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Central Cannulation by Seldinger Technique: A Reliable Method in Type A Aortic Dissection Repairs

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Data Collection B
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Data Interpretation D
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Literature Search F
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Background: Extensive type A aortic dissections that involve peripheral great vessels can complicate the choice of a cannulation site for cardiopulmonary bypass. We started to employ direct cannulation of the true lumen on the concavity of the aortic arch by Seldinger technique and evaluated the efficacy of this access technique as an alternative arterial inflow target in aortic surgery.

Material/Methods: Twenty-four consecutive patients (mean age: 59±14 years) underwent type A aortic dissection repair using selective antegrade cerebral perfusion. Direct aortic cannulation was used in 14 cases, subclavian access in 6 patients, and femoral entry in 4 patients. Perioperative factors were evaluated to identify the reliability and eventual benefits of direct cannulation method at the aortic arch.

Results: There were no operative deaths and cumulative 30-day mortality rate was 25% (6). Permanent neurological deficits were not observed; in 1 patient transient changes occurred (4%). Time to reach circulatory arrest was the shortest in the direct access group, with mean 27±11 (CI: 20.6–33.3) min *vs.* 43±22 (28.0–78.0) min (p=0.058) and 32±8 (23.6–40.4) min (p=0.34) by femoral cannulation and subclavian entry, respectively. Direct arch cannulation resulted in the best renal function in the first 72 h after surgery and similar characteristics were observed in lactic acid levels.

Conclusions: Ultrasound-guided direct cannulation on the concavity of the aortic arch using a Seldinger technique is a reliable method in dissection repairs. Prompt antegrade perfusion provides not only cerebral but also peripheral organ and tissue protection, which is an advantage in this high-risk group of patients.

MeSH Keywords: **Aortic Aneurysm • Aortic Diseases • Hemodynamics • Tissue Preservation**

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Background

Acute Stanford type A dissection, with or without involvement of the aortic arch, is a clinical emergency that requires immediate surgical intervention. Despite remarkable achievements by Cooley [1], DeBakey [2], Alley [3], and Bahnson [4], surgery of the aortic arch remains a high-risk intervention. Surgical therapy today consists mainly of an interposition graft replacement of the ascending aorta. When indicated, this may be extended to include aortic arch replacement; usually as a hemiarch replacement or, when required, total arch replacement. Acute aortic valve insufficiency, when present, is generally treated by valve resuspension or replacement. Mortality rates of these operations have dramatically improved as the result of recent advances in preoperative preparation, intraoperative techniques, and postoperative care [5]. Nevertheless, operations for acute type A dissections are still associated with a relatively high rate of mortality and postoperative morbidity compared to routine heart surgery [6].

In patients undergoing aortic surgery, especially with involvement of the aortic arch, perioperative stroke and death can be precipitated by either dislodgement of atherosclerotic debris from the aortic wall or organic malperfusion. Cardiopulmonary bypass (CPB) via axillary/subclavian artery has become popular as an alternative perfusion site in recent years, predominantly for acute aortic dissections and patients with severe aortic atherosclerosis [7–13]. Despite several advantages of axillary/subclavian artery cannulation (e.g., antegrade perfusion of the aorta), problems and complications of this technique are becoming increasingly recognized with more frequent use of this approach. Axillary/subclavian artery inflow may not be suitable for rapid establishment of antegrade perfusion in cases with hemodynamic instability, because it requires more time for preparation prior to cardiopulmonary bypass. In patients with a small body surface area, limitation of pump flow due to a narrow axillary artery may be a concern [14,15].

However, cannulation for extensive aortic lesion in type A aortic dissection can present an enormous challenge, either through axillary/subclavian or lower limb arteries, if they are involved in the pathological process [12,16,17]. In light of problems associated with the above cannulation techniques, we started to use an innovative ultrasound-guided entry method on the usually uninvolved aortic wall segment on the concavity of the aortic arch via Seldinger technique. This aortic wall segment at the ligamentum arteriosum is not completely identical to the vast majority of the aorta, because it contains more connective tissue as a remnant of the ductus arteriosus; also, coarctations are located here due to this exclusive histological background. This relative rigidity can play a role in preventing dissections in the area and therefore providing an ideal point for arterial cannulation without purse-string stitches. As this aortic area allows easy landing into the true lumen at cannulation, the rest of the configuration of the aortic dissection is not important for perfusion. With the aid of preoperative CT scan for planning the cannulation spot and continuous intraoperative transesophageal ultrasound (TEE) guidance throughout the direct cannulation procedure of the diseased aorta, we achieved prompt antegrade perfusion to repair the involved ascending aorta and aortic arch, and subsequently evaluated its safety and efficacy.

