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SHORT COMMUNICATION EMBOLISATION (ARTERIAL)

Embolization of Rectal Arteries for Treating Hemorrhoidal Disease Using a Combination of Microspheres and Microcoils: A Pilot Study

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Abstract

Purpose To investigate the feasibility and initial results of superior (SRA) and middle (MRA) rectal artery embolization for patients with symptomatic hemorrhoidal disease.

Materials and Methods Prospective, single-center cohort that included ten consecutive patients (Goligher classification was II in 70% and III in 30%.) who underwent SRA and MRA embolization using a combination of microspheres and metallic coils, who completed a follow-up period of 12 months. Technical success was defined as embolization of SRA and MRA whenever MRA dominance was observed. Clinical success was defined as an improvement of the hemorrhoid severity score (HSS) and quality of life (QoL) scores without recurrence, with the need for additional treatment. Procedure-related adverse events (AEs) were recorded and defined according to CIRSE classification as minor or major complications.

Results Technical success was achieved in all patients. SRA was embolized in 100% of patients and MRA in 80%. The improvement in HSS and QoL scores was 88% and 88% ($p < 0.05$), respectively, without clinical recurrence in the 12-month follow-up. One patient had a major complication (level D), a rectal ischemia and perforation of the rectosigmoid leading to perforative acute abdomen with sepsis that required surgical treatment (Hartmann's procedure).

Conclusion Embolization of both SRA-MRA using a combination of microspheres and metallic coils was feasible and significantly improved HSS and QoL scores. One major complication was observed and therefore it is essential to further investigate the safety boundaries of this technique.

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Graphic Abstract

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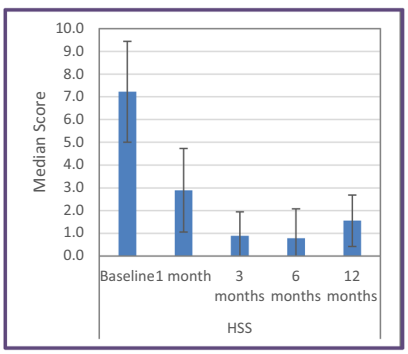
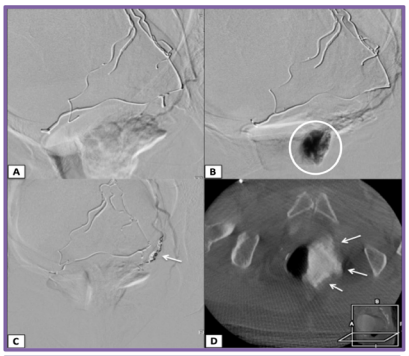
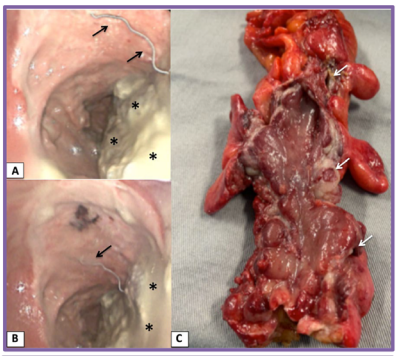


Graph : Hemorrhoid Severity Score (HSS) of all patients at pre-embolization, 1 month, 3 months, 6 months and 12 months.



A: control arteriography after microspheres injection demonstrating MRA. B: DSA demonstrating extravasation and contrast retention (circle), representing vessel rupture. C: DSA after embolization with microcoils (arrow). D: CBCT after embolization confirming contrast extravasation in the low rectum region, territory of the left MRA (arrows).



A,B:Rectosigmoidoscopy demonstrating an extensive ischemic area (asterisk) on the left lateral wall of the rectum extending to the rectosigmoid transition, showing extruded coils (white arrows) beyond the mucosa. C: Segment resected during surgery, with extension from the low rectum to the rectosigmoid transition, with irregular and swollen areas, in addition to small ulcers (black arrows).

Embolization of both SRA-MRA using a combination of microspheres and metalic coils was feasible and significantly improved hemorrhoid severity and quality of life scores. One major complication was observed, and therefore it is essential to further investigate the safety boundaries of this technique.

