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Hemothorax Management After Endovascular Treatment For Thoracic Aortic Rupture

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WHAT THIS PAPER ADDS

This study has focused on the characteristics and management of hemothorax, occurring in a large cohort of patients with thoracic aortic rupture, treated with TEVAR. It may contribute further insights into the management of ruptured descending thoracic aorta and into optimizing the post-operative risk stratification after urgent TEVAR. Furthermore, it is hoped it will lead to larger studies to optimize current practice on the best management of hemothorax after TEVAR.

Objectives: The aim was to describe and analyze the management of hemothorax (HTX) and the occurrence of respiratory complications after endovascular repair of thoracic aortic rupture (TEVAR).

Methods: This was a multicenter study with retrospective analysis. Between November 2000 and December 2012, all patients with confirmed HTX due to rupture of the descending thoracic aorta treated with TEVAR were included. Respiratory function (acid base status, Pao_2, $Paco_2$, lactate, and respiratory index) was monitored throughout hospitalization. Primary endpoints were survival and post-operative respiratory complications.

Results: Fifty-six patients were treated. The mean age was 62 ± 21 years (range 18–92 years). Etiology included traumatic rupture ($n = 23$, 41%), atherosclerotic aneurysm ($n = 20$, 36%), Debakey type IIIa dissection ($n = 8$, 14%), and penetrating aortic ulcer ($n = 5$, 9%). The primary technical success of TEVAR was 100%. The in hospital mortality rate was 12.5% ($n = 7$). Hemothorax was drained in 21 (37.5%) cases. In hospital respiratory complications occurred in 23 (41%) patients who required a longer intensive care unit stay (days 2.3 ± 0.7 vs. 1.9 ± 0.8, $p = .017$), and hospitalization (26 ± 17 *vs*. 19 ± 17, $p = .021$). Those who developed post-operative respiratory complications had lower pre-operative PO_2 values (mmHg, 80 ± 24 vs. 91 ± 21, $p = .012$). Respiratory complications and in hospital mortality did not differ among aortic pathologies ($p = .269$ and $p = 1.0$, respectively), nor did in hospital mortality differ between patients with and without respiratory complications (13% vs. 12%; $p = .990$).

Conclusions: Thoracic aortic rupture still has a high mortality rate. Respiratory complications have not been eliminated by endovascular repair. HTX evacuation may have had a positive influence on the survival in these patients. Although traumatic and degenerative ruptures are two significantly different scenarios, survival and respiratory outcomes were similar and were not affected by the underlying aortic disease.

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INTRODUCTION

Rupture of the descending thoracic aorta has traditionally been treated by open graft replacement, with its associated mortality and complication rates which remain disturbingly high.[1–3] More recently, thoracic endovascular aortic repair (TEVAR) has proved to be an effective, less traumatic, alternative for the treatment of all thoracic aortic pathologies; indeed several papers have advocated TEVAR as the first choice for the emergency treatment of thoracic aortic catastrophes.[4–7] Rupture of the thoracic aorta is frequently associated with hemothorax (HTX); however, the

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management of HTX after TEVAR has not been debated until now, and there is still uncertainty on indication and timing of its treatment.[8–14] Hemothorax may lead to major complications such as compression of the esophagus and/or cardiovascular structures, respiratory insufficiency, and infection. All these complications may compromise the post-operative survival in an already critically ill subset of patients.[8] The purpose of this study was to analyze the management of HTX in patients with descending thoracic aortic rupture treated with TEVAR.