Material and Methods

Within a period of 2.5 years, 24 consecutive patients (mean age: 59±14 years, CI: 53.0–64.8, 17 men and 7 women) underwent operations on the thoracic aorta. In all patients, a standard operative technique for acute aortic dissection was used and the only difference in surgical strategy was the choice of site for arterial cannulation. Direct cannulation by Seldinger technique was used in 14 patients (57%), subclavian access in 6 patients (25%), and femoral entry in 4 patients (17%). Further preoperative data is provided in Table 1.

The preoperative diagnosis was established on the basis of emergency computed tomography with additional intraoperative transesophageal echocardiography in all patients. Aortography or coronary angiography was not performed for preoperative evaluation.

Table 1. Demographic and preoperative data. Significance calculations are given as comparisons to the group with direct cannulation.

Characteristics	Direct	Subclavian	Femoral
No. of patients	14	6	4
Male	8	6	3
Female	6	0	1
Age (years (median))	65±10 (66)	51±17 (49) [N.S. p=0.11]	51±13 (46) [N.S. p=0.13]
Hypertension	13	5	3
Preoperative ventilated	4	4	3
Preoperative renal insufficiency	2	2	0

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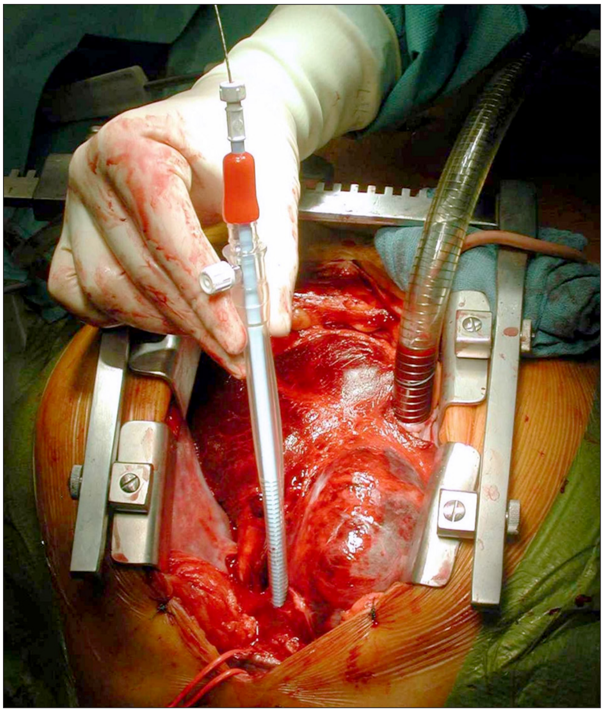

Figure 1. Direct aortic cannulation via Seldinger technique.

The standard operative technique for aortic dissection repair at our institution has been graft replacement of the ascending aorta and proximal aortic arch. Inspection of the supraaortic vessels was always carried out to decide whether to perform a concomitant island transposition, depending on the supraaortic status. The patient was placed in the standard supine position. The arms were horizontal beside the body as for the usual cardiac procedure. Monitoring of arterial pressure was performed by placing 3 lines routinely in both radials and the right femoral artery.

