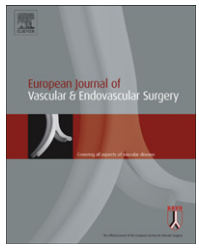
Eur J Vasc Endovasc Surg (2010) **40**, 209–215



Packing Technique for Endovascular Coil Embolisation of Peripheral Arterial Pseudo-aneurysms with Preservation of the Parent Artery: Safety, Efficacy and Outcomes

R. Loffroy [a,*], P. Rao [a], S. Ota [a], M. De Lin [a], B.-K. Kwak [a], D. Krause [b], J.-F. Geschwind [a]

[a] *The Russell H. Morgan Department of Radiology and Radiological Science, Division of Cardiovascular and Interventional Radiology, The Johns Hopkins Hospital, 600 North Wolfe Street, Blalock 545, Baltimore, MD 21287, USA*
[b] *Department of Vascular and Interventional Radiology, University of Dijon School of Medicine, Bocage Teaching Hospital, 2 bd du Maréchal de Lattre de Tassigny, BP 77908, 21079 Dijon, France*

Submitted 27 January 2010; accepted 4 March 2010
Available online 17 April 2010

KEYWORDS
Artery;
Pseudo-aneurysm;
Hemorrhage;
Trans-catheter Embolisation;
MR angiography

Abstract *Objectives:* To evaluate the endovascular treatment of pseudo-aneurysms (PAs) with super-selective coil embolisation using the 3D packing technique.
Design: Retrospective study of consecutive patients in one academic centre.
Materials: From 2002 to 2009, 16 patients (mean age 51.6 years, range 24–82) underwent PA sac packing with coils. Four patients were asymptomatic, nine had PA rupture, and three had other symptoms. Lesion location was as follows: splenic artery (8), carotid artery (2), hepatic artery (2), superior mesenteric artery (1), cystic artery (1), uterine artery (1), and hypogastric artery (1).
Methods: The sac was packed with 0.018-inch controlled-detachable microcoils, preserving the parent artery. Magnetic resonance angiography was done within 6 months, at 12 months then yearly.
Results: Technical success rate was 100%. Complete definitive PA exclusion was achieved with a single procedure in 15 (93.8%) patients. One patient with a secondary bleeding arterio-digestive fistula underwent successful surgery. No major complications or late recanalisations occurred during follow-up (mean, 24.7 months; range 6–49).
Conclusions: Coil PA embolisation by 3D sac packing is safe and effective and may induce less morbidity than complete parent vessel occlusion, stent placement, or open surgery. This procedure should be used whenever possible, as it preserves parent artery patency.

* Corresponding author. Tel.: +1 410 955 6081; fax: +1 410 955 0233.
E-mail address: romaric.loffroy@yahoo.fr (R. Loffroy).

1078-5884/$36
doi:10.1016/j.ejvs.2010.03.009

Pseudo-aneurysms (PAs) are rare, but are clinically important because they carry a risk of rupture with severe bleeding. PAs arise when inflammation, trauma, cancer or surgery causes injury to an artery with extravasation of blood into the surrounding tissues and development of a fibrous capsule around the lesion.[1] Without treatment, bleeding from PAs is often fatal.[2–4] Traditionally, open surgical repair or laparoscopic resection was performed.[5] Recently, endovascular treatment with covered stent placement or trans-catheter embolisation has emerged as the treatment of first choice for PAs.[6,7] However, the only available data on trans-catheter arterial embolisation for the first-line treatment of PAs come from case-reports and small series.[3,8–11] Moreover, little is known about long-term outcomes. Stent-grafting is often technically impossible because of the location of PAs, and embolisation traditionally compromises the patency of the native vessel.

Here, we evaluated the treatment of peripheral PAs with a technique generally used for endovascular occlusion of intracranial aneurysms, namely, super-selective coil embolisation with sac packing and parent artery preservation. We retrospectively assessed the effectiveness, immediate advantages and short- and long-term outcomes of this procedure in 16 consecutive patients.