Keywords Superior rectal artery (SRA) · Middle rectal artery (MRA) · Cone-beam CT (CBCT) · Hemorrhoid severity score (HSS)

Introduction

The "Emborrhoid" technique proposed by Vidal [1] consists of superior rectal artery (SRA) embolization with coils with technical and clinical success rates of 100% and 72%, respectively. Since then, many studies [2–6] have been carried out in this field in search of the best clinical results without compromising safety. It is noted that approximately 30% of patients experience bleeding recurrence after SRA embolization, possibly related to revascularization from collaterals via the middle (MRA) or inferior (IRA) rectal arteries [1, 3–5]. Thus, technical innovations were investigated, such as using different embolizing agents [7] or the target territory, such as additional MRA embolization, when it contributed to hemorrhoidal disease [8, 9]. It is not understood if/when the MRA should be embolized. This pilot study aimed to evaluate the feasibility and clinical results of SRA and MRA embolization with coils and microspheres in a prospective cohort of patients.

Material and Methods

Ten patients underwent SRA and MRA embolization (whenever appropriate) using a combination of microspheres and coils. They completed a 12-month follow-up between 05/2021 and 01/2023. The study was approved by the hospital Ethics Committee, and written informed consent for the procedure was obtained from all the patients.

Technical success was defined as the embolization of both SRA and MRA whenever MRA dominance was observed. Clinical success was defined as the absence of recurrence of symptoms (bleeding) without the need for additional treatment at 12 months. Demographic data are summarized in Table 1.

Embolization technique

Two interventional radiologists (10 and 5 years of experience) performed all procedures. Initial access was under local anesthesia via femoral arterial approach using a 5-Fr sheath (Cordis, USA). The inferior mesenteric artery was catheterized with a 5-Fr Simmons 1 catheter (Cordis,

Table 1 Demographic data and pretreatment clinical aspects of patients

Variable	$n = 10$	%
Male	4	40
Female	6	60
Age	59(+ / − 13)	
Goligher		
2	7	70
3	3	30
HSS (median 7.8)		
4	1	10
5	2	20
7	2	20
8	1	10
9	1	10
10	2	20
13	1	10
QoL (median 3.4)		
3	6	60
4	4	40

USA). Cone-beam CT (CBCT) was performed to identify all SRA supplying the corpus cavernosum recti. The protocol consisted of a 10-s rotation over an angular range of 40°/s during the injection of 16 mL contrast medium (Henetix 300; Guerbet), diluted to 50% at a flow rate of 1.5 mL/s and 300 psi. The image datasets were transferred to a workstation and reconstructed using the EmboAssist software (GE Healthcare) [10].

Each SRA branch was catheterized using a 2.8-Fr microcatheter (Progreat, Terumo, Japan) and 0.014″ guidewire (PT^2—Boston Scientific, USA). Embolization was performed with microspheres 1100 µm (Embozene—Boston Scientific, USA), 2.0 mL diluted in 10 mL contrast and 10 mL saline solution, until near stasis, followed by coils 3 mm × 15 cm (Pod—Penumbra, USA). The angiographic endpoint was defined as a static column of contrast in the main branches of the SRA associated with an interrupted blood flow in the hemorrhoidal territory. Afterward, the internal iliac artery was catheterized bilaterally using a 5-F catheter (CPC—Merit, USA). CBCT was obtained to identify an eventual dominant MRA (which means a relevant involvement with the hemorrhoidal vascularization). The MRA was catheterized in these cases, and embolization was performed with the same microspheres and coils. Manual compression of the arterial puncture site was performed.

Follow-up

The patients were remotely assessed for clinical follow-up during the first week and in person with 1, 3, 6 and 12 months. The examinations assessed the progression of hemorrhoid severity score (HSS) and patient satisfaction (QoL score), in addition to perianal inspection and anoscopy.

Statistical Analysis

Statistical analyses were done using the RCore Team 2019 (R Foundation for Statistical Computing, Austria). Continuous variables were described by means and standard deviations (SDs). Absolute numbers and percentages describe categorical variables. The Mann–Whitney–Wilcoxon test for continuous variables and the McNemar test for categorical variables were used. Bicaudal values of $p < 0.05$ were considered statistically significant.

Results

Details of the procedures are summarized in Table 2. Graphics 1, 2 and Table 3 demonstrate follow-up and reduction of HSS/QoL scores.

