Original Article

Preceding Coil Embolization for Internal Iliac Artery Aneurysm before Open Repair

Akimasa Morisaki, Mitsuharu Hosono, Masanori Sakaguchi, Toshihiko Shibata

Abstract

Introduction: In the era of endovascular repair, open repair for abdominal aortic aneurysm (AAA) is still needed in the patients who had anatomical difficulties with the endovascular repair. Open repair for internal iliac artery aneurysm (IIAA) is a challenge because of the deep operating field, which is associated with high morbidity. Therefore, we performed preceding coil embolization for IIAA before open repair to control the bleeding from gluteal arteries.

Materials and Methods: The present study is a retrospective case series study. Ten patients underwent preceding coil embolization for IIAA before open repair between January 2010 and August 2015. Three patients had two-stage coil embolization for bilateral IIAA. Six patients also had infrarenal AAAs. After preceding coil embolization, open repair consisting of vascular graft replacement with aneurysmectomy and closure of IIAA was undertaken.

Results: The mean age was 72.5 ± 10.7 years. There were nine men and one woman. Operative time and intraoperative bleeding were 270 ± 50 min and 817 ± 671 mL, respectively. There was no postoperative mortality. Three patients developed morbidity, which consisted of paralytic ileus, pneumonia, and shower embolization caused by shaggy aorta. No recurrent IIAA, buttock claudication, and intestinal ischemia after the open repair were observed.

Conclusion: Preceding coil embolization for IIAA before open repair may be an effective procedure to control the bleeding from gluteal arteries and prevent recurrent IIAA.

Key Words: Coil embolization, internal iliac artery aneurysm, open repair

Introduction

Open repair for internal iliac artery aneurysm (IIAA) has higher postoperative mortality and morbidity than abdominal aortic aneurysm (AAA) although the incidence of IIAA is rare. Therefore, endovascular repair (EVAR) may be favorable as a treatment for IIAA because of the higher operative morbidity of open repair. However, open repair for IIAA is still necessary for patients who have anatomical difficulty with EVAR, such as severely angulated aorta, short landing zone, and shaggy aorta. Therefore, similar to EVAR for IIAA, we performed preceding coil embolization of draining arteries of IIAA before open repair to control bleeding from the draining arteries.

Materials and Methods

The present study is a retrospective case series study. From January 2010 to August 2015, we performed open repair with preceding coil embolization in ten patients with IIAA, with or without AAA or common iliac artery aneurysm (CIAA) at our institution. Surgical indications were IIAA >3 cm or AAA >5 cm. All patients were assessed by computed tomography (CT) angiography.

The operative strategy is shown in Figure 1. When patients had only unilateral IIAA with or without AAA or CIAA, we first performed preceding coil embolization for unilateral IIAA. Then, over 2 days after preceding coil embolization, we performed open repair consisting of vascular graft replacement with aneurysmectomy and closure of IIAA. When patients had bilateral IIAA, we assessed the location of IIAA by CT. If the one side of the IIAA was located in a shallow pelvic floor that had the possibility of IIAA reconstruction, we performed coil embolization only for the contralateral IIAA located in the deep pelvic floor. If it was difficult to reconstruct the bilateral internal iliac arteries because an aneurysm was located in the deep pelvic floor, we performed two-stage repair.

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coil embolization to prevent intestinal ischemia. At 2 weeks after the first coil embolization for one side of the IIAA, we performed a second coil embolization for the contralateral aneurysm. After the second coil embolization, we undertook open repair consisting of vascular graft replacement and closure of bilateral IIAAs with or without AAA.

Preceding coil embolization was performed under local anesthesia in the fluoroscopy room. The common femoral artery approach was frequently used with the Seldinger technique. Draining arteries of the IIAA were occluded as proximally as possible with coils (Tornado or MR-eye embolization coil; Cook Medical, Bloomington, IN, USA) or vascular plugs (Amplatzer™ Vascular Plug II, St. Jude Medical, St. Paul, MN, USA).