The ascending aorta and aortic arch were exposed through a median sternotomy. The approach of concavity of the aortic arch at level of Botallo's ligament (ligamentum arteriosum) was followed by a minimally invasive cannulation with dilation steps by Seldinger technique (Fem-Flex Femoral Arterial Cannula®, 24 Fr TFA 02425H Edwards Lifesciences LLC, Irvine, USA; Joline Special Dilatatorset®, Hechingen, Germany) (Figure 1). As previously described, no purse-string sutures are required in this area; the arterial line is fixed with a stitch to the cranial sternotomy skin incision corner to avoid accidental dislocation. Correct position of the guide wire and cannula in the aorta was routinely confirmed by TEE, or by epiaortic ultrasound in rare cases of technical difficulty with TEE. The same type of cannula was inserted in both peripheral access sites. CPB was instituted between the arterial cannulation site and right atrium. The patient was cooled to a tympanic temperature of 19–20°C (Mon-a-therm® Thermistor YSI 400 Series tympanic temperature probe, Mallinckrodt Inc., St. Louis, USA). Rectal (Thermocouple probe, Mallinckrodt Medical, USA) and bladder (Curity®, Degania, Israel) temperatures were also followed-up simultaneously throughout the procedures. After cross-clamping, an ascending aortic incision was made and antegrade crystalloid cardioplegic solution (2000 ml Custodiol® HTK-Solution by Brettschneider, Dr. F. Köhler Chemie, Hähnlein, Germany) was administered proportionally through both coronary orifices. During deep hypothermic circulatory arrest (HCA), selective antegrade cerebral perfusion (SACP) was applied via the carotid arteries (DLP Retrograde Coronary Sinus Perfusion Cannula with manual Inflating Cuff®, Medtronic Inc., Minneapolis, USA) at a flow rate adapted to keep a constant cerebral O_2 saturation on each side, providing a perfusion pressure of 35–40 mmHg. Cerebral monitoring was performed with near infrared spectroscopy (INVOS® cerebral oximeter, Somanetics Inc., Troy, USA), and brain tissue oxygen saturation measured 65–70% continuously during perfusion, which corresponded to the induction values.

Reconstruction of the aorta was done with a woven Dacron side-branched vascular prosthesis (Hemashield Platinum Woven Double Velour Vascular Graft®, Boston Scientific Inc., Wayne, USA) including the island-type reinsertion of all supraaortic vessels, if applicable. The false lumen was eradicated with 45% bovine serum albumin-10% glutaraldehyde glue (BioGlue®, CryoLife International Inc., Kennesaw, USA); aortic valve commissures were refixed with the resuspension suture technique. The valve was replaced if it appeared diseased. Composite valve graft replacement was applied in patients with Marfan syndrome or if intraoperatively severe local involvement of the aortic wall could be observed. The decision whether to implant a composite graft did not depend on the maximal diameter of the aortic root, but rather was based on the presence of Marfan syndrome or the severity of wall destruction. Systemic reperfusion and rewarming was started through the graft side-branch. The summary of performed surgical procedures is presented in Table 2.

Statistical analysis

Statistical analysis was performed using SPSS v15.0 software (IBM Corporation, Armonk, New York, USA). For graphic demonstration, Microsoft Excel 2007® (Microsoft Corporation, Redmond, Washington, USA) was used.

For statistical comparisons of the groups, the Mann-Whitney U test and chi-square test. Although the number of cases in 2 groups (femoral cannulation and subclavian approach) was relatively low (4 and 6 cases, respectively), we considered a p-value <0.05 to be significant to enhance the statistical power of the comparisons. Where appropriate, confidence interval (CI) was calculated with a confidence level of 95%. Data are presented as mean values ±SD and, where applicable, the corresponding CI is in parentheses.

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Table 2. Surgical procedures.

Surgical procedure	Direct	Subclavian	Femoral
Ascending aorta + hemi arch	13	6	4
Ascending aorta + total arch	1	*	*
° David reconstruction	1	*	*
° Yacoub reconstruction	2	1	1
° Bentall procedure	3	1	*
° Coronary bypass grafting	2	1	*

° Marks an additional procedure of aortic graft implantation.

Table 3. Intraoperative data. Significance calculations are given as comparisons to the group with direct cannulation.

