OMCR

OMCR 2014;6 (4 pages)
doi:10.1093/omcr/omu019

Case Report

# Meningeal haemorrhage secondary to cerebrospinal fluid drainage during thoracic endovascular aortic repair

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Received 18 February 2014; revised 7 May 2014; accepted 13 May 2014

Thoracic endovascular aortic repair (TEVAR) has shown lower mortality compared with open surgical repair (OSR). However, the risk of spinal cord ischaemia (SCI) remains similar than OSR. As a prophylactic measure to reduce the risk of SCI, cerebrospinal fluid (CSF) drainage has been widely used in OSR. In TEVAR, the utility of this adjunct is still controversial. We report a case of a 56-year-old man referred for TEVAR for a descending thoracic aneurysm that previously underwent an abdominal aneurysmectomy with aortobifemoral bypass graft. On the day before, a lumbar cerebrospinal drain was placed prophylactically. Forty-eight hours after the procedure, meningeal symptoms without neurological deficits developed. Clinical investigation revealed meningeal haemorrhage. Therapy with nimodipine was initiated with symptomatic relief. Evidence from randomized controlled trials supporting the role of CSF drainage in TEVAR is still lacking. We discuss the current recommendations, potential benefits and risks and cautions associated with CSF drainage in TEVAR.

## INTRODUCTION

Thoracic endovascular aortic repair (TEVAR) is emerging as a less invasive alternative to open thoracic aortic aneurysm (TAA) and thoracoabdominal aortic aneurysm (TAAA) repair. Recent series have reported encouraging results in terms of technical success and mid-term outcomes compared with traditional open repair [1, 2]. Although morbidity and mortality rates are lower with TEVAR, risk of neurological complications still remains, including stroke and spinal cord ischaemia (SCI) [3].

SCI is one of the most feared complications of TAA or TAAA repair, and TEVAR. Patients with post-operative SCI have a mortality rate three times that of patients without SCI [4]. The precise pathophysiology underlying the SCI is unclear. In open surgical repair (OSR), peri-operative haemodynamic instability has been associated with the occurrence of SCI [4]. In endovascular repair, the haemodynamic related derangements are generally reduced since it does not require aortic cross clamping [4, 5]. However, in the latter, the intercostal arteries covered by the stent graft cannot be re-implanted thus potentiating the risk of ischaemia. Factors associated with SCI after TEVAR include long-segment stenting (particularly when involving the Adamkiewicz artery area), occlusion of the left subclavian or hypogastric arteries and previous abdominal aortic surgery [5].

SCI can be ameliorated or even prevented through the use of cerebrospinal fluid (CSF) drainage [6–8]. The rationale for CSF drainage is that a hypothetical decrease in intrathecal pressure may increase medullary blood perfusion and thus minimize potential spinal cord ischaemia. Lumbar CSF drainage is widely used with open descending and TAAA repair. To date, three randomized controlled trials have examined the benefits of CSF drainage in open TAAA repair [9–11]. However, the utility of this adjunct is still controversial in TEVAR. CSF drain placement is not without complications as well [12, 13].

We report a case of meningeal haemorrhage following CSF drainage during TEVAR, and discuss the current recommendations, potential benefits and risks associated with CSF drainage in this setting.

## CASE REPORT

A 57-year-old man with a history of abdominal aneurysmectomy with aortobifemoral bypass graft in the previous year was scheduled to undergo TEVAR for a descending thoracic aneurysm (78 × 82 mm). The day before, a lumbar cerebrospinal drain at L4–5 was placed. Right femoral access was obtained by surgical dissection of the right graft branch. The aortic aneurysm was corrected with the use of two endovascular grafts (34 × 150 mm and 38 × 150 mm, Valiant Captivia, Medtronic®, Minneapolis, MN, USA) which extended from the mid-segment of the descending thoracic aorta to the beginning of the abdominal aorta. The procedure was uneventful. During the intervention, 10 ml of CSF was drained and drainage was maintained for 24 h up to a total volume of 25 ml. On the second day post-intervention, the patient developed frontal headache, nuchal rigidity and fever (axillary temperature of 38.3°C). No neurological motor or sensitive deficits were documented. Laboratory findings included leucocytosis and high-serum reactive C-protein. The urgent cerebral computed tomography (CT) scan showed parietal subarachnoid haemorrhage, most probably due to meningeal vessel haemorrhage. Lumbar puncture confirmed the diagnosis of subarachnoid haemorrhage and excluded central nervous system infection. Bacteriological blood and CSF cultures were also negative. Therapy with nimodipine was initiated, resulting in symptomatic relief along with apyrexia and decreasing inflammatory laboratory parameters. On the tenth day post-intervention, a cerebral and neuroaxial magnetic resonance imaging scan was performed showing haemorrhagic residuals in the parietal sulci of both cerebral hemispheres and vertebral canal lumbar segments, as well as leptomeningeal haemosiderosis. The patient was discharged home 14 days after hospital admission, asymptomatic and on one month dual antiplatelet therapy. At the 6-month follow-up the patient remained asymptomatic, and no vascular complications were detected with multislice CT.