MATERIALS AND METHODS

Study population

The study was designed as a multicenter retrospective study. Between November 2000 and December 2012, all patients presenting with rupture of the descending thoracic aorta and HTX treated with TEVAR were identified and included in the analysis. Thoraco-abdominal lesions were excluded. Clinical and procedural data were collected prospectively and recorded in a dedicated database. All patients underwent pre-operative thoraco-abdominal computed tomography (CT) scans. Intervention was performed in the operating theatre, equipped to perform either open surgical or endovascular procedures. General anesthesia and antibiotic prophylaxis with a second generation cephalosporin was used in all patients. Four different thoracic endografts (EGs) were implanted: Excluder/TAG/C-TAG (W.L. Gore and Associates, Flagstaff, AZ, USA), Talent/Valiant/Captivia (Medtronic Vascular, Santa Rosa, CA, USA), TX-1/TX-2 (Cook, Bloomington, IN, USA), and Relay (Bolton Medical, Sunrise, FL, USA). Post-operatively, the patient was transferred to the intensive care unit (ICU). In all patients, respiratory function was monitored at admission and during hospitalization: acid base status, Pao_2, $Paco_2$, lactate, and the respiratory index (Pao_2/Fio_2) were evaluated.[15] Evacuation of the HTX was always discussed case by case by the operating team and the intensive care unit (ICU) physicians; generally, HTX was drained when the respiratory index (RI) was < 200 or when signs of respiratory or cardiovascular impairment were detected. The hemothorax was drained with a chest tube; video assisted thoracoscopy or open thoracotomy which was used selectively for complicated trapped HTX. Clinical and CT scan follow up were performed at 1, 6, and 12 months after the intervention, and annually thereafter.

Definition

Thoracic aortic rupture was defined as hemorrhage outside the boundaries of the aorta. Hemothorax was considered as any collection of blood in the pleural cavity, but isolated peri-aortic/mediastinal hematoma suggestive for a contained rupture was not counted as HTX. Comorbidities were defined according to the Society of Thoracic Surgeons Adult Database definitions.[16] On admission, hemorrhagic shock was defined as a combination of systolic blood pressure $<$ 80 mmHg after fluid resuscitation or need for α-amines, tachycardia ($>$ 110 bpm), anuria or urine output $<$ 15 mL/hour, unconsciousness, or circulatory arrest.[17] The HTX at its point of greater thickness in the baseline CT was classified: $<$ 2 cm, 2–3 cm, $>$ 3 cm. Delay was defined as the time interval between the diagnosis of aortic rupture/onset of symptoms and the start of the intervention. Traumatic aortic injury severity grading was classified accordingly to the clinical practice guidelines of the Society for Vascular Surgery (SVS).[18] The operative risk profile was estimated according to the EuroSCORE.[19] Operative outcomes were classified following the ad hoc committee on TEVAR reporting standards of the Society for Vascular Surgery/American Association for Vascular Surgery (SVS/AAVS).[20] Specifically, respiratory complications were defined as grade 1 if recovery was prompt with medical treatment, grade 2 for prolonged hospitalization or intravenous antibiotics, and grade 3 for prolonged intubation, tracheotomy, deterioration in pulmonary function, O_2 dependence, or fatal outcome. Primary endpoints were the evaluation of survival and respiratory complications.

Data analysis

Clinical data were recorded in Microsoft Excel (Microsoft Corp, Redmond, WA, USA). Results are presented as mean $\pm$ SD for continuous variables, and number (percentage) for categorical variables. Continuous variables were compared with the Mann–Whitney U test, and categorical variables by the Fisher exact test. The survival rate was estimated by means of the Kaplan–Meier method with the log-rank test. A p value $<$ .05 was considered significant. Statistical analysis was computed with SPSS, release 20.0, for Windows (IBM SPSS Inc., Chicago, IL, USA).

RESULTS

General data

During the study period a total of 500 TEVARs for descending thoracic aortic diseases were performed: 402 (81%) intact aortic lesions were treated; 42 (8%) were ruptured or traumatic lesions without HTX. Rupture with HTX was present in 56 (11%) cases: there were 40 (71%) males. Mean age was 62 $\pm$ 21 years (range 18–92 years). Traumatic ruptures ($n = 23$, 41%) were caused by blunt injuries in all cases; a grade IV injury was present in all cases. In particular, traumatic rupture involved the distal aortic arch below the left subclavian artery ($n = 9$, 39%) and the descending aorta ($n = 14$, 61%). Non-traumatic ruptures were caused by atherosclerotic aneurysm ($n = 20$, 36%), Debakey type IIIa dissection ($n = 8$, 14%), and penetrating aortic ulcer ($n = 5$, 9%). Overall demographic data, co-morbidities and risk factors are reported in Table 1.

Operative data

Emergent TEVAR was performed in 19 (34%) cases: all but three (5%) patients were treated within 3 hours of rupture with a median delay of 1.5 hours (range 0.5–24). The proximal landing zone was “zone 2” in 18 (32%) cases and “zones 3 or 4” in 38 (68%). Primary technical and primary