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## Prospective, Randomised Bicentric Study of Endovascular Repair of Abdominal Aortic Aneurysm With or Without Sac Embolisation

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**Short title:** EVAR of AAA With or Without Sac Embolisation

### WHAT THIS PAPER ADDS

This is the first multicentric prospective randomised trial comparing standard endovascular aneurysm repair (EVAR) to standard EVAR associated with aneurysm sac coil embolisation. Only patients at high risk of type II endoleak (EL) were enrolled. Peri-operative and two year outcomes demonstrated that aneurysm sac coil embolisation can prevent type II EL and significantly decrease re-intervention rates during follow up after EVAR. Significant aneurysm diameter and volume decrease were observed at one and two years when aneurysm sac coil embolisation was performed. Further studies are required to determine whether aneurysm sac coil embolisation could decrease the costs associated with EVAR follow up.

**Objective:** The benefit of aneurysm sac coil embolisation (ASCE) during endovascular aortic repair (EVAR) of abdominal aortic aneurysm (AAA) remains unclear. This prospective randomised bicentric study (SCOPE 1: Sac COil embolisation for Prevention of Endoleak) compared the outcomes of standard EVAR in patients with AAA at high risk of type II endoleaks (EL) *versus* EVAR associated with ASCE during the period 2014–2019.

**Methods:** Patients at high risk of type II EL were randomised to standard EVAR (group A) or EVAR with coil ASCE (group B). The primary endpoint was the rate of all types of EL during follow up. Secondary endpoints included freedom from type II EL-related re-

interventions, and aneurysm sac diameter and volume variation at two year follow up.

Adverse events include type II EL and re-interventions. CTA and Duplex ultrasound exams were scheduled at 30 days, six months, one year, and two years after surgery.

**Results:** Ninety-four patients were enrolled, 47 in each group. There were no intra-operative complications. At M1, 16/47 early type II EL occurred (34%) in group A vs. 2/47 (4.3%) in group B ( $p < .001$ ). At M6, 15/36 type II EL (41.7%) occurred in group A vs. 2/39 (4.26%) in group B ( $p < .001$ ). At M12, 15/37 type II EL (40.5%) vs. 5/35 (14.3%) in groups A and B, respectively ( $p = .018$ ), and 8/32 (25%) vs. 3/29 (6.5%) at 24 months ( $p = .19$ ). Kaplan–Meier curves of survival free from EL and re-interventions were significantly in favour of group B ( $p < .001$ ). Aneurysm sac volume decreased significantly in group B compared to group A at M6 ( $p = .081$ ), at M12 ( $p = .004$ ), and M24 ( $p = .001$ ).

**Conclusion:** For selected patients at risk of EL, ASCE seems effective in preventing EL at one, six, and at 12 months. However, the difference was not statistically significant at 24 months. ASCE decreases the re-intervention rate at two years after EVAR. A significantly faster shrinkage of aneurysm volume is observed at one and two years following surgery. (SCOPE 1 trial: NCT01878240)

**Keywords:** Aneurysm, Embolisation, Endoleak, Endovascular, Prevention

## INTRODUCTION

One major difference when comparing open repair of abdominal aortic aneurysms (AAA) and endovascular repair (EVAR) is the aneurysm sac management. The sac can sometimes grow during follow up after EVAR, mostly in the setting of type IA or IB endoleaks (EL), which are rarely observed nowadays. The literature reports a re-intervention rate of approximately 10% following EVAR associated with aneurysm sac enlargement.<sup>1,2</sup> Non-diagnosed type I or III EL are a common cause of failure of type II EL treatment after EVAR and should be excluded first before treating a type II EL.<sup>3</sup> Secondary interventions are needed in case of aneurysm enlargement with a low success rate.<sup>4</sup> The cost of the follow up for patients with EL and/or aneurysm enlargement is high and could lead National Health Institutions to limit the use of endograft for economic reasons.<sup>5</sup> The need for a very close follow up is associated with increased exposure of patients to radiation and contrast agents during follow up.<sup>6</sup> Such limitations of EVAR reduce its early benefit (reduced morbidity, mortality, and hospital stay).<sup>7</sup> EL prevention is of paramount importance to improve the long term outcomes and costs associated with EVAR.

Efficacy of ASCE has already been demonstrated through retrospective non-randomised studies,<sup>8,9</sup> and through one prospective randomised study (association of coil and glue for embolisation).<sup>10</sup> In a previous non-randomised study, the present authors showed a significantly reduced incidence of type II EL-related complications during mid term follow up when performing ASCE during EVAR in patients at high risk of type II EL.<sup>11</sup> In the literature, risk factors for type II EL have been reported.<sup>8-10</sup>

The purpose of this study was to evaluate the early and mid term benefits of this procedure compared to standard EVAR with a prospective randomised bicentric trial (RCT) in patients at risk for type II EL. In addition, the effect of coil embolisation was investigated during EVAR on aneurysm sac volumetric variation during follow up. The SCOPE 1 trial is the first RCT to compare standard EVAR to EVAR performed with concomitant ASCE in patients at high risk of type II EL.

## **METHODS**

### ***Trial design***

The SCOPE 1 trial is a French RCT conducted in two vascular surgery departments. Eligible patients were randomly assigned in a 1:1 ratio to standard EVAR (group A) or to EVAR with concomitant ASCE (group B). Simple randomisation was performed with the use of a web-based system. Randomisation was stratified according to investigational site to ensure proportional assignment. Because of the type of interventions, patients and treating physicians were aware of study-group assignments. This trial is registered with ClinicalTrials.gov (NCT01878240). The full protocol is available online at <https://clinicaltrials.gov/ct2/show/NCT01878240>.

It was calculated that a sample of 50 patients per group, randomly assigned in a 1:1 ratio would be required to provide the study with 80% power to detect a between-group difference of 20 percentage points in the level of type II EL rates (25% in group A and 5% in group B), at a two-sided alpha level of 0.05, considering the literature-reported prevalence of type II EL ranging from 10% to 30%.<sup>1</sup>

### ***Patients***

Briefly, patients were eligible for randomisation only if an elective EVAR was considered, and only if considered at high risk of type II EL. The primary endpoint was all EL rate at one month, six months, one year, and two years. Secondary endpoints included freedom from type II EL-related re-interventions, and aneurysm diameter and aneurysm sac volume variation during follow up.