Materials and methods

Patient population

The medical records of 47 consecutive patients who were diagnosed with PA from April 2002 to March 2009 at our institution were retrospectively reviewed. We identified 16 (34%) patients who underwent endovascular PA management with selective microcoil embolisation using the packing technique: seven men and nine women with a mean age of 51.6 years (range: 24–82 years). Patients were selected to be treated with this endovascular technique as the first approach based on the following criteria: PA involving a major peripheral or visceral arterial branch, presence of a thin neck and size $\leq$50 mm. The distal location at the level of a small terminal or intra-parenchymal branch was an exclusion criterion. Each patient had a single PA. Causative factors are presented in Table 1. The diagnosis of PA was established in all patients by multi-slice helical computed tomography (CT) angiography. Four patients had asymptomatic lesions that were discovered incidentally. Three patients presented with isolated abdominal pain. The remaining nine patients experienced rupture of their lesions with haemorrhagic shock. Lesion diameter varied widely and showed no obvious relationship to the clinical presentation: 15–30 mm for ruptured lesions, 22–45 mm for un-ruptured symptomatic lesions and 20–30 mm for asymptomatic lesions. Overall, the median diameter was 24 $\pm$ 7.9 mm. The PA locations and main clinical data are reported in Table 1. The 31 (66%) remaining patients who did not meet the inclusion criteria were treated with different techniques including surgery, covered stenting, sandwich coil embolisation of the parent vessel covering both sides of the PA neck, distal coil or glue embolisation of the terminal feeding artery and ultrasound-guided compression. This retrospective study was performed in compliance with the requirements of our institutional review board. Informed consent was not required.

Endovascular procedure

All 16 patients underwent emergency diagnostic angiography and same-stage trans-catheter arterial embolisation under local anaesthesia by two experienced interventional radiologists. Selective angiography of the parent artery was performed routinely using 5-Fr standard catheters (Cordis Johnson&Johnson®, Roden, The Netherlands) inserted through a 6-Fr sheath placed in the common femoral artery. In all cases, embolisation was achieved using a super-selective coaxial technique with a Tracker-18 microcatheter (Target Therapeutics®, Fremont, CA, USA) placed into the pseudo-aneurysmal sac. The endovascular procedure was performed with 0.018-inch controlled-detachable non-fibred microcoils (DCS, Standart or Soft Detach-18 Embolisation Coil System, Cook®, Bjaeverskov, Denmark) of various lengths and diameters. PA coiling usually consisted in the delivery across the neck of a straight complex microcoil to create a good basket followed by smaller helical microcoils to concentrically fill the residual lumen (packing technique) while preserving the parent artery (Figs. 1–4). All sizes from 6 to 30 mm in diameter and 10–50 cm in length were available. A total of 101 microcoils were used. The microcoils passed easily through the microcatheter with no friction in all cases. In each PA, four to 14 microcoils (mean per patient: 6) were placed to obtain good packing. The main technical data are reported in Table 1.

Immediate outcome and patient follow-up

Follow-up information was available for all patients but one. Clinical surveillance was complemented by a review of the medical records from the outpatient department or primary care physician. Procedural success was defined as complete exclusion of the PA on the post-embolisation arteriogram. Clinical success was defined as cessation of bleeding and stabilisation of haemodynamic parameters. All patients underwent follow-up imaging including magnetic resonance (MR) imaging and three-dimensional (3D) MR angiography (MRA) within 6 months of the procedure, at 12 months and yearly thereafter to assess the long-term exclusion of arterial lesions and enhancement of downstream organ parenchyma. Follow-up imaging was available for all patients except one, with a mean follow-up of 24.7 months (range: 6–49 months). Major and minor complications were evaluated according to Society of Interventional Radiology reporting standards.[12]

Results

Endovascular treatment was technically successful at the first attempt in all 16 (100%) patients, with complete angiographic exclusion of the PA and preserved patency of the parent artery on the post-embolisation arteriogram. In all cases, 3D packing was achieved by filling the PA sac in a concentric fashion. Immediate coil detachment occurred consistently. There was no coil rupture, coil migration or involuntary coil detachment. No technical complications