Open repair was performed under general anesthesia. All patients underwent vascular graft replacement via laparotomy. The surgeon decided which type of vascular prosthesis to use: Hemashield Platinum, InterGard (Maquet Holding B.V. and Co. KG, Rastatt, Germany), or J Graft SHIELD NEO (Japan Lifeline Co. Ltd., Tokyo, Japan). For the IIAA that underwent preceding coil embolization, we closed the IIAA after confirming that there was no flow from the draining arteries. The IIA was reconstructed with branches of vascular graft leg if the IIA was large and had no severe atherosclerosis. If the vascular graft replacement included the inferior mesenteric artery (IMA), we reconstructed the latter whenever possible [Figures 2c, 3c and 4c].

After open repair, the patients underwent CT angiography to confirm complete occlusion of the IIAA and patency of the bypass graft before postoperative day 7. After discharge, the patients underwent a physical examination at 1, 3, and 6 months, and then on an annual basis after open repair. CT was performed to identify recurrence of IIAA at 6 months and 1 and 2 years after open repair in all patients. If the patients had no renal dysfunction or allergy of contrast agent, CT angiography was performed. If the patients had renal dysfunction or allergy of contrast agent, plain CT was performed.

We reviewed all clinical data retrospectively. Preoperative renal insufficiency was defined as creatinine level >2.0 mg/dL. Preoperative pulmonary disease comprised chronic obstructive pulmonary disease, including emphysema and bronchial asthma treated with steroids. Postoperative renal failure was defined as creatinine level >2.0 mg/dL or >1.5-fold higher than the preoperative level and requiring hemodialysis. Values were expressed as a mean ± standard deviation.

This retrospective study was approved by the Institutional Review Board of Osaka City Medical School Hospital, Osaka, Japan, and it complied with current ethical guidelines according to the standards of the Declaration of Helsinki. Individual consent for later retrospective studies was obtained at the same time as consent for cardiovascular surgery.

**Results**

There were nine men and one woman with a mean age of 72.5 ± 10.7 years. Three patients underwent two-staged coil embolization for bilateral IIAA. Table 1 shows the patients’ characteristics. Six patients had infrarenal AAA. Operative time and intraoperative bleeding were 270 ± 50 min and 817 ± 671 mL, respectively. Three patients developed morbidity, consisting of paralytic ileus, pneumonia, and blue toe caused by shower embolization resulting from shaggy aorta without ischemic colitis, and paraplegia. The patient who developed shower embolization after open repair was considered for EVAR owing to peritoneal dialysis, but EVAR was contraindicated by shaggy aorta.

Case 2 was a 63-year-old obese man who had bilateral CIAA and left IIAA (solid arrow) with AAA [Figure 2a and b]. Previously, he underwent laparotomy for gallbladder stones with cholecystitis and coronary artery bypass grafting for ischemic heart disease. He underwent preceding coil embolization for left IIAA. Thirteen days after that we performed open repair consisting of vascular graft replacement with reconstruction of the IMA and right IIA.
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had bilateral IIAA. The left IIAA was located in a shallow region of the pelvic floor, which indicated the possibility of reconstruction of the left IIA or occlusion in open repair. Three days later, we performed open repair consisting of vascular graft replacement with preservation of the IMA and closure of the left IIAA [Figure 2c]. He was discharged uneventfully on postoperative day 16. At 2 years after open repair, CT angiography showed a complete occlusion of the left IIAA (broken arrow) and good patency of the vascular graft [Figure 2d].

