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Case Report

Transradial approach for coil embolization of a ruptured intracranial aneurysm during pregnancy to minimize fetal radiation exposure [☆]

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ABSTRACT

Endovascular treatment of aneurysmal subarachnoid hemorrhage during pregnancy involves a risk of intraoperative radiation exposure to the fetus. The transradial approach does not require fluoroscopy of the maternal abdominopelvic region, which reduces fetal radiation exposure. We report a case of a female at 21 gestation weeks who developed subarachnoid hemorrhage due to a ruptured right posterior communicating artery aneurysm. The patient underwent balloon-assisted coil embolization via the transradial approach, which achieved aneurysmal obliteration with minimal fetal radiation exposure and without puncture site complications. The patient was free from neurological sequelae. Further, the patient delivered a healthy newborn through an elective cesarean section at 37 gestation weeks without any complications. The transradial approach allows endovascular treatment of ruptured intracranial aneurysms during pregnancy, with minimal risks of fetal radiation exposure.

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Introduction

Subarachnoid hemorrhage (SAH) due to ruptured intracranial aneurysms during pregnancy is a rare condition with an incidence of 3–10 per 100,000 pregnancies [1,2]. Aneurysmal SAH

(aSAH) during pregnancy has a high maternal mortality rate, which reaches 11%–14% and 42%–63% after surgical and conservative treatments, respectively [3,4]. The fetal mortality is 5% after surgical treatment and 27% after conservative treatment [4]. There are few treatment recommendations for aSAH during pregnancy given its rarity [1,3]. Previous reports have

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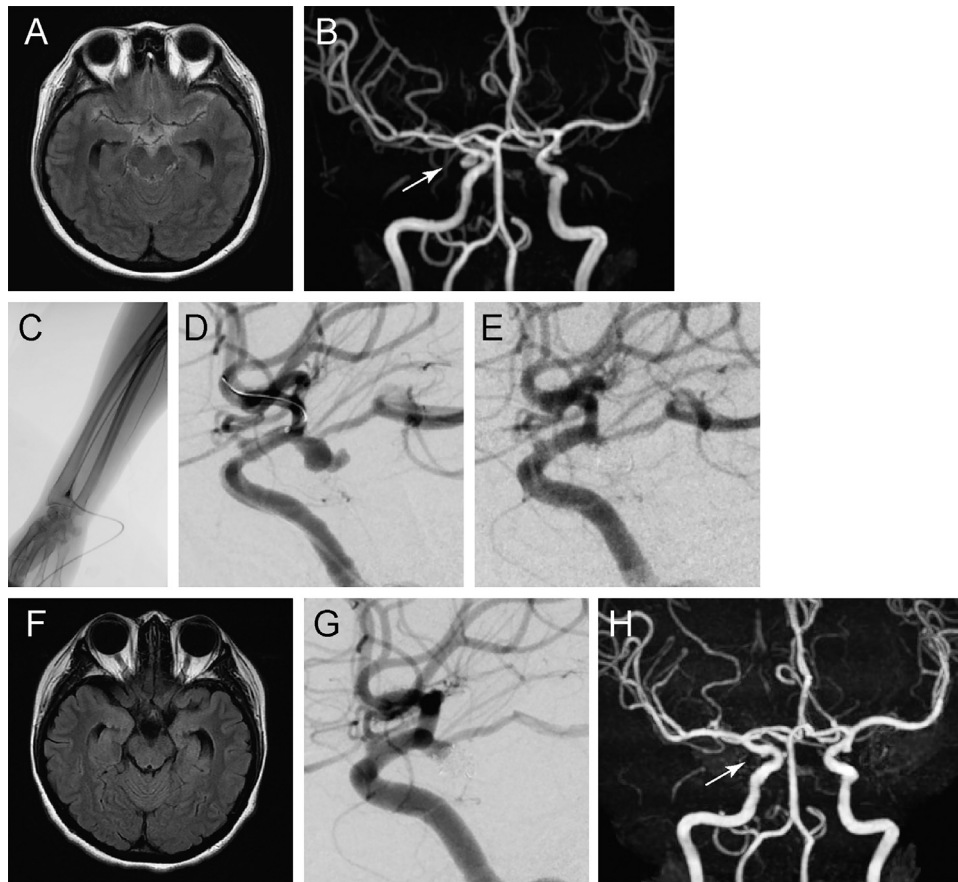


