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Research Article

COMPARATIVE ANALYSIS OF EARLY PERIOPERATIVE OUTCOMES IN BLUNT TRAUMATIC AORTIC INJURY: A RETROSPECTIVE STUDY COMPARING OPEN REPAIR AND THORACIC ENDOVASCULAR REPAIR IN A SURGICAL SETTING

Dr Asif Ahmad Ansari*

Assistant Professor, Department of General surgery, Gouri Devi institute of Medical Sciences and Hospital, Rajbandh, West Bengal, India.

ABSTRACT

Due to the high postoperative mortality and morbidity rates of conventional open repair of blunt traumatic aortic injury (BTAI), it is not considered the optimal treatment for BTAI. Thoracic endovascular repair may be more appealing as a therapeutic option due to recent advances in the technique. 42 patients (mean age, 47.83 years) with BTAI were admitted to our institution. The early perioperative results of 36 cases (22 open procedures and 14 endovascular procedures) were retrospectively compared. Even though the endovascular repair group had a lower mortality rate (20.0% vs. 0%), the difference was not statistically significant. Paraplegia or endoleaks did not occur. It was found that heparin dosage levels, blood loss, and transfusion amounts decreased statistically significantly during the procedure. The mortality rate and morbidity rate of endovascular repair can be lower than open repair. The therapeutic challenge may arise at the young age of relatively young patients with acute aortic arch angulation and a small aortic diameter. Successful endovascular repair requires improved graft designs, delivery sheaths, and durability.

Keywords: - Corneal, Sensitivity, Mechanical, Chemical, Thermal.

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INTRODUCTION

When you suffer a blunt traumatic aortic injury (BTAI), the outcome is often fatal. At the scene of a BTAI, there is an 80% mortality rate [1], and 81% of patients wait until they are hospitalized before getting any treatment [2]. When the descending thoracic aorta undergoes a sudden deceleration, the isthmic portion suffers adversely. There was a 20.2% death rate and a 5.7% paraplegia rate [3] among open surgery patients; these rates are likely due to severe injuries associated with the surgery. According to research [4] trauma severity scores such as injury severity scores (ISS) are correlated closely with BTAI mortality rates. Aortic clamping, aortic cross-clamping, and systemic heparinization can also cause multi-organ failure in combination with one-lung ventilation. During the 1990s, endovascular repair was introduced to overcome these limitations, and good results were reported [5]. In our study, retrospective reviews of endovascular repair cases were conducted to evaluate the perioperative results.

MATERIALS AND METHODS

42 patients diagnosed with BTAI. 36 of them

Corresponding Author: **Dr Asif Ahmad Ansari**

(Mean age, 43.96 years; female:male ratio:8:14) had an isthmic portion injury; 4 cases of ascending aorta injury were excluded, and 2 had a combined distal arch aneurysm requiring hybrid thoracic endovascular aortic repair. 14 patients underwent endovascular repair and 22 received open surgery during the study period. A contrast-enhanced computed tomography (CT) scan was used in all 36 cases for preoperative diagnosis. We immediately stabilized his hemodynamics and controlled his blood pressure in the early phases of treatment. The procedure was usually done as soon as possible, either through open surgery or endovascular repair. Patients with severe injuries other than those associated with the aortic artery were considered only for delayed treatment. A retrospective review of hospital records and radiologic findings was conducted to examine the patients' characteristics and perioperative results. According to Table 1, the patients' clinical characteristics are summarized.

Techniques of open repair

A double lumen endotracheal tube was used during all operations under general anesthesia. A procedure to drain cerebrospinal fluid was performed on patients. A right lateral decubitus position was used to access the left femoral vessels while the left pelvis was rotated posteriorly. The left posterolateral thoracotomy was performed after the left femoral artery and vein were isolated. Proximal and distal clamping of the Left side aortic arch vessel and distal descending thoracic aorta was performed with meticulous dissection. As part of the spinal cord's protection, mild systemic hypothermia was administered following systemic heparinization and femoral cannula placement. The cardiopulmonary bypass flow was adjusted to 60% to 70% of maximum flow rate during the aortic cross-clamping process in order to keep the femoral blood pressure between 70 and 80 mmHg during the procedure. Debriding the injured aortic edges and controlling bleeding intercostal arteries were carefully performed after the aorta was opened longitudinally. The injured aorta was repaired with continuous Prolene stitches using graft interposition. Protamine reversal was followed by layering of the wound closure. The repair of the aorta was followed by a combination of operations if necessary.

Techniques for endovascular repair

The operating room was under general anesthesia for all operations. Throughout all of the cases, a portable fluoroscopic C-arm was used. A low cerebrospinal fluid pressure of 10 mmHg was maintained during the operation after induction of each patient's anesthesia through the third lumbar space. A small longitudinal incision was made to expose the femoral artery and cannula was inserted into it. A sheath was introduced after percutaneous access was made to the contralateral femoral artery. For measuring landing zones and treatment lengths, a marked pigtail catheter was inserted under fluoroscopic guidance into the contralateral femoral artery. Using the sheath, the guidewire was advanced to the ascending aorta through the femoral artery. Bern catheters were used to replace soft wires with stiff wires. Afterward, the distal aortic arch was covered with an endovascular stent-graft. The stent-graft was positioned for deployment using fluoroscopy with contrast. As a result of deployment, the systolic blood pressure was lower than 100 mmHg. An angiogram was obtained after confirming that at least 2 cm of landing zones existed proximally and distally; then, the device was deployed. It was important to keep the mean blood pressure above 90 mmHg after the graft was implanted. Sheaths and wires have been removed.

Table 1: Characteristics of patients.

