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Editor's Choice – Durability of Endovascular Repair in Blunt Traumatic Thoracic Aortic Injury: Long-Term Outcome from Four Tertiary Referral Centers

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WHAT THIS PAPER ADDS

In recent years TEVAR has emerged as the preferred treatment for patients with blunt traumatic thoracic aortic injury, regardless of age. However, there are very limited data on long-term outcomes. In particular, little is known about long-term device related complications and device integrity in the aging aorta. The present data support previous findings that in patients undergoing TEVAR most early deaths are unrelated to the aortic injury, but predominantly caused by brain damage. In patients surviving the trauma and the primary hospitalization, long-term survival is excellent, and the need for re-intervention is very rare after 1 year, albeit fairly common during the first year.

Objectives: To analyze the early and long-term survival and re-intervention rate in patients undergoing TEVAR for blunt traumatic thoracic aortic injury.

Methods: This was a consecutive case series. Between the years 2001 and 2010, a total of 74 patients underwent TEVAR for blunt traumatic thoracic aortic injury at four tertiary referral centers, three in Sweden and one in Switzerland. The median age of the patients was 41 years, and 16% were women. Demographic, procedural, and outcome data were collected and reviewed retrospectively. The patients were followed up during 2013–2014.

Results: Early (30 day) mortality was 9% (7 patients), with only two cases directly related to the aortic injury; in hospital mortality was 14% as three patients died during the primary hospital admission within the first 6 months. Most patients had sustained severe injuries to other organ systems, and among all in hospital deaths brain injury was the predominant cause. Five year survival in the whole group was 81%. Re-intervention was needed in 16% (12 patients) during the first year, half of them within the first month. Only one patient underwent re-intervention more than 1 year after the initial procedure. Infolding and partial stentgraft collapse was the reason for the secondary procedure in five of the 13 patients; in three it occurred within 3 weeks of the acute TEVAR.

Conclusion: TEVAR allows rapid and effective therapy in trauma patients with blunt aortic injury. The outcome is dependent on the severity of the concomitant injuries. The treatment is durable during the first decade after the procedure, but even longer follow up is needed to determine the impact of TEVAR in young patients on the degenerative changes that take place in the aging aorta.

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INTRODUCTION

Blunt traumatic thoracic aortic injury is the second most common cause of death from blunt trauma after head injury.[1,2] Blunt aortic injury most commonly occurs after sudden deceleration, such as in car or motorcycle crashes, falls or crush injuries.[2] In a landmark report by Parmley et al. in 1958, the regions of the aorta found to be most prone to blunt traumatic injury were the isthmus and the

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ascending aorta, as these are subjected to the greatest strain in sudden deceleration.[3] Parmley et al. also found that patients with injury to the isthmus had a higher probability of early survival than patients with more proximal aortic injuries, and that patients who were managed conservatively were at risk of developing false aneurysms and late rupture — findings that are still valid.

During the last decade there has been a paradigm shift in the management of patients with blunt traumatic thoracic aortic injury. The use of intra-luminal stent grafts, Thoracic EndoVascular Aortic Repair (TEVAR), has become the therapy of choice for most patients, based on single and multicenter trials. The clinical practice guidelines of the Society for Vascular Surgery (SVS) state that TEVAR is associated with better survival than open repair or non-operative management, and a lower rate of paraplegia than surgical graft replacement of the aorta.[1,2,4–6]

Not all traumatic aortic injuries are equally severe, as the extent of damage to the aortic wall varies from an intimal tear to complete transection and rupture. A classification system grading the seriousness of the injury was suggested by Azizzadeh et al. and endorsed by the SVS: type I (intimal tear), type II (intramural hematoma), type III (pseudoaneurysm), and type IV (rupture).[1,7] Moreover, as victims of high impact collisions often have multiple injuries they are initially managed according to the Advanced Trauma Life Support (ATLS) concept, and, as the aortic injury is rarely an isolated finding, the timing of TEVAR, if indicated, must be decided while taking other injuries into consideration.