Fig. 1 – (A) Axial fluid-attenuated inversion recovery (FLAIR) magnetic resonance (MR) imaging at initial presentation showing subarachnoid hemorrhage (SAH) in the basal cisterns and bilateral Sylvian fissures. **(B)** MR angiography at initial presentation revealing the right posterior communicating artery (PcomA) aneurysm (arrow). **(C)** Intraoperative fluoroscopy showing the sheath inserted from the right radial artery. **(D and E)** Intraoperative right internal carotid artery (ICA) angiography before **(D)** and after **(E)** coil embolization of the right PcomA aneurysm. **(F)** Axial FLAIR MR image at 1 postoperative month presenting the disappearance of SAH and no hydrocephalus. **(G)** Right ICA angiography at 6 postoperative months showed a small residual neck of the PcomA aneurysm. **(H)** MR angiography at 1 postoperative year revealed no progression of the aneurysmal recurrence (arrow).

described the use of endovascular treatment or microsurgical clipping based on aneurysm characteristics and obstetric factors [1,3]. However, endovascular treatment during pregnancy involves intraoperative fetal radiation exposure, which can cause fetal complications, including malformations and childhood cancer [5–7]. The risk of fetal complications depends on the fetal developmental stage and radiation exposure dose [8], with the latter being influenced by the access route of the endovascular procedure [9].

Currently, the transradial approach (TRA) is being widely used for endovascular treatment of intracranial aneurysms [10]. The TRA does not require fluoroscopy of the maternal abdominopelvic region, which can reduce fetal radiation exposure, compared with that with the conventional transfemoral approach (TFA) [9]. Here, we report a case of aSAH during pregnancy treated by coil embolization via the TRA.

Case report

A 35-year-old female at 21 gestational weeks (gravida 3, para 1) presented with a sudden severe headache. The patient had no neurological deficits. The patient had a history of a cesarean section for placental abruption 5 years prior. Other medical and family histories were unremarkable.

Brain magnetic resonance (MR) imaging revealed SAH in the basal cisterns and bilateral Sylvian fissures (Fig. 1A). MR angiography revealed a 7-mm-sized right posterior communicating artery (PcomA) aneurysm (Fig. 1B). The patient was diagnosed with SAH of World Federation Neurological Surgeons grade II due to a rupture of the right PcomA aneurysm.

On the day of onset, the patient underwent coil embolization of the right PcomA aneurysm under general anesthe-

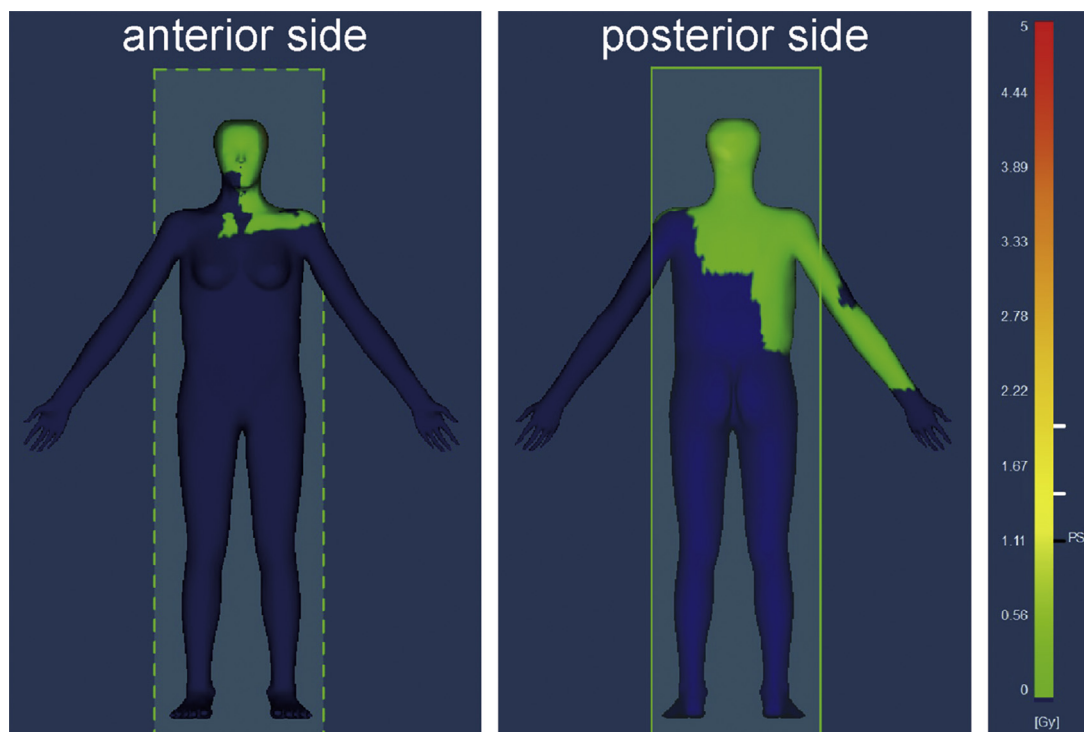


Fig. 2 – Distribution map of the intraoperative absorbed dose (at the shield surface in the case of the abdominopelvic region) obtained using Radimetrics (Bayer Yakuhin, Ltd, Osaka, Japan). The abdominopelvic region received a lower dose than the access route of the procedure.

