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Outcomes and Intensive Care Management of Cerebrospinal Fluid Drainage in Patients with Thoracoabdominal Aortic Aneurysm Surgery

Torakoabdominal Aort Anevrizma Cerrahisinde Beyin Omurilik Sıvı Drenajının Sonuçları ve Yoğun Bakım Süreci

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Abstract

Objective: Thoracoabdominal aortic aneurysm (TAAA) surgery is accepted as a life-saving surgical repair, but its postoperative morbidity and mortality rates are high. Postoperative paraplegia and paraparesis, hospital-acquired infections, and renal insufficiency are serious complications that prolong hospital stay. Cerebrospinal fluid drainage (CSFD) has been shown to significantly reduce paraplegia and paraparesis risk, especially when used in combination with other methods. Despite its potential benefits, CSFD is not an innocent process because of possible infectious complications, such as localized infections, meningitis, intracranial hemorrhage, and neurological damage. In the present study, we aimed to appraise the postoperative outcomes and intensive care unit period of patients with TAAA surgery who underwent CSFD.

Material and Methods: The records of all patients treated at the Türkiye Yüksek İhtisas Training and Research Hospital Cardiovascular Surgery Clinic between January 2014 and January 2018 for TAAA were reviewed retrospectively.

Results: Although the early mortality rate was reported as 10% in the literature, in non-emergent cases, our mortality rate was higher in the present study. The probable reason for this is that we only assessed CSFD cases and total in-hospital mortality, suggesting that urgent cases constitute half of the patients. Excluding postoperative complications, the morbidity rate was 37.9% when the total number of morbidities following intensive care was included. The rate of CSFD-related complications was 10.33%.

Conclusion: Previous studies have supported the use of CSFD in TAAA repair, and practical guidelines minimize the connatural risk of CSFD. Therefore, it is crucial to be aware of both the efficacy and the possible risks of CSFD. Although deficiency of the control group and being in

Öz

Amaç: Torakoabdominal aort anevrizması (TAAA) ameliyatı, hayat kurtarıcı bir cerrahi onarım olarak kabul edilmektedir ancak postoperatif morbidite ve mortalite oranı yüksektir. Postoperatif parapleji ve paraparezi, hastane kökenli enfeksiyonlar ve böbrek yetmezliği hastanede kalış süresini uzatan ciddi komplikasyonlardır. Beyin omurilik sıvısı drenajının (BOSD), özellikle diğer yöntemlerle kombine olarak kullanıldığında, parapleji ve paraparezi riskini önemli derecede azalttığı gösterilmiştir. Potansiyel faydalarına rağmen BOSD, lokalize enfeksiyonlar ve menenjit gibi enfeksiyöz komplikasyonlara, intrakraniyal hemoraji ve nörolojik komplikasyonlara yol açabilmesi nedeniyle masum bir işlem değildir. Bu çalışmanın amacı, TAAA cerrahisi geçiren ve BOSD işlemi uygulanan hastaların postoperatif sonuçlarını ve yoğun bakım sürecini değerlendirmektir.

Gereç ve Yöntemler: Ocak 2014-Ocak 2018 tarihleri arasında Türkiye Yüksek İhtisas Eğitim ve Araştırma Hastanesi Kalp ve Damar Cerrahisi Kliniğinde TAAA tedavisi gören tüm hastaların kayıtları geriye dönük olarak gözden geçirildi.

Bulgular: Acil olmayan vakalarda erken mortalite oranı literatürde %10 olarak bildirilmesine rağmen bu çalışmada mortalite oranımız daha yüksekti. Muhtemelen bunun nedeni yalnızca BOSD'lı vakaları - acil vakalar hastaların yarısını oluşturuyordu- ve toplam hastane içi mortaliteyi değerlendirmemizdir. Postoperatif komplikasyonlar hariç tutulduğunda yoğun bakım sürecinde görülen toplam morbidite oranı %37,9 idi. BOSD'la ilgili komplikasyonların oranı %10,33 olarak gerçekleşmişti.