There is no doubt that the use of TEVAR for traumatic aortic injuries has revolutionized the management of such patients, but as these patients are often young there are several concerns regarding long-term outcome, such as device integrity, aortic degeneration and expansion with progressive age, and cumulative radiation exposure. The aim of the present study was to analyze the long-term outcome of TEVAR in patients with traumatic aortic injuries with respect to survival and rate of re-intervention by merging data from four European tertiary referral centers.

MATERIALS AND METHODS

All patients undergoing TEVAR for traumatic thoracic aortic injury were registered in the local registries of the four participating tertiary referral centers; one in Switzerland (Zurich), and three in Sweden (Malmö, Uppsala, and Stockholm). Data from all four centers were available for the period January 1, 2001 through December 31, 2010, which constituted the study period. The study period was not extended beyond 2010 to permit follow-up of all patients. During the 10 year period, 74 patients underwent TEVAR for blunt traumatic injury to the thoracic aorta; 29 patients were treated in Zurich, 21 in Malmö, 17 in Uppsala, and seven in Stockholm. The medical records of the patients were identified and reviewed with respect to demographics, concurrent injuries with assessment of the Injury Severity Score (ISS),[8] and operative variables. The ISS, in turn, was calculated by way of the Abbreviated Injury Scale (AIS), allocating the injuries to one of six body regions, ranking the injuries on a scale of 1 to 6, with 1 being minor, 5 critical, and 6 unsurvivable.[9] Early and long-term survival, as well as complications and re-interventions were documented. The arch landing zone was categorized according to the Ishimaru classification.[10] The severity of the aortic injury was grouped according to the SVS scheme.[1]

All patients were initially managed according to the ATLS guidelines. The initial evaluation was followed by computed tomography (CT) according to a trauma protocol, including CT of the head, spine, chest and abdomen, and further specific radiological examinations whenever necessary. The patients were evaluated by a team of trauma, cardiothoracic, vascular surgeons, anesthesiologists, and radiologists. The aortic injury was characterized with respect to location, diameter, and length of the lesion, along with concomitant injuries, so as to decide the timing and effectuation of the procedure. In patients with concurrent injuries that were considered to be more life-threatening than that of the aorta, those were managed prior to TEVAR. Arterial access was established through surgical exposure or percutaneously, and the stent grafts were deployed over a stiff wire. Oversizing of 15–60% was applied, depending on device availability at the time of the trauma and on the instructions for use (IFU) of the manufacturers. All four centers followed the same patient management principles and had 24/7 on call systems with readiness to perform TEVAR around the clock. The Uppsala protocol for trauma patients with blunt aortic injury has been reported previously,[11] and so has an early Zurich series of patients.[12]

The patients were monitored by CT angiography before discharge and at 1 month, after 3–6 months, and at 12 months, and annually thereafter. As a unique 10 digit personal identity number is allocated to all Swedish citizens and permanent residents, long-term survival can be followed accurately in all patients. Two of the Swedish patients were lost to follow up, however, as they were foreign nationals. The Swiss patients were followed up by way of phone calls or reports from local hospitals if they were not Zurich residents. Three Swiss patients had relocated and could not be retrieved. During the course of 2013–2014 all the 69 remaining patients were followed up with respect to survival and re-interventions and could be assigned a date of death or identified as being alive. The study was ethically approved by the local/regional ethical review boards.

Continuous variables were summarized with medians and ranges, and categorical variables with frequencies. The Kaplan–Meier method was used to estimate the survival function. SPSS for Windows 22.0 was used for data processing and statistical analyses.

RESULTS

Of the 74 patients undergoing TEVAR for blunt traumatic aortic injury there were 12 women (16%) and 62 men. Median age was 41 years (range 16–89). Nearly half of the patients, 36 (49%), had sustained the aortic trauma in association with car accidents, the second most common cause