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A summary of the first 100 neurointerventional procedures performed with the Rist radial access device in a Finnish neurovascular center

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ABSTRACT

Background and purpose: Transradial access (TRA) has increased popularity among neurointerventionalists during a short time period but until recently there have been no devices designed especially for radial use.
Materials and methods: Consecutive neurointerventional procedures with an intention to perform TRA with the Rist radial access guide catheter between April 2021 and May 2022 were retrospectively reviewed. Possible access site complications, other procedure-related complications and information on successful catherization of the target vessel as well as whether the procedure had been successful were collected.
Results: Information from 100 patients was included in the study. The most general procedure was flow diversion (29%) followed by WEB embolization (20 %). Four patients (4%) needed conversion to femoral access. The triaxial system was used in 76% of the procedures. Four patients (4%) experienced access site or device related complications, none of those were serious. Six patients had clinically relevant procedure related complications.
Conclusions: It is concluded that the Rist device can be used safely for a large variety of neurointerventions with a short learning curve.

1. Introduction

The popularity of utilizing transradial access (TRA) in endovascular neurointerventions has increased during recent years [1,2]. Patient satisfaction, the smaller number and the reduced severity of access site complications as well as shorter post-procedure bed-rest time all favour radial over femoral access [1,3,4]. While TRA was initially adopted by invasive cardiologists over 20 years ago, it has also been convincingly demonstrated to achieve equivalent procedure results when compared with the more traditional transfemoral techniques in neurointerventions [2,5,6,7,8]. One major roadblock has been the lack of devices especially designed for a radial approach. Femoral catheters can be used off-label, but the smaller size of the radial artery and the different approach route do not permit the most optimal performance with these femoral-first devices. The aim of this study was to report the unit's primary experiences using the new Rist radial access system for different types of neurointerventions conducted consecutively.

2. Material and methods

2.1. Rist radial access device

The Rist radial access system (Medtronic) consists of a 5F diagnostic catheter (Simmons or Berenstein configuration) and a 7F (inner diameter 0.079 in.) guide catheter. The diagnostic catheter comes in 120 cm and 130 cm lengths and the guide catheter in lengths of 95 cm, 100 cm and 105 cm. According to the manufacturer, the stiffness of the Rist guide is specially designed to increase proximal stability and distal navigability when exploiting a radial approach. The distal flexible end is 29.5 cm long with a hydrophilic coating length of 25 cm.

2.2. Study design

This is a retrospective and observational study conducted in a high-volume neurovascular center. Local research approval was obtained from the hospital, and the need for informed consent was waived by the

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hospital's ethical research committee because of the retrospective nature of the study.

2.3. Patients

All consecutive patients, including both elective and acute neurointerventional procedures with an intention to perform TRA with the Rist radial access guide catheter between April 2021 and May 2022 were identified and enrolled into this study. The decision to use TRA and Rist was made by the main neurointerventionalist. The operator made the decision based on the planned procedure, radial artery ultrasound and evaluation of aortic arch computed tomography angiography (CTA) or previous digital subtraction angiography (DSA) if those were available.

2.4. Clinical and radiological assessments

For each patient, the relevant clinical information was recorded: patient's age, sex, and type of neurointervention.

Detailed information of each intervention was analyzed with respect to radial artery size, type of aortic arch, target vessel, information on antiplatelet therapy and values of platelet function tests as well as the use of distal access catheters (DAC).

Possible access site complications, other procedure-related complications and successful catherization of the target vessel as well as information on whether the procedure had been successful were defined as outcomes of interest. The catherization was defined as successful if the operator was able to navigate the Rist guide to the target vessel and the desired location. The procedure was defined as successful if the intervention was successfully performed via TRA through the Rist guide.