Sonuç: Daha önce yapılan çalışmalardaki veriler, TAAA onarımında BOSD kullanımını desteklemektedir ve pratikte kullanılan kılavuzlara uyulması bu işlemin doğal riskini en aza indirmektedir. Bu nedenle, BOSD işleminin hem etkinliğini hem de olası risklerini bilmek önemlidir. Bu kısa

retrospective nature prevents precise inferences in the present study, our results are consistent with the literature. We believe that this short-lived study needs to be repeated on a wider basis.

Keywords: Thoracoabdominal aortic aneurysm, cerebrospinal fluid, drainage, surgery

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süreli çalışmada kontrol grubu olmaması ve retrospektif yapısı kesin çıkarımlara engel olsa da sonuçlar literatürle uyumlu olarak gözlenmiştir. Ancak bu çalışmanın daha geniş bir çerçevede tekrarlanması gerektiğini düşünüyoruz.

Anahtar kelimeler: Torakoabdominal aort anevrizması, beyin omurilik sıvı, drenaj, cerrahi

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Ethics Committee Approval: Authors declared that the research was conducted according to the principles of the World Medical Association Declaration of Helsinki "Ethical Principles for Medical Research Involving Human Subjects", (amended in October 2013).

Informed Consent: An extra formal consent other than the patients had given prior to hospitalization was not required for the current study since it was a retrospective medical record review.

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Hasta Onamı: Bu çalışma, vakaların tıbbi kayıtlarının geriye dönük taranması ile oluşturulduğundan- hastane yatışı öncesi alınan bilgilendirilmiş onam formu haricinde- onam formu alınmasına gerek duyulmamıştır.

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Introduction

With improvements in the awareness of the disease and diagnostic modalities, the prevalence of thoracoabdominal aortic aneurysm (TAAA) is increasing.

Although advances in postoperative care and surgical techniques have derogated mortality and complication rate after TAAA repair, it is still associated with a high incidence of serious complications, such as respiratory or renal collapse, neurological deficits, or even death (1, 2). Compared with other cardiovascular or systemic diseases, TAAA and its complications remain significantly understudied, but the most devastating complication–paraplegia or paraparesis due to spinal cord ischemia (SCI)–is explored immensely. Not only SCI due to the disequilibrium between O_2 demand and O_2 delivery as a result of aortic occlusion but also reperfusion damage is accused of neurological complications (NCs). SCI has been reported from 4.5% to 16% in either open surgical repair (OSR) or thoracic endovascular aortic repair (TEVAR) (3).

The etiology of SCI is multifactorial, and a number of preclusive policies, such as identification of the Adamkiewicz artery preoperatively, distal aortic perfusion, neurophysiological monitoring of the spinal cord, and cerebrospinal fluid drainage (CSFD), are used to prevent NCs. Execution of the CSFD in patients at high risk for SCI injury is recommended in accordance with the American Heart Association guideline as evidence at Level B (3, 4). CSFD is thought to be not only assisting spinal cord perfusion but also removing chemicals toxic to ischemic neurons, such as endorphins (5). On the other hand, important complications, such as subdural hematoma, catheter fracture, spinal fluid leak, meningitis, intracranial bleeding, and neurological deficit related to CSFD, are also reported. The probability of these complications must be remembered against the benefit of CSFD in reducing NC incidence (6). In the present study, we aimed to appraise the postoperative outcomes and intensive care unit (ICU) period of patients with TAAA surgery who underwent CSFD.

Material and Methods

A retrospective study was carried out through the analysis of patients who underwent TAAA repair and CSFD in the Türkiye Yüksek İhtisas Training and Research Hospital from January 2014 to January 2018. These patients were selected as high risk for neurological deficits by cardiovascular surgeons before surgery and were implanted intrathecal catheters. Exclusion criteria included aneurysms limited to the descending thoracic aorta, TAAA repair without CSFD, and reoperated patients. A total of 36 patients underwent TAAA repair with CSFD during the study period (5 reoperated patients and 2 patients who died intraoperatively were excluded from the study owing to incomplete data), and a total of 29 patients were included in our present analyses. Data of patients were collected from the hospital database, and the following variables were retrospectively collected: demographics (age and gender), operative approach (OSR versus TEVAR), urgency of the procedure (elective versus urgent), in-hospital mortality, follow-up duration in the ICU and in the hospital separately, and postoperative complications. Postoperative complications were mainly NCs (stroke or transient ischemic attack, paraplegia, and paraparesis), respiratory complications (hemothorax and pneumothorax), infectious complications (surgical site infections, blood stream infections, meningitis, and respiratory infections), and renal dysfunction. A serum creatinine level >1.8 mg/dL or the need for dialysis characterized renal dysfunction, and in-hospital mortality included any death occurring within 60 days after surgery, regardless of the cause.