Intraoperative data	Direct		Subclavian		Femoral	
	Mean ±SD (median)					
Time to HCA (min)	27±11	(26)	32±8	(31)	43±22	(48)
CPB time (min)	181±77	(149)	188±32	(193)	180±52	(200)
HCA time (min)	51±20	(52)	51±22	(50)	53±31	(48)
SACP time (min)	39±18	(39)	36±24	(25)	41±29	(31)
SACP flow right start (ml/min)	201±41	(200)	218±52	(200)	258±59	(250)
SACP flow right end (ml/min)	196±37	(185)	282±56	(300)	350±54	(330)
SACP flow left start (ml/min)	216±54	(205)	243±99	(275)	240±37	(240)
SACP flow left end (ml/min)	227±68	(220)	283±49	(300)	275±64	(275)
Tympanic temperature minimum	20.8±0.9	(20.8)	19.5±1.0	(19.7)	20.8±0.3	(20.9)
Rectal temperature minimum	26.9±3.3	(27.3)	26.8±4.3	(27.6)	26.0±2.3	(26.0)
Urinary bladder temperature minimum	26.0±4.8	(25.6)	24.8±3.4	(24.8)	23.8±2.3	(23.7)

HCA – hypothermic circulatory arrest; CBP – cardiopulmonary bypass; SACP – selective antegrade cerebral perfusion.

Results

There were no intraoperative deaths; cumulative 30-day mortality rate was 25% (6) for the entire patient population; 3 of 14 (21%) in the direct group, 2 of 6 (33%) in the subclavian group, and 1 of 4 (25%) in the femoral cannulated group (p=0.24 and p=0.46, respectively), all due to multiorgan failure. Direct aortic cannulation was safely performed in all cases and there was no need to switch to an alternative cannulation site. The adventitia of the dissected aorta was firm enough to support the cannula inserted by Seldinger technique with staged dilatators, and there was no case of complicated local massive hemorrhage at the cannulation site. No malperfusion or apparent thromboembolism due to cannulation was observed. Malperfusion would have been anticipated if a cerebral saturation difference of 10% occurred compared to preoperative values and/or if there was a pressure difference between the peripheral arteries greater than 20 mmHg. Permanent neurological deficits were not present. Transient changes occurred in 1 patient (4%) in the direct group. Because the Seldinger technique was easier and quicker to apply than the peripheral approaches (Table 3) and it showed certain advantages in the preliminary results, we permanently changed our cannulation method to the direct aortic entry in all patients. The transesophageal echo guidance was useful for aortic cannulation along with color Doppler imaging, which provided real-time information about the true lumen antegrade perfusion.

Mean extracorporeal perfusion duration was 183±63 min (156.4–209.6) and mean time to reach circulatory arrest was 28±14 (23.1–34.9) min in the entire cohort, with no significant differences between groups (Table 3). Initial SACP flow was comparable in all 3 groups, but we observed a significant difference between the SACP flow required to maintain

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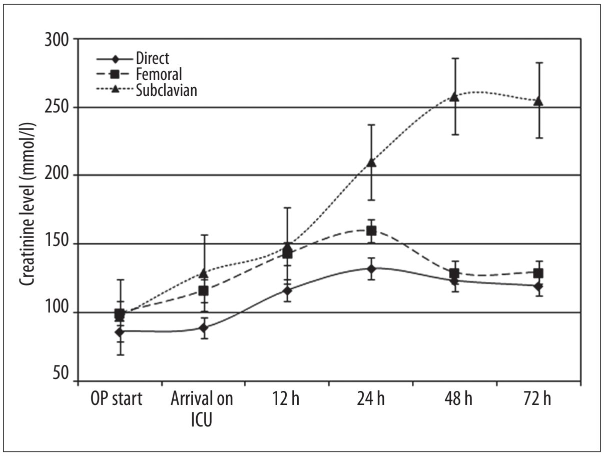

Figure 2. Changes in creatinine levels with different cannulation methods.