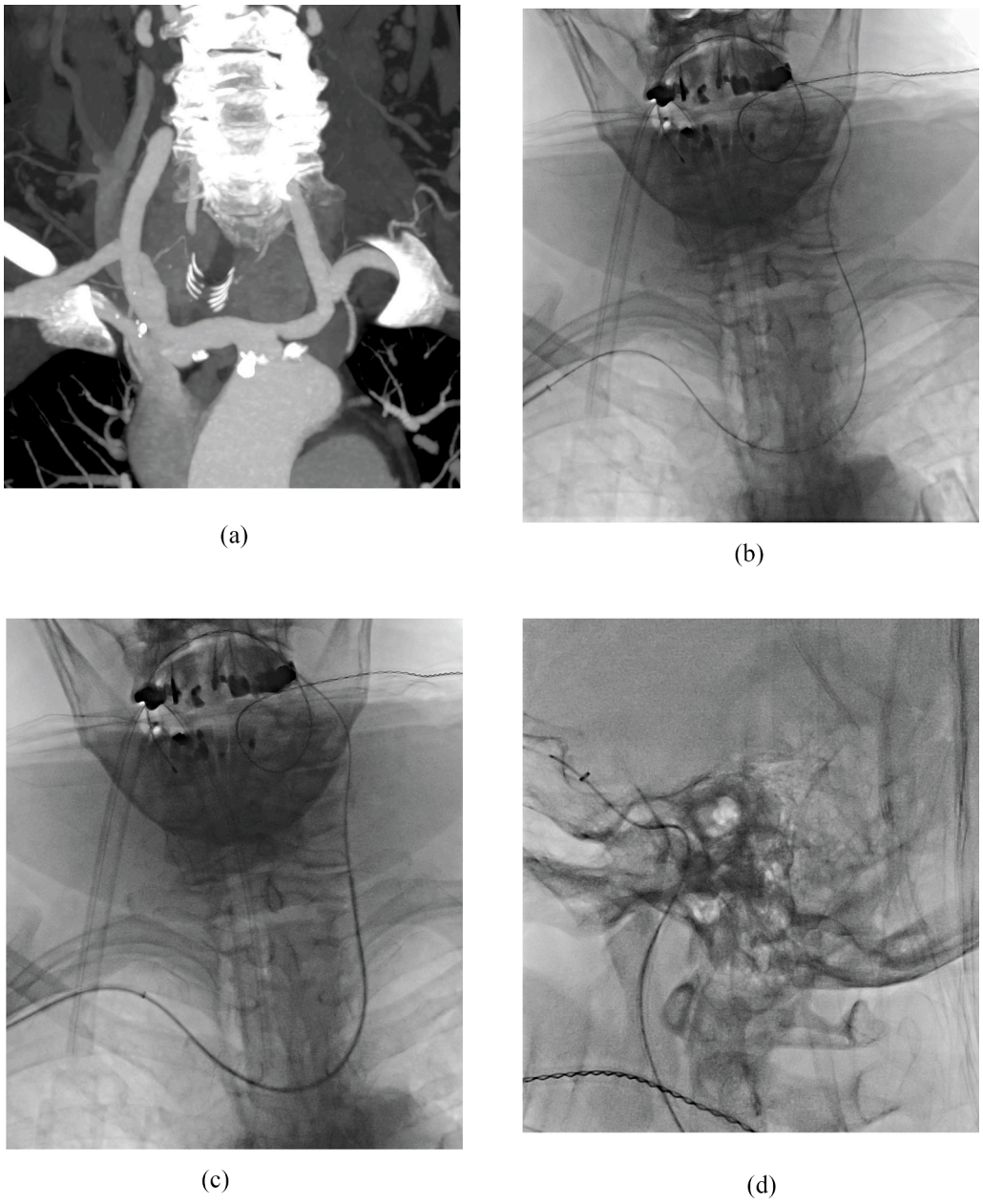

Fig. 1. Bovine arch configuration (a) (arrow) is usually unfavorable for femoral access. Entering from right radial access the guidewire mostly finds its way directly to the left carotid avoiding the need for catheter formatting. (b and c) The flexible distal tip of Rist guide allows its high positioning in petrous segment of the internal carotid artery with strong proximal support. (d).