### ***Procedure***

Use of general or local anaesthesia depended on physicians' choice; ASCE was performed using removable coils (Interlock embolisation coil, 18-10-20 cm; Boston Scientific). As already published by Piazza *et al.*,<sup>12</sup> the number of coils was correlated to the aneurysm volume calculated on the pre-operative CT scan. A minimum of 2 m of coils was inserted for a standard aneurysm lumen volume of 125 cm<sup>3</sup>, and 20 cm coils were added for every additional 25 cm<sup>3</sup> of volume. The patient's pre-operative demographics were filed. The Society for Vascular Surgery comorbidity grading system was used to assess the operative comorbidity risk.<sup>13</sup>

### ***Definition***

During follow up, adverse events included type II EL and re-interventions. The definition of "high risk for type II EL" is based on anatomical evaluation of the pre-operative CTA: patients with (1) patent IMA, with a luminal diameter at its origin > 3 mm; or (2) at least three pairs of patent lumbar arteries, or two pairs of lumbar arteries and a medial sacral artery or an accessory renal artery (<https://clinicaltrials.gov/ct2/show/NCT01878240>). Patients who did not match these criteria were considered at low risk for type II EL and excluded from this study.<sup>14</sup>

The follow up included examination and contrast-enhanced CTA and Duplex ultrasound (US) at one, six, and 12 months and two years after surgery, and is summarised in Fig. 1, including a consort diagram with loss to follow up (LTFU) and non-complete follow up (NCFU). CTA was defined as the reference exam to confirm an EL and used to measure aneurysm diameters and volumes on 1-mm-thin CTA slices using an Aquarius Terarecon 3D workstation. Aneurysm sac volume variation between pre-operative and follow up CTA scans was measured for all randomised patients. A single-energy metal artefact reduction algorithm was used for metallic coil artefact reduction to evaluate correctly EL, aneurysm sac and volume. Indications for EL-related re-intervention were an increase of > 5 mm in maximum diameter on two consecutive CTA studies and persistent EL.

Freedom from EL-related re-intervention concerned those patients who did not have an EL during follow up, or had an EL that did not require an additional procedure (no sac enlargement > 5 mm).

The ASCE technique has been previously described in detail.<sup>11</sup> Briefly, before deployment of the controlateral iliac extension, a guidewire is pushed in the aneurysm sac. After deployment of the controlateral iliac extension, a microcatheter is placed in the sac to perform non-selective embolisation using removable coils.

### ***Study oversight***

The SCOPE 1 trial was conducted in accordance with the ICH-E6, French Good Clinical Practice guidelines, and appropriate regulatory requirements. The ethical committee approved the study for France (dossier IDRCB 2012-A0125–35) All patients provided written informed consent. A safety monitoring committee oversaw the safety of the trial. The trial was designed by the first author (D.F.) in collaboration with all investigators. Data were gathered and analysed by the investigators.

### ***Statistical analyses***

Continuous variables were summarised by their mean ( $\pm$  standard deviation) and compared with a *t* test if their distributions were normal in both groups, and their median (with range and quartiles) followed by a non-parametric Mann–Whitney test. Categorical and discrete variables were illustrated by counts and percentages in each group, and compared by a Pearson’s chi-square test. Frequencies of outcomes of interest were also estimated with the Clopper-Pearson confidence interval and analysed with a Fisher test to estimate odds ratios (OR).

Univariate and multivariate analyses on the main outcomes (EL and/or re-interventions) at different follow ups were performed through logistic regressions to attest the group A *vs.* group B OR and evaluate effects of other variables. To study the events occurrence during time since the procedure date, the survival free from events (defined as EL and re-interventions) was illustrated with Kaplan–Meier curves between groups, accompanied by a log-rank test and Cox models. Group B *vs.* group A ratios were adjusted in multivariate analyses with patients’ variables.

The level of significance was set at 5% and results were presented with their 95% confidence intervals (CI).

## **RESULTS**

### ***Study population***

Between June 2014 and February 2017, all patients undergoing EVAR for infrarenal AAA at high risk for a type II EL were prospectively randomised in the SCOPE 1 trial after written informed consent was obtained. The flow chart is detailed in Fig. 1, including a consort diagram.

During the study period, a total of 102 patients at high risk for type II EL were enrolled in both institutions. Eight were excluded before the 30 day evaluation because they refused the randomisation arm or a Nellix device was implanted rather than a standard bifurcated device. A total of 94 bifurcated endografts was evaluated at 30 days, 47 in group A and 47 in group B.

The mean number of coils implanted for embolisation in group B was 15 coils with 20 cm length, but others lengths were also used to obtain 3.4 m of coiling on average for each case.

There were no significant differences in age, sex ratio, risk factors, medical history, and treatments between patients of both groups (Table 1), except for body mass index (BMI) (group A:  $28.28 \pm 4.77$  vs.  $26.08 \pm 3.74$  in group B,  $p = .019$ ), active smoking (87.23% vs. 66.67%, respectively,  $p = .022$ ), and statin treatment (75.00% vs. 48.89%, respectively,  $p = .021$ ).

### ***Procedures***

Procedural characteristics at baseline are described in Table 2. Procedural success rate was 100% in both groups. There were no differences between the two groups in terms of major medical or surgical complications within 30 days, except a longer fluoroscopy duration for group B compared to group A (28 min [23 – 33] vs. 21 min [15 – 28], respectively,  $p = .005$ ). There was also no difference in terms of rate of per-procedure events, nor post-procedure events.

### ***Outcomes***

#### ***Primary outcome (rate of EL)***

At M1, 94 patients completed follow up and a total of 18 type II EL was detected: 16/47 (34% [95% CI 20.9 – 49.3]) in group A vs. 2/47 (4% [95% CI 0.5 – 14.5]) in group B ( $p < .001$ ) (Fig. 2). The estimated OR for group B with group A as baseline group was 0.09 [95% CI 0.1 – 0.4] and the adjusted OR (with smoking, chronic obstructive pulmonary disease, BMI, and statin as co-variables) was 0.07 [95% CI 0.1 – 0.4] ( $p = .005$ ).