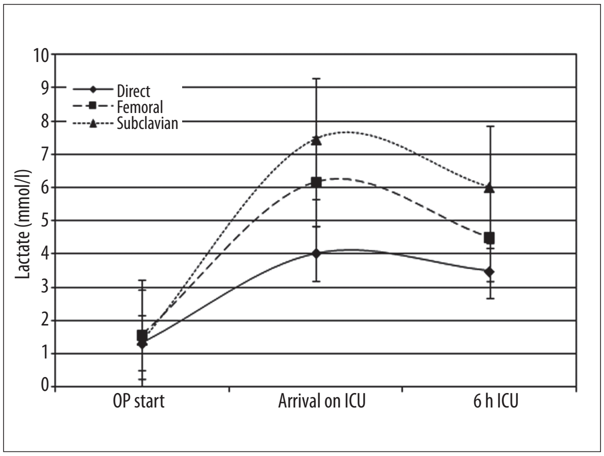

Figure 3. Lactate mirror of the 3 perfusion groups.

the initial cerebral saturation at constant blood pressure at the end of the perfusion period between the direct cannulation group (right: 196±37 ml/min [177.3–227.4]; left: 227±68 ml/min [184.8–247.2]) and both the femoral entry group (right: 350±54 ml/min [264.1–435.9] [p=0.006]; left: 275±64 ml/min [173.2–376.8] [p=0.24]) and the subclavian access group (right: 282±56 ml/min [223.2–340.8] [p=0.02]; left: 283±49 ml/min [231.6–334.4] [p=0.05]) in favor of the direct cannulation. Further intraoperative data were evaluated to identify the reliability and benefits of direct cannulation method (Table 3).

Time required to reach circulatory arrest was the shortest in the direct access group, with mean 27±11 (20.6–33.3) min; in the femoral cannulation group it was 43±22 (28.0–78.0) min (p=0.058); and in the subclavian entry group it was 32±8 (23.6–40.4) min (p=0.34).

Direct arch cannulation resulted in the best renal function on the first postoperative day, with a creatinine level of mean 140±48 mmol/L (112.3–167.7); the femoral entry showed 179±79 mmol/L (53.4–304.6; p=0.08); at subclavian access 199±69 mmol/L (89.3–308.7; p=0.25). Although comparison of creatinine levels in the direct cannulation group and the other 2 approaches shows the clear superiority of the direct cannulation technique, the differences did not reach the level of significance due to a relatively low number of patients in the subclavian access and femoral entry groups. Figure 2 demonstrates the plasma creatinine levels during the first postoperative 72 hours. Two of the direct and 2 of the subclavian cannulated patients were excluded from the statistical analysis due to preoperative renal impairment. Similar characteristics could be observed in lactic acid levels in the intensive care unit as a marker of preoperative global ischemia (Figure 3). Four of the direct, 1 of the femoral, and 2 of the subclavian perfused patients were not considered for statistical analysis due to an initial lactic acid level over 2 mmol/l.

Treatment duration in the intensive care unit (ICU) of over 5 days occurred in 5 of 14 (36%) patients in the direct group, 4 of 6 (66%; p=0.21) in the subclavian group, and 2 of 4 (50%; p=0.51) in the femoral cannulated patients.

Discussion

Our study demonstrates that direct cannulation on the concavity of the aortic arch instead of the femoral or right subclavian artery may improve the results of ascending aorta and aortic arch replacement. However, this was an observational study because the 3 groups were not balanced.

Although the idea of cannulating ascending aorta in type A aortic dissection was described decades ago [18,19], direct cannulation to the ascending aorta has only been performed occasionally as an emergency technique to avoid retrograde malperfusion [20]. Recently, successful attempts have been made to establish antegrade perfusion via the ascending aorta primarily for type A dissections [21–23]. Ascending aorta or arch cannulation may have the great advantage of technical simplicity, especially when there is hemodynamic instability or at dissected limb arteries [24–27]. According to these reports, this technique can be performed safely under ultrasound guidance. Establishing an access point at the level of Botallo's ligament by Seldinger technique could provide a useful alternative to establish rapid arterial entry. At this section of the aorta the pulmonary bifurcation is firmly connected by massive connective tissue, which usually prevents complete dissection in this area. With the aid of this rapid and atraumatic cannulation method, CPB can be established, thereby reducing the likelihood of perioperative shock, which would lead to an increased mortality [28]. Although the time to reach circulatory arrest was remarkably lower using the direct cannulation technique compared to the other 2 accession methods, the level of significance was not reached because of the

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relatively low number of patients in the other 2 groups and greater standard deviation values.