2.5. The TRA technique as performed with Rist

All cases were performed by experienced (minimum three years of daily practice) neurointerventionalists with previous limited (less than 20) experience in utilizing the radial approach. The right radial artery was chosen as the puncture site, unless the target vessel was the left vertebral artery. The radial artery was checked with ultrasound (GE Logic, L8-18iD hockey stick probe) before the procedure to measure its size and possible calcifications. If the diameter of the radial artery was less than 1.7 mm, the access site was switched to the femoral artery. No collateral testing was performed. The puncture was made under ultrasound guidance in order to achieve the best possible visualization of the radial artery and the puncture needle as well as ensuring that the wire was moving freely in the radial artery lumen. A hydrophilic Terumo Glidesheath 7F sheath was used in all procedures.

The Rist catheter was telecscoped inside the Rist guide and advanced together over a 0.035 Terumo wire. The Sim2 catheter was re-formed in the descending aorta or against the aortic valve and then hooked at the aortic arch. The wire was then advanced into the petrous ICA (or other target vessel) and the Rist guide was advanced to the target vessel. (Fig. 1) The Ber catheter does not need reformatting and it was advanced over the Terumo wire directly into the vertebral artery together with the Rist guide.

After the procedure, a TR-band (Terumo) was used to achieve hemostasis.

2.6. Antiplatelet therapy

Patients coming for elective flow diverter procedures or carotid stenting were administered dual antiplatelet therapy for five days before the procedure with platelet function being evaluated in a Multiplate Analyzer (Roche Diagnostics, Mannheim, Germany).

2.7. Statistical analysis

Data is expressed as mean (range) for continuous variables and as a frequency for categorical variables. The evaluation of endpoints was descriptive.

3. Results

Between April 2021 and May 2022, neurointerventions were planned to be performed via radial access using the Rist device in a total of 100 patients. The mean age of the patients was 62.5 years (range 28–88 years) and 46 patients (46 %) were women.

The most general procedure was flow diversion (29 %) followed by WEB embolization (20 %) (Table 1). The majority, 82 %, of the procedures were in the anterior circulation with the remaining 18 % in the posterior circulation.

Only the right radial artery was punctured during 97 procedures, the left radial artery was utilized in two and one patient was treated through both right and left radial arteries. One puncture was performed via distal radial access (snuffbox).

The mean radial artery size was 2.6 mm (range 1.7–3.8 mm). Six patients already had an arterial line which had been placed by the anesthesiologist and the change was made with a Control –V 018 wire.

The first nine patients received a radial cocktail composed of nitroglycerine 200 mg, verapamil 2.5 mg and heparin 2500 IU. In the next 34 patients, nitroglycerine was omitted and thereafter only those patients who were not intubated received the nitroglycerine-free cocktail after sheath insertion. The first change to the nitroglycerine-free cocktail occurred because the hospital pharmacy at one time could not supply that vasodilating agent (Nitrosid 1 mg/ml) and no substitute medication was available. Thus, while nitroglycerine had been omitted, this was found to result in no major adverse consequences and thus the contents of the cocktail were altered. After measuring the radial diameter pre- and post-anesthesia, it was discovered that muscle relaxation caused a considerable change in the diameter of the radial artery and therefore the cocktail was administered only to those patients who were not intubated.

In four patients, the catherization of the target vessel was not successful with the Rist catheter, but was adequately performed after switching to a Penumbra Select Sim2 120 cm catheter. In three of these patients, the target vessel had been the left carotid artery whereas in the fourth patient, it was the left vertebral artery. In two of these patients, the Terumo guide wire M was changed to Terumo Glidewire Advantage to increase distal support.

The triaxial system was favoured in most of the procedures (76 %). No DAC was used in middle meningeal artery (MMA) embolizations, carotid stenting or embolizations to terminate nasal bleeding. One stent-assisted coiling for a basilar tip aneurysm (patient # 33) was performed without a DAC when fitting two microcatheters simultaneously. Table 2 shows a list of the various DACs along with their popularity.

In three patients, the primary DAC was changed to another catheter to achieve a more stable positioning. In two of these individuals, the radial approach was switched to the femoral route; in both of these cases, the target vessel had been the left carotid artery. One procedure (target left pericallosal artery) was performed successfully after changing the DAC.

