Post eclamptic aneurysmal rupture subarachnoid haemorrhage diagnosed in the puerperium

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Abstract

The incidence of subarachnoid and/or intracerebral haemorrhage in women during pregnancy is rare. The risk depends on the stage of pregnancy, but seems to be highest during the late third trimester, during delivery and in the puerperium. Headache can be a symptom of both preeclampsia, subarachnoid haemorrhage and other pathologies or conditions. It is essential for pregnant women with a suspected ruptured aneurysm to be investigated and treated without delay, irrespective of fear of harm to the foetus, to avoid complications from aneurysm rupture.

This case study presents a 39-year-old woman who was 35 weeks and 3 days pregnant with known preeclampsia. She endured a headache for the three days leading up to the delivery with associated diplopia on the third day, but these symptoms were thought to be related to her preeclampsia. Over the three hours following childbirth, her headache became more severe and she suffered from vomiting, loss of vision, torticollis and seizures. Computed tomography (CT) of her head revealed a subarachnoid haemorrhage while CT angiography of the Circle of Willis failed to reveal an aneurysm and 4-vessel angiography only demonstrated an area slightly suspicious for the presence of an aneurysm. 3D rotational angiography clearly demonstrated a 1–2 mm aneurysm superior to the left terminal internal carotid artery. In this case, 3D rotational angiography proved to be a valuable additional technique. This patient underwent surgery for her ruptured aneurysm and has made an excellent recovery.

Keywords: 3D rotational angiography, aneurysm, computed tomography, computed tomo
graphy angiography, digital subtraction angiography, preeclampsia, pregnancy, subarachnoid haemorrhage.

Introduction

Among maternal deaths of non-obstetric causes, intracranial haemorrhage is the third most common cause of mortality and is responsible for 10% to 14% of these deaths. Subarachnoid and/or intracerebral haemorrhage during pregnancy is rare but does result in significant maternal and foetal mortality and significant neurological complications in those patients who survive. The most frequent cause of intracranial haemorrhage during pregnancy is the rupture of an aneurysm or arteriovenous malformation. Aneurysmal subarachnoid haemorrhage in pregnancy results in maternal mortality of 13% to 35% and foetal mortality of 7% to 25%. Another common cause of intracranial haemorrhage in the pregnant patient is eclampsia.

Preeclampsia is a disorder of placental implantation and hence is not completely preventable. It is the development of hypertension and proteinuria after the 20th week of gestation. When cerebral symptoms are present in association with hypertension, but in the absence of proteinuria, preeclampsia should also be considered. Complications of preeclampsia include liver rupture, pulmonary oedema, renal failure, aspiration pneumonia (if the patient vomits), cardiopulmonary arrest, intracerebral haemorrhage and postpartum haemorrhage. Patients with preeclampsia may develop eclampsia, the occurrence of seizures not attributable to other causes. Seizures or coma occur before delivery in 50% of patients, in 25% during labour and during the first 24 hours following delivery in 25%. Of patients with intracerebral haemorrhages associated with pregnancy, 14–44% also suffer from eclampsia or preeclampsia.

Of all cases of subarachnoid haemorrhage (SAH), 9% will occur in women of childbearing age and 24% of these have an affiliation with pregnancy, hence approximately 2% of all SAHs occur during pregnancy. Subarachnoid haemorrhage due to an aneurysm during pregnancy usually occurs in multiparous women, between the ages of 25 and 35 years, who have had normal pregnancies previously.

The risk of intracranial haemorrhage during pregnancy may be five-fold due to the effects of the physiological, hormonal and haemodynamic changes of pregnancy including alterations on the arterial and venous intima. The risk (in cases per day) is variable dependant on the stage of pregnancy, but seems to be highest during the late third trimester (0.75), during labour and delivery (2.25) and in the puerperium (0.4). The risk is lower in the second trimester (0.25) and first trimester (0.1). Hypertension, a risk factor for aneurysmal SAH, is present in 10% to 20% of pregnant patients with aneurysmal SAH.

Case study

A 39-year-old woman who was 35 weeks and 3 days pregnant, with known preeclampsia, was admitted to the Lyell McEwin Hospital with a small antepartum haemorrhage (APH) and mild hypertension. Her blood pressure (BP) on admission was...
The patient was admitted to the intensive care unit with the diagnosis of SAH secondary to eclampsia. A few hours later, she was transferred to the intensive care unit of the Royal Adelaide Hospital and underwent a CT angiogram (CTA) of the Circle of Willis (COW), which failed to identify any definite aneurysms (Figures 2 and 3).

Manufacturers recommend that breast feeding should be discontinued for 24 hours following the administration of intravenous contrast media in lactating women. This was not explained to the patient since she was not breast feeding her newborn baby while in hospital. Intravenous medical treatment for hypertensive symptoms of preeclampsia, initiated post delivery, was continued and sedation was prescribed for agitation.