One patient had a microcatheter wedged manual injection with contrast extravasation during embolization of the left MRA, and hemostasis was performed with coils (Fig. 1). She was readmitted to the hospital 17 days later with ischemic tenesmus pain without improvement after medical therapy. Computed tomography showed thinning of the left lateral rectal mucosa associated with submucosal edema until the rectosigmoid transition (Fig. 2), in addition to leukocytosis (13.600/mm^3) and an increase in C-reactive

Table 2 Procedural details. STD, standard deviation; *N*, number; AK, air kerma; DAP, median dose area product; CBCT, cone-beam computed tomography; MRA, median rectal artery

Variable	Median	STD	*N*
Technical success	10 (100%)	–	10
Procedure time	102.5	38.0	10
Fluoroscopy time	47.7	20.3	10
AK (MGY)	817.1	552.9	10
DAP (MGY/$CM^{2)}$	128.9	64.7	10
Contrast volume	159.0	27.2	10
CBCT	10 (100%)	–	10
Particles	2.0 ml (1 vial)	–	10
Microcoils	4.2	1.1	10
MRA	8 (80%)	–	10

Table 3 Hemorrhoid severity score (HSS) and quality of life (QoL) of all patients in the baseline, 1 month, 3 months, 6 months and 12 months

Measure	Time (months)	Average	Standard deviation	Minimum	Median	Maximum	*P*-value
HSS	Before	7.2	2.2	4	7	10	–
	1	2.9	1.8	0	2	6	0.6241
	3	0.9	1.1	0	1	3	0.0003
	6	0.8	1.3	0	0	4	0.0002
	12	1.6	1.1	0	2	3	0.0175
QoL	Before	3.3	0.5	3	3	4	–
	1	1.2	1.0	0	1	3	0.0729
	3	1.0	0.9	0	1	3	0.0175
	6	0.4	0.5	0	0	1	0.0015
	12	0.9	0.6	0	1	2	0.0104