If Rist was positioned at the level of the carotid bifurcation or lower and no DAC was used, this was often associated with some instability issues; one way to overcome this problem was to use a 035 Terumo wire as a buddy wire during the procedure.

Stability was categorized as good (1), intermediate (2) and poor (3); in only three patients was the stability evaluated as intermediate. In all three of these cases, the procedures had been performed without an intermediate catheter; one procedure was an MMA embolization, one nose-bleed embolization and one was an intracranial internal carotid artery PTA and stenting due to a symptomatic stenosis.

One radial access procedure did not proceed further than sheath insertion due to problems with the radial artery (radial loop). Four patients (4 %) needed conversion to femoral access due to instability but subsequently, the procedure went smoothly. The target vessels for those that needed conversion due to instability were right cerebri media artery, left pericallosal artery, left internal carotid artery (ICA) and left external carotid artery (ECA).

Table 1
List of different procedures and their appearance.

Type	Number of treatments
Flow diversion	29
WEB	20
MMA embolization	13
Dural fistula embolization	9
Coiling	7
Thrombectomy	5
Embolization of epistaxis	5
Intracranial PTA and stenting	4
AVM embolization	4
Carotid stenting	3
Stent assisted coiling	1

Table 2
List of various distal access catheters.

Distal access catheter	Nr of target vessels
Sofia 5F	27
Sofia EX	24
Navien	21
Catalyst 5F	3
Fubuki 043	1
Phenom plus	2
no DAC	24

A 68-old male patient who was to undergo basilar artery thrombectomy had a severe elongation in iliac arteries and aorta. Since neither of the vertebral arteries could be reached via femoral access, the access site was switched to the right radial artery. Subsequently, the procedure was both rapid and uneventful.

4. Complications

4.1. TRA related

Transradial complications occurred in 4 % of the cases. One silent radial artery occlusion was discovered at the six-month follow-up (FU) with DSA-imaging after a flow diverter procedure although it had been open at the three-month FU DSA assessment. Two patients needed surgical closure of the puncture site after the radial procedure; both of these patients were receiving dual antiplatelet treatment. They were both discharged home on the day after the initial neurointervention. One Rist became broken while the carotid stent was inserted into the left common carotid artery (CCA) and consequently the Rist needed to be removed by a vascular surgeon.

4.2. Procedure-related

Six patients had clinically relevant complications. These are described in greater detail in Table 3. A prolonged attempt was made in patient # 59 to reach the left carotid artery by utilizing a radial approach; her activated clotting time (ACT) was over 200 s at the beginning of the intervention and it remained at that value throughout the procedure and thus she was not heparinized. Since it is recognized that the presence of oral anticoagulants prolongs the ACT [9] during elective procedures, the aim is to achieve an ACT value of 200 s, but it is possible that this had been an underestimation in this patient.

5. Discussion

It was evident that the Rist radial access system could be used in multiple various neurointerventional procedures without any major or even minor technical difficulties.

In the present study, Rist was used in a triaxial system in 76 patients (76 %) which is more frequent when compared to the previous reports. Wagas et al. [10] reported using DAC in only 24.3 % of cases and Abecassis et al. [11] reported applying the triaxial technique with Rist in 40.1 % of cases. It was observed that navigating Rist up to the petrous segment of the ICA without any extra manoeuvers could be done easily in most of the cases and support was evaluated as good with Rist alone. Since the regular practice includes devices which require good distal support such as flow diverters and WEB devices, distal support is preferred and the triaxial system can be utilized mimicing a femoral approach. In some of the cases, the operator stated that when DAC had been used together with the Rist guide, it increased the proximal stability.

There are arguments against the use of TRA; it has been claimed to increase fluoroscopy time and radiation exposure as well as representing a limited access-specific technology with a learning curve. The *meta*-analysis published by Plourde et al., revealed that coronary artery interventions were initially associated with longer procedure times and increased radiation exposure in comparison to those utilizing transfemoral access. This difference declined over time with a significant narrowing between the two approaches, and finally no difference could be determined in the hands of experienced operators [12].