The following day, a 4-vessel angiogram was performed which did not demonstrate an aneurysm (Figures 4 and 5). Rotational angiography (RA) was then performed in addition to the digital subtraction angiography (DSA). The 3D Spin angiogram demonstrated a small 1–2 mm broad-based aneurysm on the superior aspect of the left terminal internal carotid artery (ICA) and no other aneurysms (Figure 6). The combination of the angiogram and RA resulted in a total screening time of 7 minutes and 48 seconds. The patient began to experience diplopia and remained agitated. The intravenous preeclampsia treatment was ceased and sedation was continued.

On day three, two days after delivery, she underwent six hours of surgery. A left pterional craniotomy and clipping of the left terminal internal carotid artery aneurysm was performed.

Finally on day 29 post eclamptic aneurysm rupture, demonstrated in the form of a SAH on Day 1, she was transferred to the brain injury rehabilitation unit for two to three weeks rehabilitation. The rehabilitation registrar deemed her to be suffering from poor short-term memory, poor balance and lack of endurance and decided she required help to accept postnatal responsibilities.

Follow-up neurological and CT head scan examinations six months after the SAH were normal.

**CT scanning and angiography protocols**

The scanning parameters for helical CT of the head at Lyell McEwin Hospital (4-slice Aquilion; Toshiba, Tokyo, Japan) included 135 kVp, 190 mA, slice thickness of 2 x 0.4 mm (reconstruction thickness of 5 mm and reconstruction interval of 5 mm), table speed of 6.0 mm/rotation and the scanning time for one rotation was 0.75 seconds. The scan range was from the base of skull to the vertex. All resultant images were transferred to the Picture Archiving Communication System (PACS) and printed on film (Agfa; Agfa-Gevaert, Mortsel, Belgium) by using a dry laser.
The major symptom of a SAH is a headache which usually occurs suddenly that many patients describe as the ‘worst headache of their life’. It is usually located in the sub-occipital or frontal area. When the headache begins less dramatically, it can be

**Figure 4** Digital subtraction angiography of the left internal carotid artery. Left anterior oblique 25° and 15° downtilt view.

**Figure 5** Digital subtraction angiography of the left internal carotid artery. Anteroposterior 15° downtilt view.

**Figure 6** 3D image, obtained from rotational digital subtraction angiography, of the left internal carotid artery demonstrating the aneurysm (arrowhead). Left anterior oblique 10° and 15° downtilt view.
confused with preeclampsia (as it was in the case of this patient), migraine, cerebral venous thrombosis or meningitis. Neck stiffness occurs in 90% of cases of SAH but may not develop until several hours following the acute haemorrhage. In 15% of cases SAH presents as seizures and focal neurologic deficits are observed in one third of cases. Symptoms can also include nausea and vomiting and photophobia.

Several days or weeks prior to aneurysmal rupture, 20–50% of SAH patients experience a headache which can be localised or generalised and may resolve by itself or with the help of a non-narcotic analgesic. This is known as a ‘warning headache’. The patient in this case study had suffered from a headache three days before being diagnosed with a SAH and this could have been a warning headache.

The Hunt and Hess Scale was originally developed in 1968 to predict mortality after SAH surgery but today it is used by 71% of neurosurgeons as a clinical grading tool for assessing SAH. Grade 0 represents unruptured aneurysms. Grade I means the patient is asymptomatic or has a minor headache and nuchal rigidity. Grade II implies the patient has a moderate to severe headache, nuchal rigidity and no neurological deficit other than cranial nerve palsy. Grade III describes the patient who is drowsy, confused and has mild focal deficit. Grade IV (the grading of the patient in this case study) signifies the patient has stupor, moderate to severe hemiparesis, possible early decerebrate rigidity (stiffness due to the elimination of cerebral function) and vegetative disturbances. Grade V indicates the patient is in a deep coma and has decerebrate rigidity and a moribund appearance.

A CT scan of the head without contrast will demonstrate SAH in 95% of cases within 48 hours of the ictus. The findings of a SAH due to ruptured aneurysms or AVMs are hyperdensities (75–80 Hounsfield units) in the cerebrospinal fluid- (CSF) containing cisterns around the brainstem, in the interhemispheric or Sylvian fissures, or above the sella turcica beside the Circle of Willis. Hydrocephalus is also seen in 15% of patients with subarachnoid haemorrhage on their initial CT head scan.

Computed tomography angiography is a promising technique for the detection and therapy planning of cerebral aneurysms. It sensitive for the detection of aneurysms 3 mm or larger. Computed tomography angiography is only minimally invasive due to the necessary intravascular administration of contrast media and the shorter than one minute imaging time on a 16-row detector scanner. Once the data is acquired, it can be viewed from unlimited projections in both 2D and 3D modes.