sia. The TRA was used (Fig. 1C) with a lead apron shielding the abdominopelvic region. During the insertion of a guiding sheath into the right radial artery under fluoroscopy, the right arm was abducted away from the fetus. A 6-Fr Fubuki guiding sheath (Asahi Intecc, Aichi, Japan) was placed at the right internal carotid artery, and 200 mg of aspirin and intravenous 4000 units of heparin were administered. Using a TransForm Occlusion Balloon Catheter (Stryker Neurovascular, Fremont, CA) and an Excelsior SL-10 Microcatheter (Stryker Neurovascular), balloon-assisted coil embolization achieved aneurysmal obliteration with only a small residual neck (Figs. 1D and E). The total radiation time was 41.9 minutes, the dose area product was 165.208 Gy cm [2], absorbed dose at the apron surface was 0.1–0.2 mGy (Fig. 2), and the equivalent dose measured inside the apron was 56 μ Sv (right pelvis) and 7 μ Sv (left pelvis).

The patient did not develop cerebral infarction or hydrocephalus (Fig. 1F). The patient was discharged without neurological sequelae at 31 postoperative days (at 26 gestation weeks). The pregnancy course was uneventful. The patient delivered a healthy newborn through an elective cesarean section at 37 gestation weeks; moreover, the baby had no developmental abnormalities by the age of 1 year.

Follow-up cerebral angiography at 6 postoperative months revealed a small recurrence at the residual neck (Fig. 1G); however, MR angiography at 1 postoperative year revealed no recurrence progression (Fig. 1H).

Discussion

Treatment of aSAH during pregnancy is challenging because both surgical management of the aneurysm and obstetrical management of the fetus are required. An emergent cesarean section before surgical treatment of the aneurysm should be considered when the fetus is mature enough to survive outside the uterus. However, in case the fetus is immature, the surgical procedure must be performed with continued pregnancy [2,3].

Endovascular treatment during pregnancy involves a risk of fetal abnormalities resulting from radiation exposure. Radiation effects on the fetus depend on the dose and fetal developmental stage and can be categorized into 4 groups including pregnancy loss, malformation, developmental delay or retardation, and carcinogenesis [5,6]. Pregnancy loss most often occurs when radiation exposure happens during early gestation (less than 2 weeks). Radiation exposure during the organogenesis period (2–8 weeks) causes malformation and growth delay, and radiation exposure during the period of brain development (8–15 weeks) causes mental impairment [5,6]. These are deterministic effects, which means that the effect will not occur when the radiation dose is below a threshold level. A fetal absorbed dose above 100 mGy is considered to cause the deterministic effects. The risks are uncertain when the fetal dose is between 50 and 100 mGy and deemed negligible when below 50 mGy [5,6]. The total fetal equivalent dose during pregnancy

is recommended to be less than 5.0 mSv [5]. In contrast, carcinogenesis is a stochastic effect. Childhood cancers can develop at any level of radiation exposure, and the probability of developing cancers increases with the increase in the radiation dose [5].

Most previous reports on coil embolization for aSAH during pregnancy do not describe intraoperative dosimetric results. The received dose can be reduced through abdominal shielding and is considered to be well below the threshold for deterministic effects [8]. Nonetheless, the radiation dose should be minimized to reduce the risk of carcinogenesis.

The TRA does not require abdominopelvic fluoroscopy, which can reduce fetal radiation exposure compared with that with the TFA. A previous report described the utility of the TRA in reducing fetal radiation exposure with coil embolization of renal angiomyolipoma during pregnancy [9]. In the present case, measurement of the actual dose received under the shield confirmed minimization of fetal radiation exposure. This case report highlights the benefits of the TRA for endovascular treatment of aSAH during pregnancy.

In addition, the TRA does not require supine positioning for puncture site hemostasis after the procedure. The supine position after 20 gestation weeks can cause compression of the inferior vena cava and aorta by the uterus [11]. This compression can result in maternal hypotension and reduced placental blood flow, which is called supine hypotensive syndrome [11]. The TRA allows flexible positioning during and after the endovascular procedure [9] and has a lower risk of puncture site complications than that of the TFA [10]. These advantages are valuable in cases of aSAH during pregnancy.

In conclusion, the TRA should be considered in endovascular treatment of aSAH during pregnancy, which reduces the risk of fetal radiation exposure. Since we have presented only 1 case of aSAH during pregnancy, further investigation is necessary to confirm the utility of the TRA for aSAH during pregnancy.

Patient consent

Written informed consent for publishing patient information and images was directly obtained from the patient.

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