At M6, 75 patients completed follow up, and a total of 15 type II EL was detected: 15/36 (41.7% [95% CI 20.9 – 49.3]) in group A vs. 2/39 (4.26% [95% CI 0.52 – 14.54]) in group B ( $p < .001$ ). The estimated OR for group B with group A as baseline group was 0.3 [95% CI 0.09 – 0.98] ( $p = .047$ ).

At M12, 72 patients completed follow up, and the number of type II EL detected was 15/37 (40.54% [95% CI 24.75 – 57.90]) vs. 5/35 (14.29% [95% CI 4.80 – 30.25]), respectively (Fisher test  $p = .018$ ). Adjusted OR was estimated at 0.19 [95% CI 0.05 – 0.71] ( $p = .014$ ). At M24, 61 patients completed follow up, and the number of type II EL detected was 8/32 (25% [95% CI 11.5 – 43.4]) vs. 3/29 (10.4% [2.2 – 27.3]), respectively, with no statistical difference between both groups (Fisher test  $p = .19$ ).

#### ***Secondary outcomes***

During follow up, there were 10 re-interventions in both groups including eight for secondary EL associated with aneurysm sac enlargement, one kissing stenting of the aortic bifurcation at M6 (group A), and one femoro-femoral bypass (group B).

The eight re-interventions for type II EL with sac enlargement included three procedures at M12 in group A vs. 0 in group B, and four at M24 in group A vs. one in group B. The difference was not significant. The three re-interventions performed at M12 in group A were successful in two patients at M24.

In both groups, no late type II EL were observed, nor endotension with aneurysm sac expansion without any visible EL.

Kaplan–Meier curves of survival free from EL and re-interventions showed a significant difference between the groups (log-rank test  $p < .001$ ), with a total of 26/47 events in group A and 11/47 in group B during follow up (Fig. 3). The calculated survival probabilities at M6 were 62.8% (95% CI 50.2 – 78.5) vs. 93.5% (95% CI 86 – 100), at M12 46.9% (95% CI 34.3 – 64) vs. 77.9% (95% CI 66.9 – 91), and at M24 44.3% (95% CI 31.8 – 61.7) vs. 77.9% (95% CI 66.8 – 91), respectively. The crude hazard ratio (HR) was 0.32 (95% CI 0.2 – 0.6, Cox  $p = .002$ ) in favour of group B and the adjusted HR was equal to 0.28 (95% CI 0.13 – 0.64, Cox  $p = .002$ ), adding co-variables smoker, statin, BMI, and age, which had an influence on survival too (HR 1 [95% CI 1 – 1.1], Cox  $p = .028$ ).

#### *Sac diameter and volume follow up and evolution*

Overall sac volume showed no statistical difference at 30 days between the two groups with 66.5 cm<sup>3</sup> (IQR 58.9 – 83) for group A and 65.5 cm<sup>3</sup> (IQR 53.7 – 83.1) for group B ( $p = .35$ ) (Figs 4 and 5). At M6, sac volumes were 61.8 cm<sup>3</sup> (IQR 53 – 77.9) vs. 46.1 cm<sup>3</sup> (IQR 31.3 – 66.8) ( $p = .081$ ), at M12 54.3 cm<sup>3</sup> (IQR 44.5 – 71.5) vs. 35.3 cm<sup>3</sup> (IQR 27.6 – 52.7) ( $p = .004$ ) and M24 54.5 cm<sup>3</sup> (IQR 37.7 – 70.1) vs. 27.6 (IQR 18 – 41.1) ( $p = .001$ ), respectively.

The volumes and diameter reduced significantly between M1 and M12 for both groups (paired  $t$  test  $p = .008$  and  $p < .001$  respectively). Table 3 describes the evolution of the aneurysm diameter (transverse and antero-posterior at 12 and 24 months) in the two groups. There was no statistical difference observed. Patients with a diameter increase  $> 5$  mm at 12 months were scheduled to have a secondary intervention.

The shrinkage between both groups was different at M12 and M24 (Mann–Whitney  $p = .048$ ).

#### ***Complications***

In group B no spinal cord ischaemia, colonic infarction, or coil embolic migration were observed. One limb occlusion was diagnosed at M24.



In both groups, no aneurysm ruptures nor deaths were reported within two years. Also, there were no differences in the types of endograft implanted and in the number of additional endovascular procedures.

## **DISCUSSION**

The effectiveness of ASCE was confirmed in this study. There was a significant reduction in type II EL at one year, and a significant increase in freedom from re-intervention at 24 months, confirming the results from the study published by Piazza *et al.*<sup>12</sup> In addition, a significant reduction in sac volume and diameter was observed. As stated above, aneurysm shrinkage is a key marker of EVAR success during follow up. Mascoli observed the same improved outcomes in a small cohort of 26 patients.<sup>13</sup>

One of the major questions regarding this strategy is the real impact of type II ELs. It remains a question of debate in the literature as the risk of late rupture associated with type II ELs has not been clearly demonstrated, even in the presence of sac expansion. However, a more aggressive decrease in sac diameter following sac coiling may be more relevant according to the recent study by O'Donnell *et al.*<sup>14</sup> They reported that patients with stable and increasing aneurysmal sac diameters 12 months after EVAR had higher long term mortality rates, independent from re-interventions or EL in a large database, with survival based on Social Security Death Index. Referring to this publication, it can be concluded that the difference in volume regression is a good indicator of successful EVAR at one and two years.

