complications during the initial admission. Further research is needed to determine whether this is possible given the acute nature of placental abruption and preterm labour, and what diagnostic modalities might aid in the decision making around delivery following MVA. The fact that almost one in four women in this study presented to a rural hospital following an MVA, highlights the need to consider health systems and transfer issues as well as clinical interventions if we are to improve maternal and perinatal outcomes following MVA in pregnancy.

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Disclosure of interests:

The Authors have no conflicts of interest to declare.

Contribution to Authorship:

All authors were involved in developing the concept and designing the study. JVT and CLR were responsible for overall drafting of the manuscript. JSC conducted the analysis and drafted the methods and results. All authors contributed to the interpretation of data and had final approval of the manuscript to be published.

Details of Ethics Approval:

Only de-identified data were available to the researchers and the study was approved on this basis by the NSW Population and Health Services Research Ethics Committee, on 14 July 2006 (Ref No 2006-06-011).

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Table 1: Maternal characteristics and pregnancy outcomes for pregnant women involved in a MVA and giving birth ≥20 weeks gestation

Maternal characteristics and pregnancy outcome	**Involved in MVA and delivered**		**All maternities**
	At that time	***Subsequently (≥20 weeks)***	
	N=72	***N=1950***	***N=604,380***
	N (%)	***N (%)***	***%***
Maternal age			
<25	24 (33.3)	595 (30.6)	18.7
25-29	22 (30.1)	561 (28.8)	28.2
30-35	17 (23.6)	520 (26.7)	33.2
>/=35	9 (12.5)†	269 (13.8)*	19.9
Nullipara	44 (61.1)*	970 (49.9)*	41.8
Socio-economic status			
Most Disadvantaged	25 (35.2)	463 (23.8)	22.1
Disadvantaged	18 (25.4)	398 (20.4)	19.1
Average	13 (18.3)	422 (21.7)	20.0
Advantaged	12(16.9)	410 (21.1)	19.4
Most Advantaged	3 (4.2)†	255 (13.1)*	19.4
Smoker	16 (22.2)	344 (17.7)†	15.1
Gestational age *at MVA*			
<20 weeks	0 (0.0)	401 (20.6)	
20-25weeks	8 (11.1)	361 (18.5)	
26-33 weeks	21 (29.2)	719 (36.9)	Not applicable
34-36 weeks	13 (18.1)	281 (14.4)	
≥ 37 weeks	30 (41.7)	186 (9.6)	
Pregnancy Complications			
Placental abruption	18 (25.0)*	15 (0.8)‡	0.5
Other APH	7 (9.7)*	88 (4.5)*	3.0
Preterm birth			
20-33weeks	26 (36.1)	31 (1.6)	2.0
34-36 weeks	11 (15.3)*	95 (4.9)	4.4
Delivery complications			
Caesarean section	44 (61.1)*	482 (24.7)	26.4
PPH	5 (6.9)	152 (7.8)	6.7
Infant outcomes			
Perinatal Death	22 (30.6)*	12 (0.6)	0.9
Neonatal Transfer	10 (13.9)*	76 (3.9)‡	4.9

APH antepartum haemorrhage, PPH postpartum haemorrhage

Compared to women with no record of MVA using chi-square test *P<0.001, †<0.01, ‡<0.05

Numbers may not add to totals nor percents to 100 because of missing data (≤0.5%)

If not specified, referent group is those without the condition