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Review

A review of stroke and pregnancy: incidence, management and prevention

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ABSTRACT

Stroke, defined as a focal or global disturbance of cerebral function lasting over 24 h resulting from disruption of its blood supply, is a devastating event for a pregnant woman. This can result in long-term disability or death, and impact on her family and unborn child.

In addition to pre-existing patient risk factors, the hypercoagulable state and pre-eclampsia need to be taken into account. The patterns and types of stroke affect pregnant women differ from the non-pregnant female population of child-bearing age. Like other thrombo-embolic diseases in pregnancy, stroke is essentially a disease of the puerperium.

Population studies have estimated the risk of stroke at between 21.2 and 46.2 per 100,000. The US Nationwide Inpatient Sample, identified 2850 pregnancies complicated by stroke in the United States in 2000–2001, for a rate of 34.2 per 100,000 deliveries. There were 117 deaths, a mortality rate of 1.4 per 100,000. Both the mortality and disability rates were higher than previously reported, with 10–13% of women dying.

With the increasing prevalence of obesity, hypertension and cardiac disease amongst women of child-bearing age, so is the incidence of stroke during pregnancy and the puerperium. In the United States, an alarming trend toward higher numbers of stroke hospitalizations during the last decade was demonstrated in studies from 1995 to 1996 and 2006 to 2007. The rate of all types of stroke increased by 47% among antenatal hospitalizations, and by 83% among post-partum hospitalizations. Hypertensive disorders, obesity and heart disease complicated 32% of antenatal admissions and 53% of post-partum admissions.

In addition to pre-existing patient risk factors, the hypercoagulable state and pre-eclampsia need to be taken into account. The patterns and types of stroke affect pregnant women differ from the non-pregnant female population of child-bearing age. Like other thrombo-embolic diseases in pregnancy, stroke is essentially a disease of the puerperium.

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Stroke is defined as a focal or global disturbance of cerebral function lasting over 24 hours resulting from disruption of its blood supply. It is a devastating event for a pregnant woman, which can result in long-term disability or death, and impact on her family and unborn child.

In addition to pre-existing patient risk factors, the hypercoagulable state and pre-eclampsia need to be taken into account. The patterns and types of stroke affect pregnant women differ from the non-pregnant female population of child-bearing age. Like other thrombo-embolic diseases in pregnancy, stroke is essentially a disease of the puerperium [1–7].

Population studies have estimated the risk of stroke at between 21.2 and 46.2 per 100,000 [1–5]. The Nationwide Inpatient Sample, identified 2850 pregnancies complicated by stroke in the United States in 2000–2001, for a rate of 34.2 per 100,000 deliveries. There were 117 deaths, a mortality rate of 1.4 per 100,000 [1]. Both the mortality and disability rates were higher than previously reported, with 10–13% of women dying [1].

With the increasing prevalence of obesity, hypertension and cardiac disease amongst women of child-bearing age, so is the incidence of stroke during pregnancy and the puerperium. In the United States, an alarming trend towards higher numbers of stroke hospitalisations during the last decade was demonstrated in studies from 1995 to 1996 and 2006 to 2007. The rate of all types of stroke increased by 47% among antenatal hospitalizations, and by 83% among post-partum hospitalisations [8]. Hypertensive disorders, obesity and heart disease complicated 32% of antenatal admissions and 53% of post-partum admissions.

A clinician working in a unit of 3300 deliveries per year is likely to encounter such a case every 9 months to 2 years. This review seeks a balanced overview of the present knowledge and highlights the importance of prompt diagnosis and treatment. For ease of discussion, ischemic and hemorrhagic strokes will be reviewed separately.

Ischemic stroke

Pregnancy is a hypercoagulable state, resulting from increased production of coagulation factors (Von Willebrand factor, Factor VIII, fibrinogen), protein C resistance, reduced concentration of protein S, increased plasminogen activator inhibitors 1 and 2 and down-regulation of fibrinolysis.

Physiological changes are most marked during the puerperium, accounting for the dramatic increase in cardiovascular events, by a factor of 7–12 [6,7,9].

The *Saving Mother's Lives* enquiry 2006–2008 reported 18 maternal deaths from thrombosis and/or thromboembolism, a rate of 0.79 per 100,000 pregnancies (95% CI 0.49–1.25). Two of the 18 deaths were attributed to cerebral vein thrombosis and the remainder to pulmonary embolus [10]. Almost all occurred during the puerperium [10].

A nationwide Swedish cohort study found that cerebral infarction (ICD-10, cerebral infarction, unspecified) is 33.8 times (95% CI 10.5–84.0) more likely to develop in the three days surrounding delivery (defined as 1 days preceding delivery to 2 days following delivery), and 8.3 (95% CI 4.4–14.8) times more likely in the subsequent 6 weeks after delivery [6]. Antenatally the risk was negligible (OR 2.2, 95% CI 0.8–4.8) (Fig. 1).

Western population studies have concluded that ischemic cerebral events in the pregnant population are more frequent than hemorrhagic ones [1,5]. In her study of a Toronto hospital, Jaigobin identified 34 cases of stroke in pregnancy, of which 21 were infarctions, comprising of 13 arterial and 8 venous infarctions [5]. Ischemic strokes were associated with pre-existing factors such as cardiac emboli, coagulopathies and carotid dissection [5].

Cerebral sinus thrombosis (CVT) is predominantly an event of the puerperium. Indeed, seven out of eight venous thromboses identified by Jaigobin occurred after post-partum.

Venous thrombosis is more likely to occur in the pregnant population compared to the non-pregnant female population of similar reproductive age [11], an association attributed to the prothrombotic state of the pregnancy and the puerperium. Contributing risk factors include hypertension, advanced maternal age, caesarean delivery, dehydration, infection and excess vomiting [11,12].

CVT remains rare, with an incidence 11.6 per 100,000 deliveries [11,13]. Its clinical presentation depends on the site involved. Occlusion of the cerebral cortical veins results in focal neurological signs and symptoms. Occlusion of the major venous sinuses can result in intra-cranial hypertension and impaired cerebrospinal

	Third trimester	2 days before to 1 day after delivery	Day 2 to 6 weeks
Sub-Arachnoid haemorrhage	OR 0.8 95%CI 0.2-2.5	OR 46.9 95%CI 19.3-98.4	OR 1.8 95%CI 0.5-4.9
Intra-cerebral haemorrhage	OR 1.3 95%CI 0.3-4.1	OR 95 95%CI 42.1 194.8	OR 11.7 95%CI 6.1-21.6
Cerebral Infarction	OR 2.2 95%CI 0.8-4.8	OR 33.8 95%CI 10.5-84.0	OR 8.3 4.4-14.8

Fig. 1. Standardized incidence rate ratios with 95% confidence intervals of sub-arachnoid hemorrhage, intra-cerebral hemorrhage and cerebral infarction [6].