EL is the major difference between open repair and EVAR. Aneurysm shrinkage is the best marker of success<sup>15</sup> after EVAR, it is usually depicted in the absence of EL, including type II EL. EL are associated with stable or increased sac diameters, and increased rates of secondary procedures. Of note, in the IFU from the manufacturers, a patent IMA which is associated with a high risk of type II EL, was a contraindication for EVAR with the first generation endografts.<sup>16</sup> In the setting of persistent EL, inflammatory markers are increased, which seems to be associated with increased mortality, sac expansion, and secondary procedures during follow up.<sup>17,18</sup> Continuous long term follow up is responsible for the increased cost associated with EVAR, in addition to the cost of re-interventions to treat EL complications, including sac rupture.<sup>19</sup>

The risk of type II EL is correlated to various factors including patency of the inferior mesenteric artery (IMA), number of patent lumbar arteries, size and length of the aneurysm, absence of thrombus, and volume of the thrombosed aneurysm.<sup>18-20</sup>

Dosluoglu *et al.* recently published a non-randomised trial in which non-selective perigraft sac coil embolisation in patients at high risk for type II EL (20% of patients undergoing

EVAR) was effective in preventing development of type II EL and was associated with sac shrinkage and reduced re-intervention rates.<sup>9</sup> Similarly, in the present study, ASCE was performed only in a similar subgroup of patients, to improve outcomes and to reduce the costs associated with EVAR follow up because of repeated imaging and secondary procedures. Piazza *et al.* also reported promising results using coils and glue when performing non-selective embolisation.<sup>12</sup>

Many other techniques have been described to reduce the rate of type II EL. The Nellix endograft from Endologix was designed to eliminate such EL by filling the sac cavity with a polymer. It was removed from the market because of concerning outcomes but it had reached one of its goals, to significantly reduce the rate of type II EL.<sup>20</sup> Patients with a Nellix were excluded from this study, and the authors have very limited experience with this device.

Selective embolisation of large patent lumbar arteries or of the IMA is an alternative approach, with coils or amplatzer plugs.<sup>22,23</sup> Selective embolisation is more complex, time-consuming, and has not yet shown a significant benefit in reducing EL and re-intervention rates.<sup>21,22</sup> One reported complication of selective embolisation is coils migrating in the lumbar arteries or in the IMA, which can be associated with serious adverse events. These have been reported mostly after embolisation with glue, including colonic ischaemia,<sup>23</sup> and even paraplegia.<sup>24</sup>

On the contrary, non-selective embolisation of the aneurysm sac seems safe and not technically demanding. This was always performed after the complete release of the graft to avoid any coil migration. If it is associated with better outcomes, it could be widely adopted by the surgical community. Because “per definition” it is not selective, there is a concern regarding persistent patency of the aortic side branches connected to the aneurysm sac. However, the present study demonstrated a high rate of side branch occlusion during follow up in a high risk for type II EL population. The procedural time and concomitant exposure to radiation are marginally increased compared to EVAR alone (12 minutes increased operative time in this study). The number of patent collateral arteries seems also to be a risk factor for EL when they are associated with a patent IMA. Piazza *et al.* define patients at risk when the IMA and three pairs of lumbar arteries are patent.<sup>12</sup> The position of the patent collaterals could also influence the outcomes: their origin can be covered by the stent graft main body when they are positioned close to the neck, whereas at the level of the IMA they are usually not in contact with the stent graft.

One of the critical points of this technique is the artefacts generated by the coils. A CT scan single-energy metal artefact reduction algorithm was used to accurately evaluate EL,

aneurysm sac and volume. The present authors recommend using Duplex US or this technique to follow patients treated with ASCE.

In France, the added cost per patient for ASCE during EVAR is approximately 800 € (for 3 m of coils), whereas the cost of secondary re-interventions for a type II EL embolisation is 11,800 € on average. The cost could be reduced with use of cheaper 0.035 coils. And this extra cost needs to be balanced with the cost of follow up and secondary interventions associated with aneurysm enlargement.

### ***Study limitations***

The first limitation of this RCT is the primary endpoint that should have been unique (EL at 24 months) rather than at different timelines (one, six, 12, and 24 months). As secondary outcomes, the volumes and diameters of the aneurysms were studied. However, the study was not designed and powered to show a difference regarding these outcomes. Thus, strong conclusions cannot be drawn from this analysis.

Another limitation is the indication for re-intervention. The SVS 2009 guidelines recommended a 10 mm threshold for re-intervention.<sup>25</sup> Piazza *et al.* published in 2013 a study selecting “patients at risk” for type II EL.<sup>12</sup> When the present study started including patients in 2014, this paper’s recommendations were followed for re-intervention: “the indication for re-intervention was in all cases the presence of type II endoleak with aneurysm sac growth >5 mm”. This important point was highlighted by the Paris-Saclay University Ethical Committee review which stated: “The lack of prevention of endoleaks in one of the groups should not be considered as a disadvantage for the patients”. It was thus balanced by a prompt secondary intervention in case of aneurysm growth > 5 mm. Furthermore, a flow lumen aortic diameter > 30 mm and the ratio of thrombus volume versus sac volume are now reported to be high-risk factors for EL, but they were not considered for this study.<sup>9</sup>

The last limitation is the absence of complete follow up: many patients did not perform all the CT and US despite receiving letters of convocations to these scheduled exams. As planned, the study was closed two years after inclusion of the last patient. Unfortunately some two year follow up exams were performed too late to be included in the current study.

### ***Conclusions***

This is the first bicentric prospective randomised trial comparing standard EVAR to standard EVAR associated with ASCE to demonstrate that ASCE is safe and effective in preventing type II EL at one, six, and 12 months. However, the difference was not statistically significant at 24 months. ASCE significantly decreases re-intervention rates during follow up after EVAR. A significantly faster shrinkage of aneurysm is observed at one and two years

following surgery (SCOPE 1 trial: NCT01878240). Further studies are required to determine whether ASCE could decrease the costs associated with EVAR follow up.

### **CONFLICT OF INTEREST**

None.

### **FUNDING**

None.