## DISCUSSION

The incidence of SCI after TEVAR is a rare but disastrous and challenging clinical situation. Currently, there are insufficient data to allow meaningful evaluation of the risks versus the benefits of prophylactic CSF drainage in TEVAR. The prophylactic use of CSF drainage is currently recommended in selected patients [14].

SCI is a well-recognized complication of both OSR and TEVAR. SCI may complicate 8–28% of OSR [15] and 2–7%

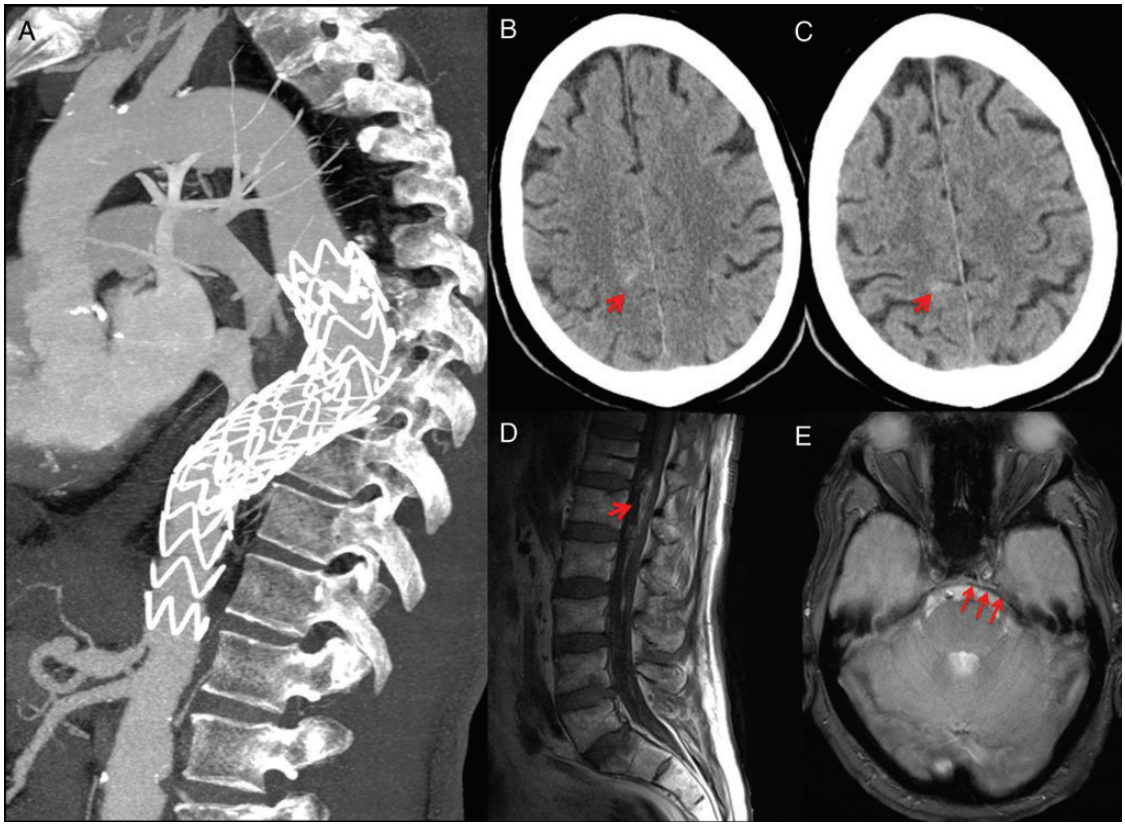


**Figure 1:** Multislice computed tomography reconstruction (**A**) showing post-TEVAR final result. Two endovascular grafts extending from the mid-segment of the descending thoracic aorta to the beginning of the abdominal aorta were used. Cerebral computed tomography scan (**B** and **C**) revealed parietal sulcus hyperdensity traducing acute subarachnoid haemorrhage. Cerebral and neuroaxial magnetic resonance imaging, T1 sequence (**D**) depicted hypersignal anterior to the cauda equine, suggesting subacute phase blood (arrow) and T2 gradient echo sequence (**E**) showed leptomeningeal hyposignal revealing haemosiderin residuals deposits (arrows) suggesting subacute subarachnoid haemorrhage.

of TEVAR procedures [16]. A series of 414 OSR and 94 TEVAR patients showed a similar incidence of SCI in both groups (6.4 versus 4.3%, $P = 0.401$); however, delayed SCI occurred more frequently in the TEVAR group [17]. Except for the delayed onset, SCI showed similar course of recovery in the two groups. It is unclear why the incidence of delayed SCI was higher in the TEVAR group. Some possible explanations could be the gradually reduced flow to the collateral network as the time passed, and the delayed intercostal artery thrombosis (with endoleak resolution).

From the European Registry on Endovascular Aortic Repair (EuREC) [18], a risk model for symptomatic SCI was developed to test the positive-predictive value of prolonged intra-operative hypotension and/or simultaneous closure of at least 2 of 4 the vascular territories supplying the spinal cord (left subclavian, intercostal, lumbar and hypogastric arteries). Symptomatic SCI was associated with the simultaneous closure of at least two vascular territories supplying spinal cord, especially in combination with prolonged intra-operative hypotension, but was not associated with extensive coverage of intercostal arteries alone. These results emphasize the need to preserve the left subclavian artery and to prevent SCI in high-risk patients.