Standard anesthesia techniques and postoperative procedures were used in all patients. A standard protocol for selective visceral perfusion was used in all cases by a cardiovascular surgery department, and an intraoperative and postoperative intracranial pressure (ICP) was monitored after the induction of general anesthesia. As a routine procedure, ICP was maintained <10 mmHg, and the drain was kept in place for 72 h postoperatively. In case of blood-stained CSF sample during drainage (rather than possible initial blood trace), CSFD was stopped. Computed tomography (CT) scan of the head and/or the spine was performed in any case of indication, such as NC.

An extra formal consent other than the patients had given prior to hospitalization was not required for the current study because this was a retrospective medical record review. Since our study was in the category of non-interventional clinical research with its retrospective structure, no ethics committee approval was needed.

The present study adhered to the principles in accordance with the 1975 Declaration of Helsinki, as revised in 2008.

Statistical Analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences version 20.0 for Windows (SPSS Inc.; Chicago, IL, USA). Continuous variables were presented as mean±standard deviation, and nominal variables were reported as total number and percentages.

Variables were first evaluated by one-sample Kolmogorov–Smirnov test as a normality test to choose the type of statistical tests (parametric or non-parametric test), and the results showed asymp. sig. (two-tailed) levels ≤0.05, thus we decided to use non-parametric tests. For statistical analysis, correlations between the variables were evaluated for significance by using the Spearman's rho test. Categorical variables were evaluated by the Kruskal–Wallis test and Mann–Whitney U test for contingency. In all analyses, a p-value <0.05 was considered as statistically significant.

Table 1. Demographic and descriptive variables of the patients

	Mean value/ frequency	Standard deviation/%
Age (years)	57.55	14.71
Male gender	27	93.1%
LOS in hospital (days)	10.69	11.26
LOS in ICU (days)	7.45	10.75
Catheter day (days)	2	1
Mortality	11	37.9%
Infectious complications	7	24.1%
Neurological complications	6	20.7%
Urgent operations	10	34.5%
TEVAR	4	13.8%
Renal complications	11	37.9%
Respiratory complications	3	10.3%

Data are presented as mean±standard deviation or frequency percent.
LOS: length of stay; ICU: intensive care unit; TEVAR: thoracic endovascular aortic repair

Table 2. Statistical difference according to mortality

	Mean value of the mortality group	Mean value of the survivor group	Z^x score	p*
Age (years)	57.91	57.33	-0.360	0.719
Catheter days	1.82	2.11	-0.502	0.616
LOS in ICU (days)	8.27	6.94	-0.091	0.928
LOS in hospital (days)	9.27	11.56	-.767	0.443
Infectious complications	4(36.4 %)	3 (16.7 %)	-1.203	0.229
Neurological complications	3(27.3%)	3 (16.7%)	-.672	0.501
Renal complications	5 (45.5 %)	2(11.1 %)	-2.061	0.039
Urgent operations	8(72.7 %)	2(11.1 %)	-3.328	0.001

LOS: length of stay; ICU: intensive care unit
Data are presented as mean value and percent
A non-parametric, unpaired test (Mann–Whitney U test) was used for comparison of continuous variables
Z^x score: the Z score given is compared with the standard normal quantiles to obtain a p-value
*Probability of type I statistical error (common p-value), 2-tailed

Results

In the present study group, between 2014 and 2018, 29 patients underwent TAAA repair with CSFD for 2±1 days after surgery. Male dominance was detected (n=27, 93.1%), and the mean age of the patients ranged from 22 to 80 (mean: 57.55) years as shown in Table 1. Overall, 25 (86.2%) patients had open repair, 4 (13.8%) patients had TEVAR operation, and 10 (34.5%) patients underwent urgent operation. Intrathecal catheter was in place for a maximum of 5 days, and in this particular case, meningitis had occurred as a complication. Catheter days (length of duration) were only related to ICU length of stay statistically, but not related to any complication or mortality. There were 7 (24.1%) patients who had a creatinine level >1.8 mg/dL preoperatively and needed hemodialysis postoperatively.