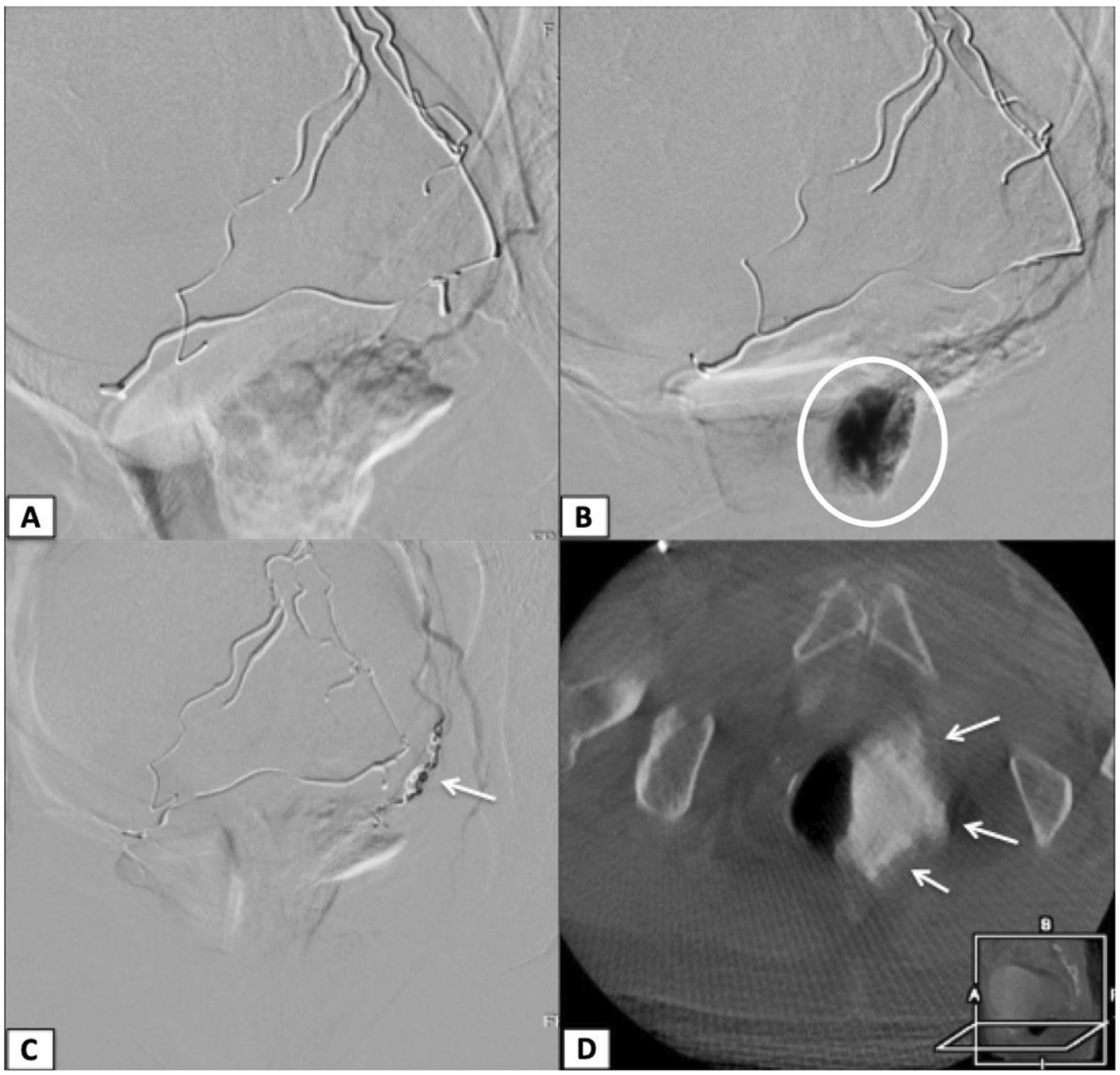


Fig. 1 **A**: Control arteriography after microspheres injection demonstrating MRA. **B**: DSA demonstrating extravasation and contrast retention (circle), representing vessel rupture. **C**: DSA after embolization with microcoils (arrow). **D**: CBCT after embolization confirming contrast extravasation in the low rectum region, territory of the left MRA (arrows)