Rapid establishment of arterial access facilitates quicker initiation of antegrade systemic perfusion and core cooling, which also reduces the duration of the surgical procedure. This may also contribute to lower morbidity through enhanced organ perfusion and reducing the probability of coagulation disorders. Our method of aortic cannulation has additional advantages. The benefit of this type of arch cannulation is combined with having the tip of the cannula located in the proximal descending aorta. Consequently, the turbulence at the tip of the cannula occurs in the descending aorta, thereby reducing the risk of embolization of debris into the carotid arteries. A further advantage of proximal descending aortic perfusion is the reduction of the fluid jet stream – Coanda's effect – which can be associated with relative carotid hypoperfusion in patients undergoing perfusion with a short cannula from the ascending aorta [29]. Most patients who have a type A aortic dissection undergo at least a hemiarch replacement in our practice, so the cannulations site is removed with the affected aortic wall segment, and the repositioned cannula fits perfectly into the side-branched prosthesis.

In addition, transesophageal or epiaortic ultrasonographic guidance may also be indispensable for reliable real lumen cannulation, examinations of which are simple methods to obtain imaging information of the ascending aorta and proximal arch. Although preoperative CT scan is mandatory to obtain correct operative planning, the ultrasonographic control provides real-time information on the location of intimal tear, intimal flap, true and false lumen, because this intraluminal situation can change progressively following the CT scan. Moreover, the guide wire and the correct position of the cannula can be checked continuously, avoiding false lumen perfusion, which is not the case with the peripheral approaches. The simultaneous application of ultrasonographic control and cerebral monitoring by near infrared spectroscopy reduces the likelihood of malperfusion, thromboembolism, and subsequent extension of the false lumen. We have observed no local complications with the Seldinger technique, but were always prepared to perform an apical cannulation described by Wada et al. [30] as a bail-out procedure.

The problem of neurological injury resulting from embolic events and cerebral malperfusion in aortic dissections should be discussed because there are a number of different cannulation approaches. Femoral cannulation is associated with a higher risk of retrograde embolization and potential perfusion of the false lumen via the distal re-entry point; although in our cohort there were no perfusion complications in this group. In this respect, techniques providing antegrade flow may offer a better option, especially in patients with Stanford A dissections [5].

In our practice, Seldinger cannulation on the concavity of the aortic arch has become the standard approach for arterial access in both elective and emergency cases as by the Hannover group [22,31]. This cannulation technique is fast and simple, which can be important, especially in hemodynamically unstable patients. It avoids additional time-consuming incisions, thereby avoiding additional surgical trauma and possible local complications at peripheral cannulation sites. In combination with cold selective antegrade cerebral perfusion and deep/moderate hypothermic circulatory arrest, this technique allows adequate protection for the body and is not associated with higher risk of cerebral microemboli [32,33]. The effectiveness of selective antegrade cerebral perfusion as an adjunct to hypothermic arrest has been proven in numerous studies [34,35].

As with other surgical approaches, there are some disadvantages that need to be recognized. This includes cannulation of the false lumen with potential malperfusion or even complete rupture of the cannulated aorta. For those emergency situations, alternative strategies have to be available. In the above-mentioned cases there are basically 3 major goals to be achieved: cerebral protection, myocardium conservation, and proper perfusion of the lower body. This stepwise approach necessitates the cooperation of the anesthesiologist, perfusionist, and surgeon to obtain optimal results.

Reece et al. applied the Seldinger technique for cannulation in 24 patients, resulting in no misplacement [36], but the study was not randomized and various aortic pathologies were excluded, leading to potential selection bias. Furthermore, the cannula is held in position manually during the cooling phase, preventing further surgical activity during this period; the authors are not convinced that sutures in the dissected aorta remain stable. With our technique there is no need for sutures in the aorta; the cannula is fixed to the cranial skin incision corner by a suture and situated deep enough in the proximal descending aorta to not require any further support. Inoue et al. report on 32 cases using the Seldinger technique, controlled by epiaortic ultrasound. Prior to ascending aortic cannulation, they cannulated the femoral artery to be able to regulate the aortic pressure [26]. Although no malperfusion occurred in their series, the double arterial approach is questionable in the context of avoiding time-consuming preparations and potential retrograde embolism or further dissection [37].