Rist is the first device specifically designed for a radial approach. If the Rist guide is used together with the new slim hydrophilic sheaths like Glidesheath, it can be safely placed in radial arteries sized 1.7 mm or more. Evidently, radial sheaths offer an advantage over the sheathless guiding catheters as they save the radial artery from extra manipulation occurring during exchange manoeuvers. In addition, as far as is known, the Rist guide has the longest distal hydrophilic portion which facilitates smooth distal navigation in intracranial vessels.

The inner lumen of Rist guide is 0.079 in. which enables the usage of any 5F DAC that is available on the market. This is an advantage over other guides like Benchmark (Penumbra) or Envoy (Codman) which were originally designed for femoral access but subsequently used for radial access before Rist came onto the market. The large 0.079 in. lumen makes it possible to work with two microcatheters (027 microcatheter and 014 microcatheter) if needed. While the Rist's large inner lumen made it possible to perform carotid stenting with Casper stent (Terumo), it is important to appreciate that not all carotid stents on the market e.g. CGuard (InSpire MD) can fit through Rist.

The published data indicate that while the learning curve for TRA is not steep, it must be overcome in order to achieve the benefits of radial access [13,14]. The present interventions were performed by two experienced neurointerventionalists, with very limited experience of utilizing radial access. If one keeps an open mind, and displays eagerness and good motivation, then the learning curve for Rist usage in various neurointerventions can be passed in a short time period. Here, the conversion rate from radial to femoral was only 4 %. This is even less than in the previous report by Wagas (6.4 %) [9]. One explanation for the improvement might be that DAC was used more often and this was found to give extra proximal support.

A recent article revealed that the frequency of embolic events on diffusion weighted MRI was more frequent after TRA compared with the TFA approach after cerebral angiography [15]. Somewhat less than every fifth (17.5 %) of the TRA cerebral angiograms demonstrated at least one hyperintense focus on MRI DWI. Of the TFA procedures, 5.2 % were considered as positive. This cannot be directly extrapolated to the neurointervention procedures; in these, the situation differs from plain angiography due to flushes and also possible heparinization. It remains for the future to show if there is a difference in the frequency of embolic events between patients that are treated with Rist i.e. a device specially designed for radial access with a long hydrophilic distal part, and those catheterized via TRA with guides originally intended for femoral access.

The access site complication rate described here was slightly higher compared to the previous report by Weinberg et al. where they analyzed their 1524 transradial procedures [16]. While their study reported a complication rate of 1.7 %, it included both diagnostic and therapeutic neurointerventions, so the sheath size was different and not directly comparable to the present results. None of the TRA related complications encountered here led to a prolongation of the hospital stay.

This study has limitations. The retrospective review might have overlooked some minor technical issues. The sample size was small and since the interventions were performed by experienced neurointerventionalists, generalizability is not straightforward.

Table 3
Procedure-related complications.

Pt nr	Procedure	Complication	recovered (yes or no)
25	Elective basilar artery PTA and stenting	Small brainstem infarction at four days after the procedure.	yes
33	Elective basilar tip Y-stenting and coiling	Small posterior circulation infarcts after the procedure.	yes
59	Elective left side ICA aneurysm flow diversion	Minor hemiparesis and multiple small infarcts in MCA territory after the procedure.	yes
63	Elective right side symptomatic AVM embolization	Minor hand symptoms after the procedure.	yes
78	Elective left dural fistula embolization	Minor right side hemisymptoms and aphasia.	yes
94	Elective left pericallosal artery flow diversion	Right hemiparesis and aphasia after the procedure. In CT CIE (contrast-induced encephalopathy).	yes

6. Conclusion

It was demonstrated that the Rist device can be used safely for a large variety of neurointerventions with an excellent technical success rate. One major advantage of the Rist device is its large inner lumen which means that either a carotid stent or 027 and 014 microcatheters can be inserted simultaneously. In addition, the Rist device's flexible and hydrophilic distal end makes it possible to position the device high above the petrous part of internal carotid artery. When the Rist guide was used together with a DAC, this was found to provide extra support both proximally and distally.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ejrad.2022.110604.

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