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<b>Demographic data and risk factors</b>	<b>Group A (n=47)</b>	<b>Group B (n=47)</b>	<b>p<sup>*</sup></b>	<b>Test<sup>†</sup></b>
Male sex	44 (94)	42 (89)	.71	(a)
Age – y	73±8	72±9	.65	(b)
BMI – kg/m <sup>2</sup>	28±5	26±4	.019	(b)
Smoking <sup>‡</sup>	41 (87)	30 (67)	.036	(a)
COPD	17 (36)	7 (16)	.051	(a)
High blood pressure	36 (77)	29 (64)	.29	(a)
Hypercholesterolaemia	34 (72)	23 (52)	.078	(a)
<i>Diabetes</i>			.90	(a)
Type 1	2 (4)	1 (2)		
Type 2	5 (11)	6 (13)		
Previous aortic surgery	10 (21)	6 (13)	.46	(a)
<i>Medical treatment</i>				
Statin	33 (75)	22 (49)	.021	(a)
Aspirin	26 (59)	20 (44)	.24	(a)
Clopidogrel	11 (26)	13 (30)	.86	(a)

Betablocker	19 (43)	13 (29)	.24	(a)
Antivitamin K	5 (11)	4 (9)	.74	(a)
ACE inhibitor	15 (34)	15 (33)	1.0	(a)
Diuretics	8 (18)	11 (24)	.64	(a)
<i>Medical history</i>				
Coronary diseases	23 (49)	12 (27)	.057	(a)
Peripheral arterial disease	8 (17)	2 (5)	.091	(a)
Atrial fibrillation	9 (19)	4 (9)	.23	(a)
Pacemaker	5 (10)	1 (2)	.20	(a)
<i>Cardiac ultrasound and creatinine</i>				
Peripheral arterial disease	2 (66)	1(100)	1.0	(a)
Median creatinine clearance (range) [IQR] – $\mu\text{mol/L}$	70 (28 ; 175) [59 – 86]	66(27 ; 133) [51 – 87]	.82	(c)
LVEF	60 $\pm$ 9	60 $\pm$ 11	.94	(b)
PAH	1 (3)	0 (0)	1.0	(a)
Valvulopathy	4 (11)	2 (6)	.67	(a)

Data are presented as  $n$  (%) or mean  $\pm$  standard deviation unless stated otherwise. BMI = body mass index; COPD = chronic obstructive pulmonary disease; ACE = angiotensin-converting enzyme; LVEF = left ventricular ejection function; PAH = pulmonary arterial hypertension; IQR = interquartile range.

\*  $p$  values at  $\alpha = .05$  were considered statistically significant.

† (a) chi-square test (b) Student  $t$  test (c) Mann–Whitney test.

‡ Includes current and former smokers.

**Table 2. Technical data of endovascular procedures for patients with endovascular aneurysm repair (EVAR) without (group A) or with sac embolisation with coils (group B).**

Endovascular procedure	Group A ( $n=47$ )	Group B ( $n=47$ )	$p$ *	Test †
<i>Anaesthesia</i>				
General	40 (86)	42 (88)		
Local	7 (14)	5 (12)		
Median vascular time (IQR) – min	65 (12)	90 (21)	.063	(c)
Median fluoroscopy time (IQR) – min	21 (11)	28 (13)	.005	(c)
Median total body irradiation (IQR) – $\text{mGy.cm}^2$	23 479 (10)	22 169 (12)	.98	(c)
Femoral percutaneous approach	21 (44)	25 (54)	.56	(a)
Femoral chirurgical approach	26 (56)	22 (46)	.90	(a)
Hypogastric coverage – none	42 (89)	44 (94)	.87	(a)
Supplementary brachial approach	0 (0)	0 (0)	–	
Associated renal stenting	2 (4)	2 (4)	1.0	(a)
<i>Number of cases/centre</i>				
Marie Lannelongue Hospital	26 (55)	28 (60)		
Henri Mondor Hospital	21 (45)	19 (40)		

Data are presented as  $n$  (%) unless stated otherwise. IQR = interquartile range.

\*  $p$  values at  $\alpha = .05$  were considered statistically significant.

† (a) chi-square test (b) Student  $t$  test (c) Mann–Whitney test.

**Table 3. Transverse and antero-posterior diameter evolution for patients with endovascular aneurysm repair (EVAR) without (group A) or with sac embolisation with coils (group B).**

Diameter	Group A (N=47)	Group B (N=47)	<i>p</i> *
<i>Transverse at 12 mo</i>	31 (34)	33 (29.7)	.22
Decrease	14 (45.1)	21 (63.6)	
Stable	17 (55)	12 (36.4)	
<i>Transverse at 24 mo</i>	28 (40.4)	28 (40.4)	.18
Decrease	12 (42.8)	18 (64.3)	
Stable	16 (57.1)	10 (35.7)	
<i>Antero-posterior at 12 mo</i>	28 (40.4)	29 (38.3)	.15
Decrease	11 (39.3)	18 (62)	
Stable	17 (60.7)	11 (37.9)	
<i>Antero-posterior at 24 mo</i>	21 (55.3)	26 (44.7)	.47
Decrease	9 (42.8)	15 (57.7)	
Stable	12 (57.1)	11 (42.3)	

Data are presented as *n* (%).

\* *p* values at  $\alpha = .05$  were considered statistically significant; Pearson's chi-square test with Yates' continuity correction.

**Figure 1.** Preferred reporting items for Systematic Reviews and Meta-Analysis (PRISMA) flow diagram of SCOPE 1 (Sac COil embolisation for Prevention of Endoleak), a prospective randomised study for patients with infra-renal abdominal aortic aneurysm at high risk of type II endoleaks treated with endovascular aneurysm repair (EVAR) without or with aneurysm sac coil embolisation and followed up at one (M1), six (M6), 12 (M12), and 24 (M24) months. FEVAR = fenestrated EVAR; LTFU = loss to follow up; NCFU = non complete follow up.

