OPEN ACCESS Freely available online

ISSN: 2329-6925
Journal of Vascular Medicine & Surgery

Short Communication

Spinal Cord Ischemia Prevention in Thoracoabdominal Aortic Aneurysm Repair: The Role of Temporary Aneurysm Sac Perfusion

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ABSTRACT

Spinal Cord Ischemia (SCI) is a dreadful complication following Thoracoabdominal Aortic Aneurysm (TAAA) repair, often resulting in paralysis and significantly reducing patient quality of life. The primary strategies for SCI prevention are Cerebrospinal Fluid (CSF) drainage and permissive hypertension. Staging the repair by at least five days is another strategy employed in endovascular and open repairs. Temporary Aneurysm Sac Perfusion (TASP) is a newly adopted technique in staged TAAA repair that reduces SCI risk by promoting the development of spinal collateral networks, making it an effective adjunct in both endovascular and hybrid staged TAAA repairs.

Keywords: Thoracoabdominal aortic aneurysm; Temporary aneurysm sac perfusion

DESCRIPTION

The prevention of Spinal Cord Ischemia (SCI) remains a critical challenge in the management of Thoracoabdominal Aortic Aneurysms (TAAA). SCI can lead to paralysis, significantly impacting patient outcomes and decreasing their quality of life [1]. The pathophysiology of SCI is complex and not fully understood, but it is more common in type II TAAA and open repair [2]. This increased risk is often due to aortic clamping during open repair, which impedes the blood supply to the spinal cord [3].

Several strategies have been used to mitigate the incidence of SCI, including Cerebrospinal Fluid (CSF) drainage and permissive hypertension. Both strategies aim to improve Spinal Cord Perfusion Pressure (SCPP), which is the difference between blood pressure and CSF pressure, with the goal of maintaining an SCPP of at least 60 mmHg. CSF drainage aims to increase SCPP by maintaining CSF pressure below 15 mmHg in the perioperative period [4]. However, it is associated with several complications, such as infection, subarachnoid bleeding, spinal headaches, and spinal hematoma [5]. Permissive hypertension involves maintaining a mean arterial pressure of ≥ 70 mmHg, which can also improve SCPP [6].

With the increasing use of endovascular techniques in TAAA repair, these traditional strategies have become less popular. The complications associated with CSF drainage and its limited role in decreasing the SCI rates after Thoracic Endovascular Aortic Repair (TEVAR) necessitate new strategies to mitigate SCI risk while minimizing complications associated with spinal drain placement [7-9]. Furthermore, delayed paraplegia can occur within 72 hours postoperatively due to the failure of the existing spinal collateral networks to maintain adequate perfusion. Despite this risk, spinal drains are rarely maintained beyond this period [6,10]. Staging the repair by at least five days is another strategy that has been employed in both endovascular and open repairs. This strategy creates a metabolic demand and oxygen delivery mismatch by the gradual decrease in the blood supply to the spinal cord, promoting the development of new spinal collateral networks [11]. In endovascular repair, a two or more-stage approach is often used, commonly with an interval of one week to several months [12]. Minimally Invasive Segmental Artery Coil Embolization (MISACE) can be performed before the thoracic repair to precondition the spinal circulation through the same mechanism [13]. A hybrid approach, combining open and endovascular techniques, has been suggested to decrease morbidity and mortality. This can be achieved by performing abdominal aorta debranching of the

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Received: 12-Jul-2024, Manuscript No. JVMS-24-26488; **Editor assigned:** 16-Jul-2024, PreQC No. JVMS-24-26488 (PQ); **Reviewed:** 30-Jul-2024, QC No. JVMS-24-26488; **Revised:** 06-Aug-2024, Manuscript No. JVMS-24-26488 (R); **Published:** 13-Aug-2024, DOI: 10.35248/2329-6925.24.12.566.

Citation: Farres H, Alsabbagh Y (2024) Spinal Cord Ischemia Prevention in Thoracoabdominal Aortic Aneurysm Repair: The Role of Temporary Aneurysm Sac Perfusion. J Vasc Surg. 12:566.

mesenteric and renal arteries, followed by total exclusion of the aneurysmal aorta [14].

Temporary Aneurysm Sac Perfusion (TASP) is a newly adopted technique in staged endovascular TAAA repair. The theory behind TASP is to create a metabolic demand and oxygen delivery mismatch in spinal cord perfusion, inducing a state of reversible ischemia. This promotes the development of new spinal collateral networks [11]. This can be achieved by leaving an intentional type 1b/c endoleak through the delayed insertion of bridging and/or iliac limbs or by leaving a bare stent in one of the visceral branches. Our literature review found that following endovascular TAAA repair, 40 out of 479 patients developed temporary SCI and 10 developed permanent SCI, supporting the benefit of this technique in SCI prevention. TASP is seldom applied in hybrid repair. We successfully employed this technique using a hybrid approach (Figure 1), preventing SCI without creating any additional complications [15]. Incorporating intraoperative neuromonitoring can further assist in decision-making regarding the utilization of TASP [16].

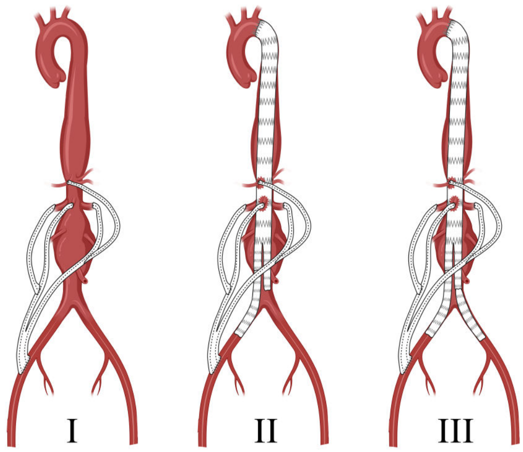

Figure 1: Illustration of hybrid Thoracoabdominal Aortic Aneurysm (TAAA) repair. 1) Abdominal aorta debranching of the mesenteric and renal arteries; 2) Endovascular thoraco-abdominal aneurysm repair, leaving the left iliac limb unbridged to allow for Temporary Aortic Aneurysm Perfusion (TASP); 3) Complete exclusion of the aneurysm.

Applying TASP can be limited to certain populations due to specific risks. Leaving the aneurysm sac unexcluded to promote the development of spinal collateral networks carries the potential risk of interval aneurysm rupture. This risk is particularly pronounced in aneurysms larger than 7.5 cm in diameter. Consequently, it is recommended to perform a single-stage repair for TAAAs >7 cm [17].

Future research may be warranted to optimize TASP protocols, enhancing both its efficacy and safety. Studies comparing different methods of the best approach to create TASP and the timing of the staged procedures would provide valuable insights. Additionally, research exploring the long-term outcomes of patients treated with TASP, including quality of life and neurological function, would help to establish its role in standard clinical practice.

CONCLUSION

Preventing SCI in TAAA repair demands a multifaceted approach, incorporating both traditional and innovative techniques. While CSF drainage and permissive hypertension remain vital, the evolution of endovascular techniques and the introduction of TASP offer new possibilities for improving patient outcomes. Our case underscores the successful application of TASP in a hybrid TAAA repair, demonstrating its feasibility and efficacy in preventing SCI. Future research may be warranted to optimize TASP protocols enhancing both its efficacy and safety.

FUNDING

This Study was funded by Mayo Clinic, USA.

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