Case 3 was a 72-year-old man who had right CIAA and bilateral IIA (solid arrow) [Figure 3a and b]. He underwent preceding coil embolization the right IIA because of its small size and severe atherosclerosis. After the operation, although

### Table 1: Patient characteristics

| Case | Age (years) | Diagnosis | BMI | Appreciable comorbidity | Previous laparotomy | Coil embolization | Distal anastomosis | Reconstruction of IMA | Operation time (min) | Blood loss (mL) | Morbidity |
|------|-------------|-----------|-----|--------------------------|---------------------|-------------------|-------------------|---------------------|---------------------|----------------|-----------|
| 1    | 61          | Male      | AAA, right CIAA, right IIAA | 27.2 | —                      | Right IIA          | Right EIA/ left CIA | —                   | 238                | 600           |           |
| 2    | 63          | Male      | AAA, Bi. CIAA, left IIAA    | 30.0 Post-CABG | +                      | Left IIA           | Right EIA + IIA/ left EIA | +                   | 379                | 2270        |           |
| 3    | 72          | Male      | Right CIAA, Bi. IIAA        | 26.5 | —                      | Right IIA          | Bi. EIA            | —                   | 247                | 600           | ileus     |
| 4    | 82          | Male      | Bi. CIAA, Bi. IIAA          | 23.5 Old cerebral infarction, COPD | —                      | Bi. IIA           | Bi. EIA            | —                   | 243                | 250         | Pneumonia |
| 5    | 78          | Female    | AAA, Bi. CIAA, right IIAA   | 22.4 Shaggy aorta, peritoneal dialysis | —                      | Right IIA         | Right EIA/ left EIA + IIA | +                   | 329                | 1570        | Shower embolization, tracheotomy |
| 6    | 84          | Male      | AAA, right CIAA, Bi. IIAA   | 25.5 Right urethral carcinoma, old cerebral infarction | +                      | Left IIA          | Right EIA + IIA/ left EIA | —                   | 336                | 1250        |           |
| 7    | 784         | Male      | AAA, Bi. CIAA, left IIAA    | 21.5 Old cerebral infarction | +                      | Left IIA          | Right EIA + IIA/ left EIA | —                   | 249                | 430         |           |
| 8    | 70          | Male      | Left CIAA, Bi. IIAA         | 15.9 | —                      | Right IIA          | Bi. EIA            | —                   | 255                | 650           |           |
| 9    | 78          | Male      | Right CIAA, Bi. IIAA        | 18.9 | +                      | Bi. IIA           | Bi. EIA            | +                   | 188                | 350          | —         |
| 10   | 53          | Male      | AAA, right CIAA, Bi. IIAA   | 33.3 Dilated cardiomyopathy, OSAS | —                      | Bi. IIA           | Bi. EIA            | +                   | 236                | 200         | —         |

AAA: Abdominal aortic aneurysm, Bi: Bilateral, BMI: Body mass index, CABG: Coronary artery bypass grafting, CIAA: Common iliac artery aneurysm, COPD: Chronic obstructive pulmonary disease, EIA: External iliac artery, IIA: Internal iliac artery, IIAA: Internal iliac artery aneurysm, IMA: Inferior mesenteric artery, OSAS: Obstructive sleep apnea syndrome, Reconstruction of IMA +: The patient underwent reconstruction of IMA; —: The patient did not undergo reconstruction of IMA, Previous laparotomy +: The patient had previous laparotomy; —: The patient had no previous laparotomy
the patient developed paralytic ileus, he recovered well with conservative management. He was discharged on postoperative day 16. At 1 year after open repair, CT angiography showed a good occlusion of bilateral IIAA (broken arrow) and patency of the vascular graft without ileus [Figure 3d].

Case 10 was a 53-year-old obese man who had right CIAA and bilateral IIAA (solid arrow) with AAA [Figure 4a and b]. We planned two-staged coil embolization for the bilateral IIAA because it was located deep in the pelvic floor. First, he underwent coil embolization for left IIAA. At 2 weeks after embolization, he underwent secondary coil embolization for the right IIAA. After that we performed open repair consisting of vascular graft replacement with reconstruction of the IMA and closure of the bilateral IIAA [Figure 4c]. The patient was discharged uneventfully without claudication and intestinal ischemia on postoperative day 9. At 3 months after open repair, CT angiography revealed no recurrence of IIAA (broken arrow) and good patency of the vascular graft and IMA [Figure 4d].