The utility of lumbar CSF drainage for the prevention of SCI following TEVAR is not clear in the current literature. No randomized studies are available, and a wide variety of protocols for lumbar CSF drainage have been used. Some units routinely use prophylactic CSF drainage in all patients undergoing TEVAR, others use it selectively for patients considered at high risk for SCI, while yet others place lumbar drain only when evidence of SCI develops post-operatively. A recent systematic review by Wong *et al*. [15] of SCI and CSF drainage after TEVAR reported a crude incidence of SCI of 3.89%. The rate of SCI was 3.2% in studies involving routine prophylactic drain, 3.47% in studies without routine prophylactic drain, and 5.6% in studies using selective prophylactic. These data appear to suggest lower rates of SCI with routine prophylactic drain placement. However, this study presented the unadjusted risks without taking account for differences in patients and procedural factors between groups.

Although there are potential benefits of CSF drainage as an adjunct to OSR or TEVAR, major and minor complications had been reported. Subdural haematoma occurred at the rate of 3.5% after TAAA repair with CSF drainage and it was associated with 67% mortality [13]. The subdural haematoma may result from the stretching and tearing of the bridging vein between the dura and cerebral hemispheres in cases of excessive CSF drainage or shrinkage of the brain due to dehydration. Other potential complications of lumbar drain placement include spinal headache, bleeding, CSF leak, meningitis, nerve injury, epidural haematoma and intracranial haemorrhage [12, 13]. Even so, few guidelines exist for proper CSF drainage.

In our centre, placement of lumbar drain is restricted to selected cases. In the clinical vignette, the patient was considered at high risk for SCI given his previous history of abdominal aortic aneurism repair, the need for extensive coverage of intercostal arteries and the possibility of upper lumbar arteries involvement. CSF drain was placed 24 h before systemic heparinization, and careful monitoring of CSF volume drained was made. Even though the CSF drainage volume after 24 h was only 25 ml, in our opinion, the blood in the subarachnoid space was most probably due to meningeal haemorrhage caused by relative excessive CSF drainage in combination with hypovolaemia (Fig. 1).

Ongoing technical developments of endovascular procedures, such as customized fenestrated grafts that incorporate intercostal arteries, may further reduce the risk of paraplegia and the need for CSF drainage. This new graft may represent one of the ultimate benchmarks for TEVAR.

## FUNDING

None.

## CONFLICT OF INTEREST

None declared.

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