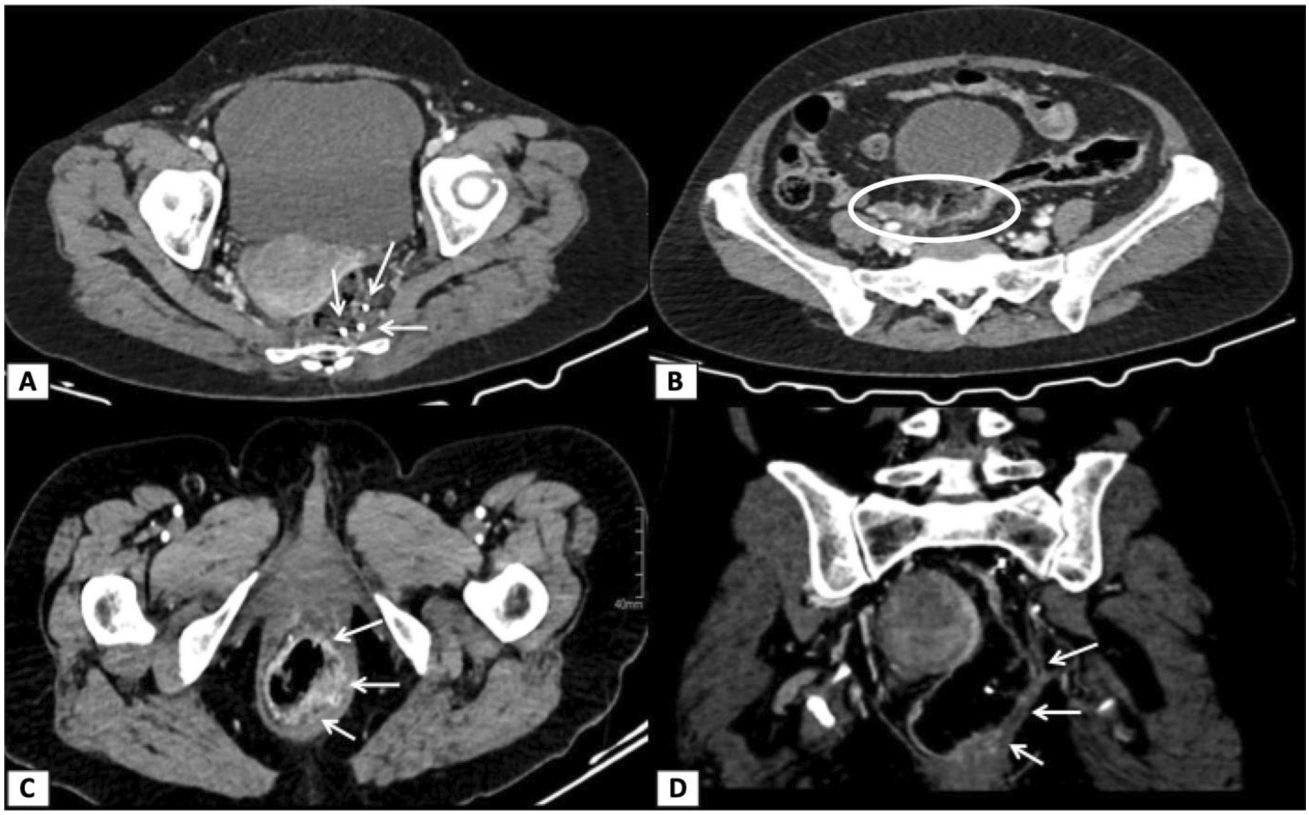


Fig. 2 CT scan two weeks after embolization. **A**: Metallic microcoils in rectum (arrows). **B**: Thinning of the rectal wall until the rectosigmoid transition (circle). **C**: Submucosal edema and slightly more hyperdense area on the left lateral wall of the rectum (arrows). **D**: CT in coronal section, showing thinning of the left lateral rectus wall (arrows)

protein by 185 mg/dL. Antibiotic therapy (ciprofloxacin and metronidazole) was initiated, and a rectosigmoidoscopy found an extensive ischemic area on the left lateral and posterior walls of the rectum, extending to the rectosigmoid transition, associated with coils exteriorization (Fig. 3). It was decided to perform a diagnostic laparoscopy, which needed to be converted to open surgery after findings of perforation and friability of the distal colon (Fig. 3), followed by Hartmann surgery with stoma creation. The patient recovered well postoperatively and was discharged with no further signs of infection.

Discussion

The recurrence of bleeding may be related to reperfusion through connections between the rectal arteries. Tradi et al. [6] reported that 24% of patients had prominent anastomosis with the MRA and also reported a prevalence of MRA dominance in patients who failed embolization (43% vs. 16%). In the present study, it was decided to actively seek MRA with the use of CBCT in order to reduce this recurrence of clinical symptoms, and it was found the presence of MRAs contributing to the hemorrhoidal plexus in 80% of patients, a number significantly higher than the reported by Vidal and Tradi in their experiences [1, 3, 6]. Particles may close the hemorrhoid plexus more distally and obstruct MRA and even IRA anastomoses, and the rationale of choosing 1100 mc sized microspheres rather than smaller is based on the randomized study that compared the use of different particle sizes, and the subgroup using larger microspheres (900–1200 μm) demonstrated the best French bleeding score improvement and no ischemic complications [7]. Another crucial factor to consider regarding technical aspects, besides the size of the microspheres, is the total amount injected in both SRA and MRA. Bagla et al. reported that they injected about 0.4 mL of 600 μm particles before implanting the coils and had no complications [8]. In the present study, approximately 2.0 mL of 1100 μm microspheres were injected into each patient, an amount five times greater.

An important ischemic complication has been reported so far secondary to hemorrhoidal microsphere embolization [11]. In the present study, there was a major complication that required surgery due to an ongoing infectious condition secondary to significant ischemia of the middle and upper third of the rectum and the rectosigmoid segment. Some hypotheses may have contributed to this