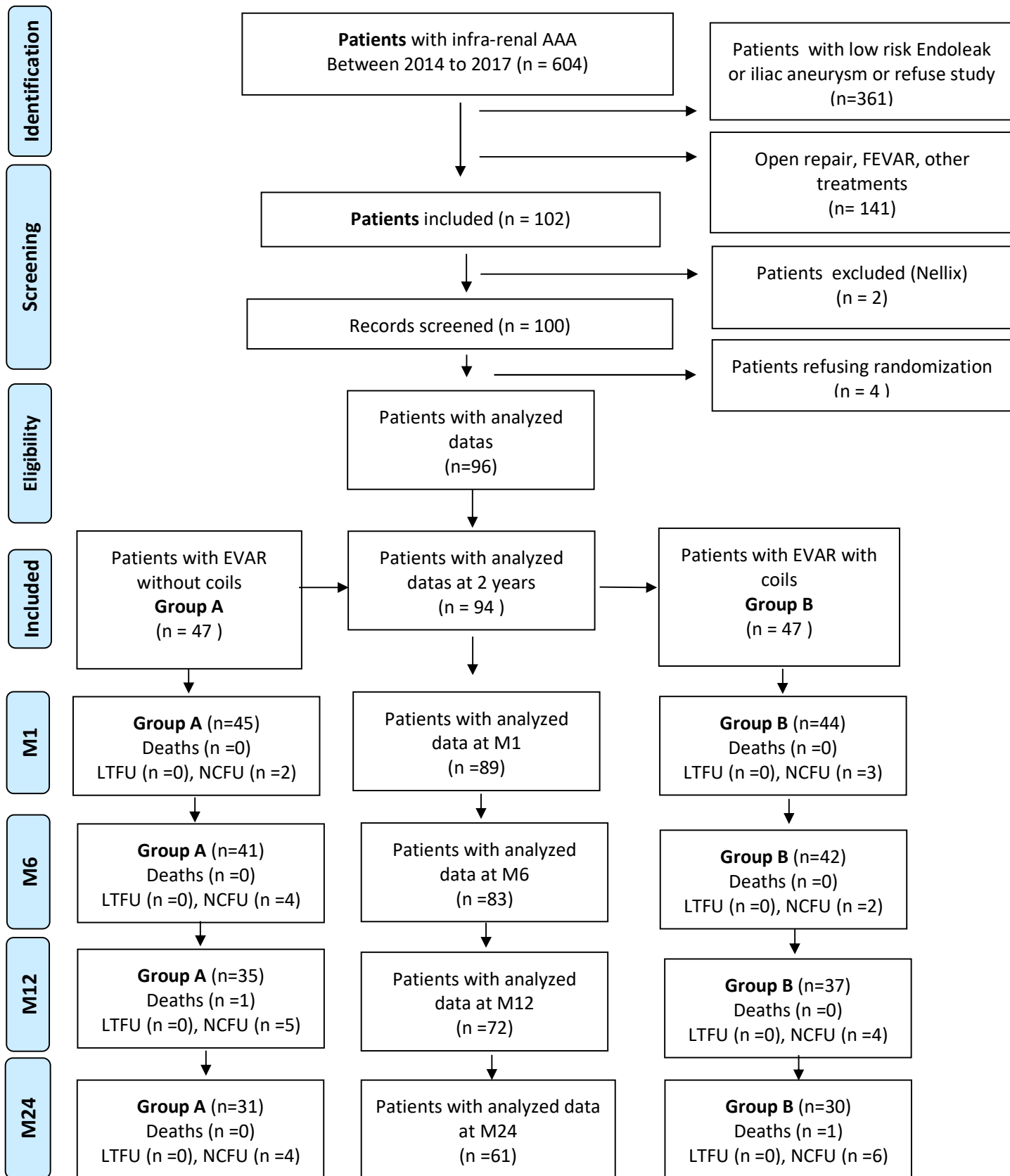
**Figure 2.** Primary outcomes events as type II endoleaks and re-interventions for patients with endovascular aneurysm repair without (group A) or with sac embolisation with coils (group B). \*  $p < .05$ ; †  $p < .001$ .

**Figure 3.** Cumulative Kaplan–Meier estimate of freedom from type II endoleak and re-interventions for patients with endovascular aneurysm repair without (group A) or with sac embolisation with coils (group B).

**Figure 4.** Sac diameter evolution for patients with endovascular aneurysm repair (EVAR) without coils (group A) vs. patients with EVAR with coils (group B) at the time of treatment and at one (M1), six (M6), 12 (M12), and 24 (M24) months after treatment. \*  $p < .05$ ; †  $p < .001$ .



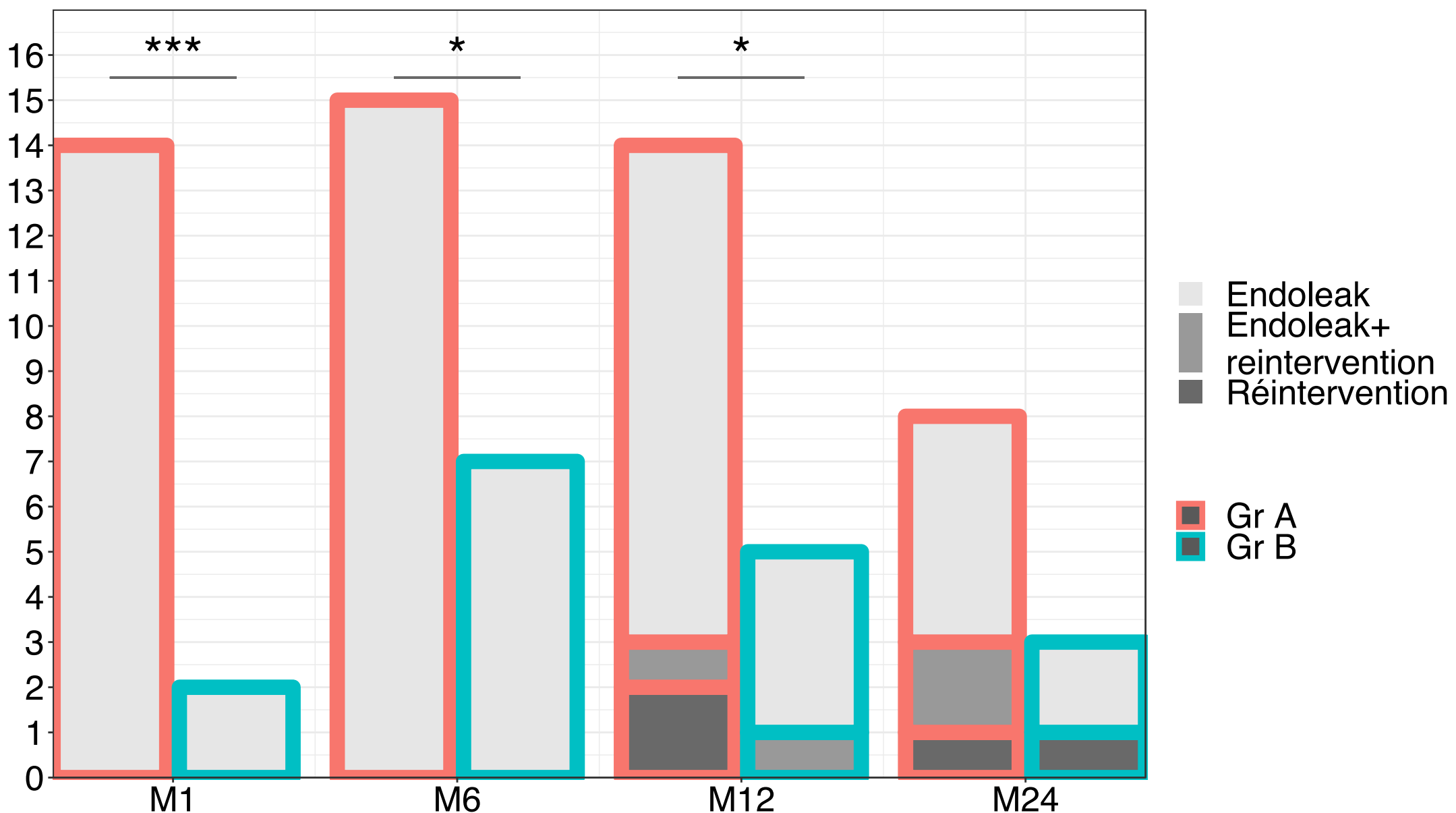
**Figure 5.** Sac volume evolution for patients with endovascular aneurysm treatment (EVAR) without (group A) or with sac embolisation with coils (group B) at the time of treatment and at one (M1), six (M6), 12 (M12), and 24 (M24) months after treatment. \*  $p < .01$ .