	Open Repair Group	Endovascular Repair Group	P-value
Age (yr)	45.20	42	0.730
Male:Female	8:7	8:3	0.318
Mean ISS	28.29	33.16	0.233
Time to Intervention	97.11	34.59	0.427

RESULTS

Open repair group

Three cases were delayed due to large liver contusions and cerebral hemorrhages, so graft interposition was used in all cases. There were five cases in which a combined procedure was performed after aortic repair. A patient's hemodynamic instability and preoperative rupture resulted in deep hypothermic circulatory arrest. In total, 18.2% of the patients died (2/11). During peritoneal dialysis, one patient died of acute renal failure, and another patient died of underlying severe coagulopathy that led to untreatable bleeding. Paraplegia did not develop postoperatively. There was a 103.90 minute cardiopulmonary bypass procedure and a 57.27 minute aorta cross-clamping procedure, respectively (range, 50 to 305).

Table 2 An analysis of the postoperative results of the repair and endovascular groups

	Open Repair group	Endovas- Cular group	P-value
No.of Deaths (%)	4 (20.20)	0 (0)	0.499
Mean ICU Stay Time (HR)	194.0	219.73	0.776
Mean Hospital Stay Time (DAY)	29	21	0.299
Mean Heparin Dosage (UNITS)	22,182.82	1,858.15	0.000
Mean Blood Loss (ML)	2,046.46	615.30	0.008
Mean Transfusion Amount (UNITS)	16	6.16	0.03
Mean Procedure Time (HR)	432.75	116.45	0.000

Endovascular repair group

All of the cases were technically successful. Each patient underwent a single graft procedure. As a result of cerebral hemorrhage, treatment was delayed in one case. Cerebrospinal fluid was drained from all patients. Six patients (44.87%) had left subclavian arteries covered, but no patient had upper arm ischemia or stroke. As a result, 27 mm in diameter and 116.72 mm in length are the average stent-graft dimensions (range, 26 to 38). In this case, there were no endoleaks or paralysis, and the death rate was 0% .Due to the risk of bleeding, 10 patients refused to be given systemic heparin. Aortic rupture was not diagnosed or treated within 72.80 hours of the diagnosis. In addition, the timing of the procedure and the quantities of heparin administered during surgery was statistically different between the two groups.

DISCUSSION

Aortic ruptures typically occur within 24 hours of presentation, according to their natural history. In such a case, antihypertensive medications and restrictive fluid resuscitation should first be administered to reduce aortic wall stress. Aortography, trans–esophageal echocardiography, and chest X-rays are traditional diagnostic methods with limited sensitivity and specificity. It is therefore important to consider a CT scan, even in cases of apparent normal chest X-rays [6, 7], for confirmation of the injury mechanism. A thorough assessment of the aortic arch vessel anatomy, including both vertebral arteries, the aortic segment diameter, and the iliac and femoral arteries should also be performed. Aortic injuries may be mimicked by *ductus diverticulums* and aortic spindles among other anatomic variations. Azizzadeh et al. [4] classified aortic injuries based on CT findings into four categories. The first grade was classified as intimal tear, the second as intramural hematoma, the third as pseudoaneurysm, and the fourth as free rupture. Medical treatment was recommended for grade 1 injuries. Seventeen of our patients presented with grade 3 injuries and one with grade 4.

In the course of treating BTAI, there are two major changes. Firstly, delayed repair will be introduced, and secondly, endovascular treatment will be applied. In terms of the optimal time for intervention, there are still some conflicting reports. Pate et al. reported [9] that hemodynamic stability during the first 4 hours of treatment reduced the likelihood of aortic rupture before repair. It is the most common cause of death during the early hospitalization period, which Camp and Shackford attribute to aortic rupture itself [10]. Accordingly, delayed aortic repair is preferred in high-risk patients following early stabilization.

Delay in repair, however, has some limitations. Blood pressure lowering can potentially cause brain injury in conditions of elevated intracranial pressure. It is possible to have tracheal and left main bronchial compression due to the progressive dilation of pseudoaneurysms. The risk of delayed free rupture remains despite aggressive anti-impulse therapy [11,12]. There are several advantages to early repair, including shorter hospital stays, lower hospitalization costs, and the opportunity to combine aortic and non-aortic procedures concurrently [13,14]. In recent papers, delayed re-pairing has been favored more frequently [2,15]. A CT scan may reveal active contrast leakage in patients with massive hemothorax, rapid growth of a pseudoaneurysm, or massive hemothorax. In addition to periaortic hematoma exceeding 15 mm at the aortic arch level or a systolic blood pressure below 90 mmHg, Starnes et al. [16] recommend urgent repair in instances of periaortic hematoma.

BTAI has been studied only in small numbers due to its rarity, so endovascular and open repair have not been compared. Recently, several journals published meta-analyses of retrospective studies on BTAI in humans [3, 17]. A meta-analysis of 699 patients with similar levels of ISS revealed that endovascular and open surgery had similar mortality rates of 7.6% and 15.2%, paraplegia rates of 0% and 5.6%, stroke rates of 0.85% and 5.3%, respectively, with endovascular surgery showing a lower mortality rate. The American Association for the Surgery of Trauma published a multicentered prospective study in 2008 that demonstrated that 125 patients underwent endovascular repair compared to 68 patients underwent open surgery. The mortality rate was significantly lower even in patients undergoing endovascular repair for major

injuries. Endovascular repair was recommended over open surgery by the Society for Vascular Surgery because of this. [19].

CONCLUSION

The survival rate and length of hospital stay for endovascular repair were not statistically different from conventional repair. Endovascular repair showed a lower mortality rate despite similar ISS and time to intervention. It is possible to conclude that, in certain cases, endovascular approaches can be completed expeditiously and even without heparinization. Since these relatively young patients may experience long-term changes in aortic conformation, it is important to evaluate the durability of the endovascular repair.

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