There were 11 (37.9%) patients who died in the hospital, 11 (37.9%) patients who required postoperative hemodialysis, 3 (10.3%) patients who were affected by respiratory complications, and 6 (20.7%) patients who developed NCs. There were 2 patients with paraplegia, 1 patient with paraparesis, 1 patient with meningitis, and 2 patients with transient ischemic attack as NCs. Bloodstream infections in 2 (6.9%) patients and respiratory system infections in 5 (17.2%) patients had been detected.

No statistical difference between TEVAR and open surgery was detected in mortality, renal complications, or NCs. Renal complications and urgent operations showed statistically significant differences in the mortality group (p<0.05) (Table 2). In view of NCs, there were no statistically significant differences with urgency, type of surgery, catheter day, or age in the present study.

The complications related to CSFD included headaches (n=2, 6.89%), meningitis (n=1, 3.44%), and pale hemorrhagic discharge (n=2, 6.89%). None of the patients had intracranial hemorrhage or epidural hematoma on CT scan.

Discussion

As a matter of course, the surgical repair of TAAA has prominent complications, such as SCI and renal failure. In spite of major advances in the knowledge of the mechanisms of these complications and protective surgical strategies to minimize risks, SCI remains the most devastating (1). In the literature, there are many studies confirming the effects of CSFD, which is one of these protective strategies in reducing the risk of SCI (3, 7). Postoperative outcomes and their relationship with in-hospital mortality have been demonstrated in the present study.

The mortality rate of TAAA surgery is sustained in the 10% range, and it is higher in urgent cases (7, 8). In our present study, the mortality rate is higher than the literature findings, but our study group was a high risk group–that was in need of CSFD–and the duration of time for mortality was 60 days and even longer. In the literature, the predictors for hospital mortality suggested an increasing age and the need for hemodialysis (8), whereas in the present study, renal complications and urgency were related to mortality, and age was not related.

The incidence of paraplegia and paraparesis was increased even in experienced institutions, and NC was 20.7% in our study. If we only consider paraplegia and paraparesis as NCs, this rate decreased to 10.3%. In the literature, transient neurological deficits are significantly higher at an incidence of up to 20% (9, 10), and this is similar to our present study.

According to the current guideline of the European Association for Cardio-Thoracic Surgery, the use of CSFD can be considered in patients at increased risk for SCI (Class IIa C). Although the risk of paraplegia with TEVAR is reported to be as high as 8% in the literature, in our study, no relationship was detected between operation type (OSR versus TEVAR) and NC (5, 10).

Safi et al. (11) showed that the use of CSFD in TAAA repair–even though it has its own complications–is protective and reduces NC. The reported randomized prospective study by Coselli et al. (12) has convinced most surgeons of its benefit, but the associated risks with CSFD must be considered as well. In our study, no devastating complication linked to CSFD had occurred–except meningitis–maybe due to strict procedure rules as some authors promote limiting the drainage volume to <15 mL/h to prevent intracranial hemorrhage (13).

Our study has some limitations. First, this was a retrospective study and, thus, consequently can only provide a descriptive picture of the outcomes and relationship that occur in patients who undergo TAAA repair with CSFD. Second, the present study was a single-center experience with a national small study population. We think that this short-lived study needs to be repeated on a wider basis.

Conclusion

The available evidence supports the use of CSFD in TAAA repair, and practical guidelines minimize the connatural risk of CSFD. Therefore, it is crucial to be aware of both the efficacy and the possible risks of CSFD.

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