From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit [www.prisma-statement.org](http://www.prisma-statement.org).

Events



Gr B 46

39

33

29

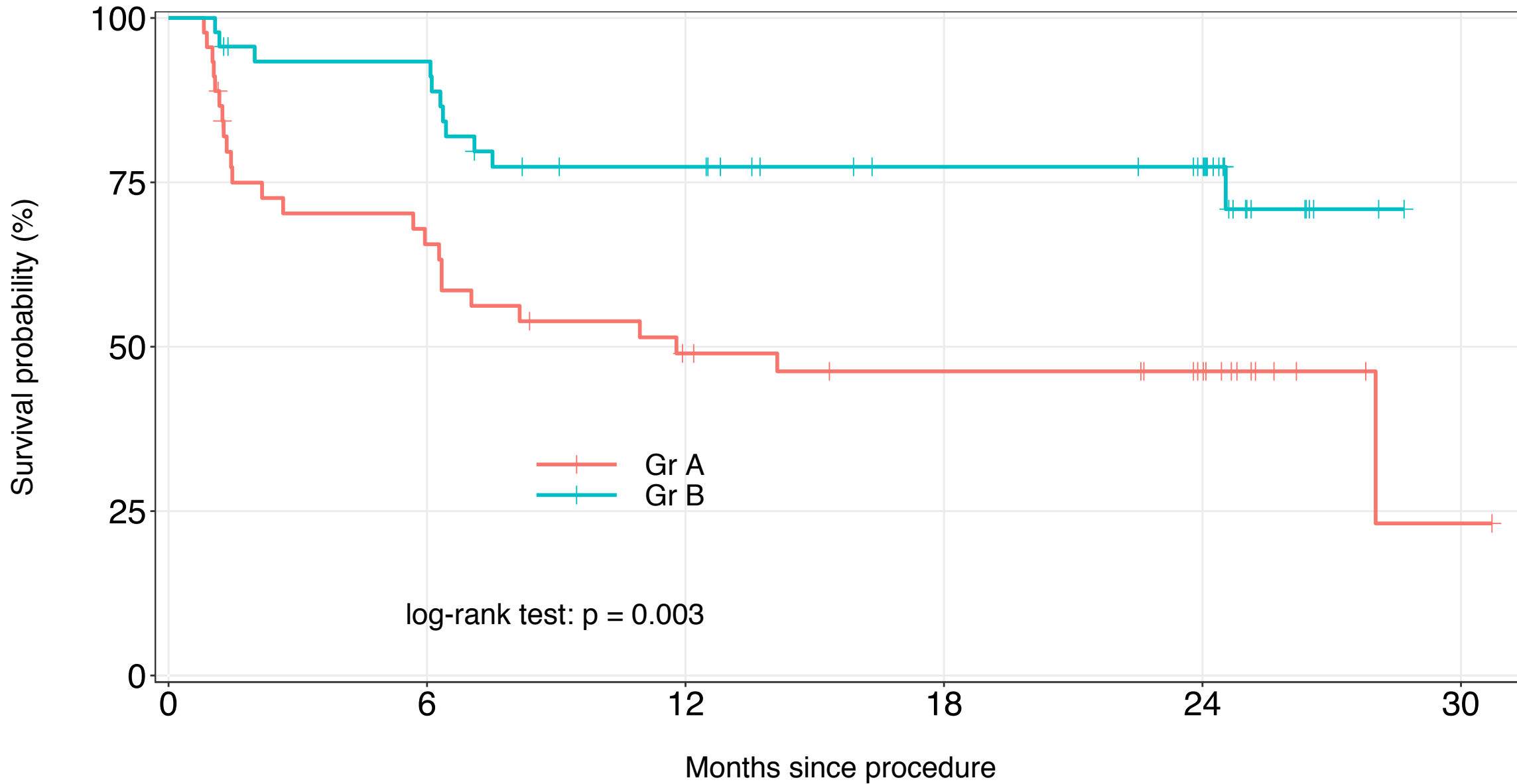
Gr A 45

36

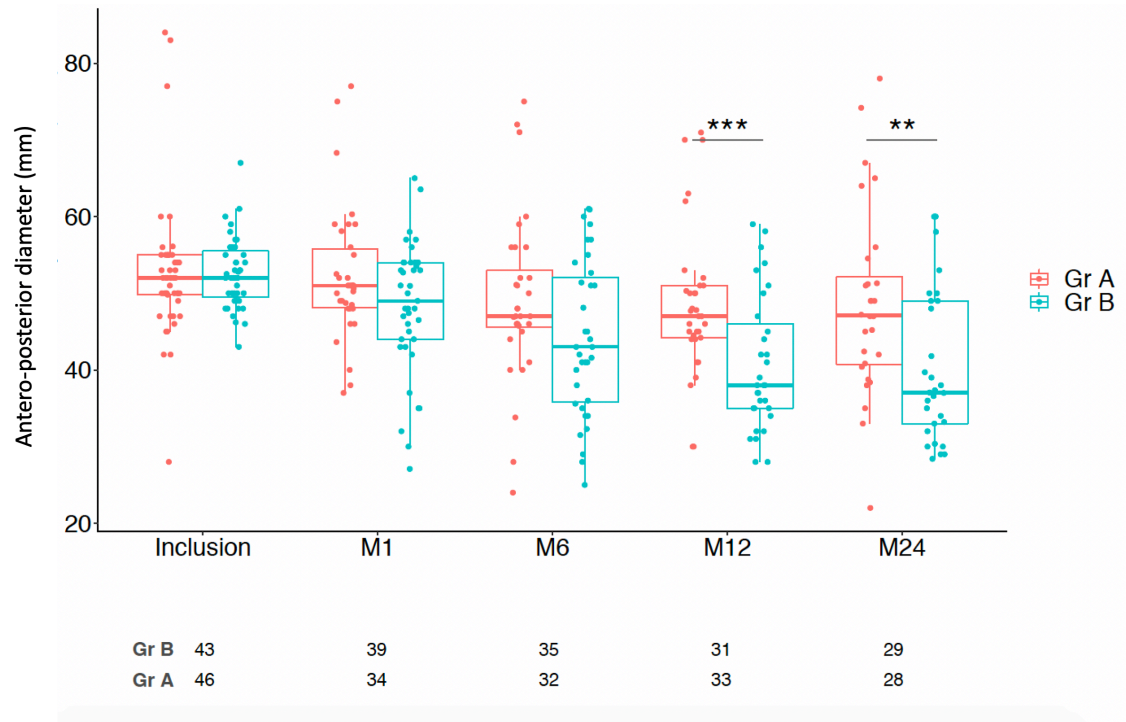