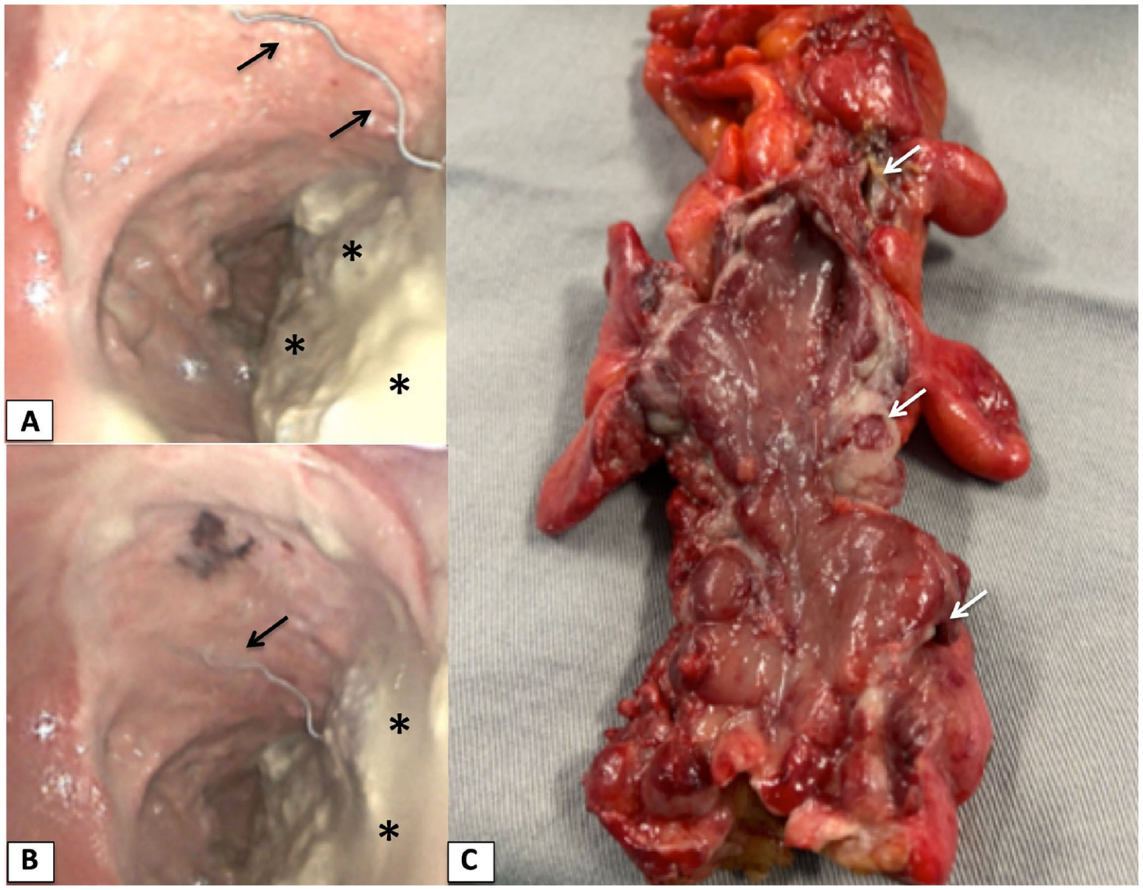


Fig. 3 **A**, **B**: Rectosigmoidoscopy demonstrating an extensive ischemic area (asterisk) on the left lateral wall of the rectum extending to the rectosigmoid transition, showing extruded coils (black arrows) beyond the mucosa. **C**: Segment resected during surgery, with extension from the low rectum to the rectosigmoid transition, with irregular and swollen areas, in addition to small ulcers (white arrows)

complication: the technical peculiarity (small parietal hematoma of the rectum after rupture of the left MRA during embolization); SRA-MRA embolization using large amounts of microspheres; nontarget embolization (SRA anastomose with the sigmoid); other clinical or anatomical conditions related to the patient that is not understood (e.g., Sudeck point [12]). We believe that the vascular rupture associated with previous embolization with less potential to develop collateral revascularization in a colonic region with a high potential for infection, associated with the use of a large amount of microspheres, which may cause a greater chance of nontarget embolization to the rectosigmoid branches, could be the main hypothesis for this complication.

The limitations of this analysis are mainly the low number of patients and the short follow-up period. One major complication was observed. It is essential to further investigate this technique's safety profile.

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Declarations

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Consent for publication Consent for publication was obtained for every individual person's data included in the study.

Informed consent Informed consent was obtained from all individual participants included in the study.

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