Transapical cannulation is another elegant method for achieving reliable antegrade access, as described by Wada et al. [30]. In a large cohort of 138 patients, the cannula was inserted through a 1-cm apical incision directly into the true lumen via the aortic valve under TEE guidance. The impact of causing an acute aortic insufficiency in this context has not been discussed in detail. Both Wada's technique and Reece's method have the disadvantages of resulting in prolonged cardiopulmonary bypass times because no additional procedures can be performed during cooling, such as inspection and preparation of the aortic root.

Axillary/subclavian cannulation is also an elegant, widely used method for arterial access during aortic arch surgery [16]. However, it is presumably more time consuming, and carries the possibility of failure rates up to 4.2%. Nevertheless, it provides the possibility of continuous unilateral blood flow without interruption [38]. Applying the standard technique, however, only the right hemisphere is continuously perfused, which can result in malperfusion of the contralateral hemisphere; Merkkola et al. demonstrated that up to 17% of the patients have an incomplete circle of Willis [39]. Even in the presence of a complete circle of Willis, it is still unclear if the exclusively right-sided perfusion can sufficiently supply the left hemisphere. Our results with SACP also demonstrate that the lowest perfusion volume is necessary to maintain the proper bilateral cerebral oxygenation in the direct cannulated group. Since the brachiocephalic trunk divides anatomically into 2 nearly equivalent branches – the right carotid and subclavian artery – the provided flow through the latter vessel on CPB can lead to a relative hyperperfusion of the right carotid parallel to a relative hypoperfusion of the aorta. This could explain our findings regarding SACP flow values and peripheral organic perfusion monitored by the renal function and lactate level. The Seldinger technique delivers rapid arterial access, which results in a shorter cerebral and peripheral ischemic periods. Subclavian perfusion provides sufficient oxygenation for the right hemisphere but may not for the contralateral side, so the required initial right SACP flow is similar to the direct group, but the left shows values similar to the femoral group. Additionally, the constant relative hyperperfusion of the right hemisphere most probably leads to an intracerebral edema, which elevates the SACP flow requirements to maintain a proper cerebral saturation at the end of HCA. The relative hypoperfusion of the body is characterized by diminished renal function at subclavian cannulation. In the subclavian approach, smaller cannulas can usually be applied due to the anatomical situation. The femoral access takes more time to establish, resulting in relative cerebral hypoperfusion/longer ischemic period shown by the higher initial SACP flow requirements in this group. The femoral perfusion, in case of no malperfusion, provides a good renal blood supply, thus the renal function is better preserved than with subclavian access, but the initial hypoxia due to delayed establishment of perfusion is clear when comparing the creatinine levels in this group to the direct cohort.

Moizumi et al. could not use axillary artery access in 5.5% of their aortic dissection cohort, because the pathological changes extended into the axillary artery [40]. Our first experience with Seldinger technique was in a patient with dissection in all limb arteries [25]. Carotid artery cannulation, performed by Urbanski in 100 patients, including 27 with Stanford A dissections, seems to be another alternative method, but also carries the risk of brain malperfusion and later complications in the vessel [41]. The report on innominate artery cannulation by Di Eusanio et al. included 55 patients, with only 2 in acute aortic dissections [42]. Fusco at al presented their results in femoral artery cannulation in 2004 [43]. With a conversion rate of 2.5% to ascending aortic cannulation, they conclude that femoral cannulation is appropriate and yields excellent clinical results, but they did not consider the problem of retrograde embolism from the downstream aorta, probably because in their experience arteriosclerosis is less common in dissection patients.

Conclusions

Our study has some important limitations. It was an observational study without randomization and presents preliminary experience with a small number of patients. These good preliminary results have to be confirmed by further studies in a larger group of patients.

In conclusion, arterial access for establishing CPB, especially in patients requiring repair of acute type A aortic dissection, is a controversial subject in the current literature [44]. Minimal invasive central cannulation by Seldinger on the concavity of the aortic arch is technically feasible and safe. It may avoid cerebral embolization and organ malperfusion, and thus may reduce the rate of neurological and malperfusion complications. This alternative arterial inflow technique can be applied for prompt establishment of CPB in type A dissections, especially during hemodynamic instability.

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