Disadvantages of CTA include the inability to visualise small arteries, difficulty in distinguishing the infundibular dilatation at the origin of an artery from an aneurysm and the inability to identify thrombosis and calcification on 3D images. The time taken between a contrast bolus to flow through the intracranial circulation in arterial phase and in venous phase is about 5–6 seconds therefore, even with 16-row detector scanners, it is not possible to produce a pure arterial phase CT angiogram. As a result, venous structures cannot be avoided and may be mistaken for an aneurysm. In about 10% of cases, a clear margin is not visualised between an aneurysm and adjacent structures. This creates an impression that a connection may exist between these vascular structures and this is known as the ‘kissing artefact’.

Multiplanar reformations (MPRs) of the Circle of Willis are focussed on the areas where aneurysms are most commonly found. The courses of the major arteries are followed and there is flexibility in choice of the imaging plane.

The use of maximum intensity projections (MIPs) is restricted by the fact that the skull base has a much higher attenuation than the intracranial arteries and therefore needs to be subtracted when MIP is used. It is often impossible to define the relationship of the aneurysm to the adjacent arteries and small aneurysms can be missed since they are eclipsed by the signal of their parent vessels averaged into the same 2D plane.

Volume rendered (VR) images are not as helpful as MPR and MIP when trying to visualise small aneurysms but they do provide a good overview of aneurysm morphology, especially in circumstances whereby the anatomy is complex. Difficulties of VR include the incorporation of vessels into the reconstruction if they cross or make contact with an area of particular interest and the aneurysm neck appearing broader than it actually is; both problems potentially significantly impacting on patient treatment. Small vessels could also not be visualised. Using MIP and VR in combination best demonstrate the neck of the aneurysm and location of the precise origin of the vessels. Surface rendering, also known as surface shaded display (SSD), is supplementary to MIP and MPR images as although the images are ascetically pleasing, it is challenging to select a threshold that will differentiate bone from contrast in vessels causing these structures to merge together.

Comparatively, DSA does, however, have greater sensitivity than CTA and the superior spatial resolution allows more accurate treatment planning for patients who have cerebral aneurysms. The sensitivity of DSA has been further improved by the development of 3D RA. A disadvantage of DSA is the radiation dose which is twice the dose from CTA. The patient radiation dose for 3D RA is lower than for biplanar DSA by almost a factor of 4 in peak skin dose and cumulative incident dose is reduced by forty percent.

The 3D RA approach has only recently become a clinically practical tool. According to Hochmuth et al., who conducted a study where 53 patients with acute SAH (Hunt and Hess grade I–V) underwent both DSA and RA, RA in combination with DSA enabled the detection of more aneurysms than with DSA alone. The visualisation of the aneurysms was superior with RA. Advantages include the 3D visualisation of complex anatomic vascular patterns, improved demonstration of the spatial relationship of the aneurysm to the vessel bearing the aneurysm and the surrounding vascular structures. In comparison with DSA, 3D RA provides more accurate measurement of the size of the aneurysm and the diameter of the neck, as the difference between real and measured size of the object does not exceed 0.4 mm. Using 3D RA is justifiable since this study revealed that when no aneurysm was visualised on DSA, seven aneurysms not visualised on DSA (mean size 1.9 mm) and located in the anterior circulation, were demonstrated on 3D RA. These advantages can impact on the patient’s therapy. Had 3D RA not have been performed, the patients would have required exploratory surgery.

It is evolving that 3D RA has improved the sensitivity of angiography and so might become an important add-on technique to ensure that DSA remains the gold standard in regards to the diagnosis of intracranial aneurysms.

Although the patient in this case study was investigated and treated for SAH due to ruptured aneurysm post delivery, the same approach would have been taken if symptoms were exhibited during pregnancy.

It is imperative to reduce the risk of complications if an aneurysm rupture is found, therefore radiological procedures and treatment should not be delayed due to concern regarding possible harm to the foetus.
Conclusion

In combination, certain physiological changes in pregnancy may be a precursor to aneurysm formation and rupture. Generally, neurosurgical considerations take priority over obstetric considerations and ruptured aneurysms detected in pregnant patients should be treated as they would be in patients who are not pregnant.39

This patient, having preeclampsia, was at risk of intracerebral haemorrhage and did suffer a Grade IV post- eclamptic aneurysmal rupture SAH. Her headache, which began three days prior to induction of labour and subsequent childbirth, could have been a warning headache and, retrospectively, should have been investigated upon the onset of the headache. Following the delivery, she suffered a severe headache which caused vomiting, loss of vision and torticollis. She endured a seizure three hours after childbirth and was then sent for a CT head scan that revealed a SAH. The 1–2 mm aneurysm was not visualised on the CTA of the COW. This case is an example of where the CTA was not sensitive for an aneurysm less than 3 mm in size. Initially, the aneurysm was also not seen distinctively on DSA either and it was 3D RA that proved to have the highest sensitivity and clearly demonstrated the aneurysm. Hence 3D RA was a valuable add-on technique. Surgical clipping was performed successfully. The patient has made an excellent recovery. Six months later she has no neurologic deficit and is performing her parenting role to her five children, including the six month old baby, without difficulty.

References
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