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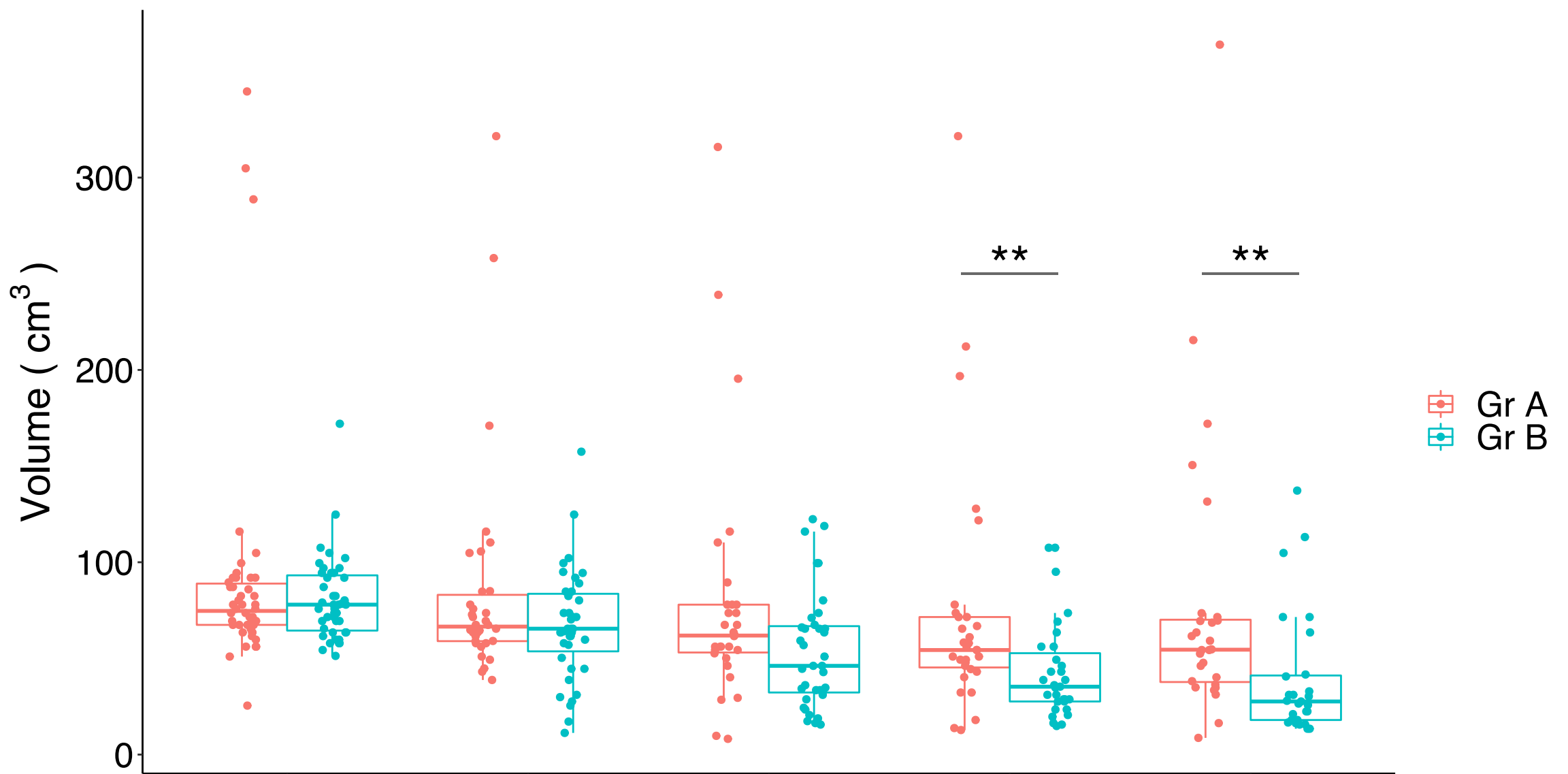
31

# Survival free from endoleak and reintervention



Gr A	45	28	19	16	12	1
Gr B	46	41	31	24	20	0





<b>Gr B</b>	43	39	35	31	27
<b>Gr A</b>	46	34	30	31	28