All patients were followed up as outpatients. In all patients, at a maximum 5 years after the operation, CT angiography showed no recurrence of IIAA or intestinal ischemia. There was no buttock claudication in any of the patients.

Discussion

IIAA is frequently associated with AAA or CIAA. However, isolated or solitary IIAA is unusual and was found in only 0.03% of the general population in a large autopsy study. IIAA is commonly treated by EVAR consisting of coil embolization or iliac branch devices because of lower postoperative morbidity compared with open repair. However, open repair for AAA is still needed in patients with anatomically difficult arteries, such as severe angulated aorta, short landing zone, small access root, or shaggy aorta, which precludes EVAR.

In open repair of IIAA with or without AAA, it is important to preserve or reconstruct the gluteal artery to prevent pelvic ischemia. However, it is difficult to reconstruct the IIA or gluteal artery located deep in the pelvic floor in patients with massive atherosclerosis and small internal iliac arteries or gluteal arteries. Moreover, for patients with IIAA located deep in the pelvic floor, ligating the draining artery of the IIAA and controlling bleeding from the pelvic floor are problems. Preceding embolization is commonly performed in patients who undergo EVAR for IIAA with or without AAA. In contrast, there is only one report that described the hybrid operations consisting of open repair and coil embolization for IIAA. Chandra and Kansal first reported a hybrid repair for isolated IIAA as a case report. Then, we also performed a hybrid repair, similar to EVAR with coil embolization for IIAA, consisting of open repair and preceding coil embolization for IIAA with or without AAA in relatively larger patients compared to the previous report. The surgery provided satisfactory results without pelvic ischemia and recurrence of IIAA.

Occlusion of the IIA can lead to pelvic ischemia, consisting of intestinal ischemia, spinal cord injury, and buttock claudication. In particular, intestinal ischemia is a lethal complication as demonstrated by recent studies showing an incidence of 1.2–4.5% in aortoiliac surgery. Buttock claudication is troublesome for some patients although its symptoms may gradually improve over time. In patients undergoing EVAR for AAA and coil embolization for IIAA, especially bilateral IIAA, there is the potential to develop intestinal ischemia and buttock claudication. Recent studies have suggested that EVAR with iliac branch devices can maintain iliac flow and prevent the complications caused by IIA occlusion. In contrast, in a recent study, preoperative angiography showed the risk factors associated with pelvic ischemia. <70% stenosis of the origin of the contralateral IIA, absence of >3 named IIA branches, and disease or absence of ascending branches from the femoral artery. From these risk factors, preserving good collateral...
circulation may be important to prevent pelvic ischemia. In coil embolization, recent reports suggest that placing the coil proximal to the first branch of the IIA is preferable to avoid pelvic ischemia by preserving collateral circulation.[18,19] Moreover, circumflex branches of the ipsilateral external iliac and femoral arteries contribute to the ipsilateral pelvic collateral circulation.[20] Therefore, compared with EVAR, open repair can preserve collateral flow and may be able to prevent pelvic ischemia, even if the IIA is occluded. In the present study, there was no intestinal ischemia or buttock claudication. This may be because we performed open repair, preserving as much as possible of the IIA and internal mesenteric artery flow, and coil embolization of the IIAA as proximal to the outflow as possible.

The recurrence of IIAA after open repair is a long-term problem. Recent studies have shown the recurrence of IIAA after open repair with simple ligation.[21,22] Simple ligation alone may not be enough to treat IIAA, owing to persistent collateral circulation and endotension. In this regard, hybrid open repair and coil embolization may be useful for IIAA to prevent the recurrence of IIAA by excluding collateral circulation and endotension. In addition, ligation of the draining artery of the IIAA and control of bleeding from the deep pelvic floor is a troublesome procedure associated with increased complications and transfusion volume. We showed that preceding coil embolization for IIAA may reduce these problems although the number of patient was small.

Conclusion
Preceding coil embolization for IIAA with or without AAA before open repair may be an effective procedure to control bleeding from the IIA in open repair and prevent recurrent IIAA.

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Conflicts of interest
There are no conflicts of interest.

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