Commentary

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On the Operative Stress of Clamp-and-Sew Technique in Traumatic Aortic Rupture: A Short Commentary

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Commentary

Untreated, approximately 30% of surviving patients admitted to a hospital for traumatic thoracic aortic injury (TTAI) die within the first 24 h [1]. Despite the increased use of restraint systems, the overall incidence of fatal vehicular crash-associated TTAIs and diagnostic rates of aortic injury have begun to increase owing to the commercialization of computed tomography. For such a fatal damage, immediate operative repair used to be the rule. However, the use of cardiopulmonary bypass with a significant amount of heparin immediately after trauma can exacerbate other accompanying injuries. To reduce this risk, here we discuss our experience with performing traumatic aortic repair as early as possible using the clamp-and-sew technique but without administering intravenous heparin and initiating distal aortic perfusion.

Between January 2002 and December 2017, a total of 92 patients were diagnosed with TTAI at our regional trauma center. Out of 92 patients, 22 patients underwent clamp-and-sew technique for traumatic descending aortic rupture.

Surgical repair in our study required intubation with a double lumen endotracheal tube and placement of the patients in the left decubitus position. After exposing the site of aortic injury through an incision in the left third or fourth intercostal space and removing the accompanying hemothorax, the site of aortic injury was identified. The proximal aorta was clamped between the origin of the common carotid artery and Left Subclavian Artery (LSA), and the distal aorta was clamped more distal to the damaged aorta. Irrigation was performed with heparinized saline to reduce microvascular thrombosis event while manipulating the injured aorta. For saving time, primary closure with 4-0 prolene was ruled out for the injured aorta. Thorough deairing was performed by changing patient posture to the Trendelenburg position before releasing the clamp, followed by surgery of concomitant injury. The mean age of these 22 patients was 43.7 years, and the most frequent reason for hospital visit was traffic accident (17 patients). Associated injuries were hemopneumothorax and multiple rib fracture, followed by hemoperitoneum and head injury. The site of the aortic injury in all patients was the isthmus. The mean total operation time was 230 min, and the mean aorta clamping time was 13.4 min. One patient died during the operation due to an increase in hemoperitoneum, a concomitant injury, whereas the remaining surviving patients experienced no paraplegia. As a result of an early surgery without intravenous heparin administration, concomitant surgery was possible in 12 patients. Efforts to reduce aorta clamping time to <20 min, and the cardiac surgeon team's cooperation produced good results. Blunt aortic injury most often occurs after sudden deceleration, usually in automobile crashes. Other causes include motorcycle and aircraft crashes, auto–pedestrian collisions, falls, and crush injury [1-4]. Blunt aortic injury is frequently related to a sudden deceleration in motor vehicle accidents, and >80% of TTAIs are located in the region of the aortic isthmus and typically within 20 mm of the ligamentum arteriosum of the descending thoracic aorta [5,6].

TTAI is graded according to severity, and depending on whether the injury is associated with significant thrombus periaortic hematoma, lumen encroachment, pseudoaneurysm, or rupture, it is our usual practice to treat it by performing thoracic endovascular aortic repair (TEVAR) or open repair surgery [7].

Owing to the procedure being simple and less invasive, TEVAR has supplanted open surgery as the primary treatment of blunt aortic injury. However, anatomic restrictions, such as severe thoracic aortic tortuosity, acutely angled aortic arch, and a short landing and sealing zones, have certain limitations [8]. The aortic isthmus is usually extremely close to the LSA and sometimes the lesion in contiguity or at a limited distance from the vessel. Proximal apposition is an important factor for long-term stability, and patients who face problems related to this often need reintervention; moreover, the long-term durability of a stent-graft remains unclear [9]. Although TEVAR has increasing become the preferred choice for treating patients with TTAI, whereas open repair is the principle choice for cases of traumatic aortic rupture.

Of course, in cases of rupture, the prognosis is better if the aortic surgery is performed before other concomitant injury repair because there is a great risk of sudden death associated

with a complete aortic rupture. In cases of such severe primary injury, the accompanying injuries can also be serious, owing to which the trauma team is unable to decide on the best way to initiate treatment. Patients may have other competing priorities, such as the need for laparotomy to control intra-abdominal injury and pelvic fractures.

Until the mid-1970s, most of these procedures were completed with an expeditious clamp-and-sew technique which usually involved an interposition graft for bridging the defect. Although there are isolated reports of reasonable outcomes, a meta-analysis of this technique reported an associated mortality of 16% and a striking 19% incidence of paraplegia [10,11]. To prevent paraplegia and protect spinal cord, various methods of distal aortic perfusion have been developed in association with aortic clamping. Early techniques incorporated the use of heparin-bonded proximal aorta-to-distal aortic shunts that passively detoured blood circulation around the site of injury [7]. Active perfusion bypass from the left atrium to the femoral artery or full bypass from femoral artery and venous cannulation through the femoral vein can be performed by administering intravenous heparin and constructing a simple circuit with a centrifugal pump.

Although a relatively safe procedure, the use of intravenous heparin and the time it takes to bypass are risk factors for damage control surgery in an emergency situation. In patients with multiple trauma with other bleeding-related injuries, prolonged administration of intravenous heparin could further induce coagulopathy. Bleeding is the most lethal in trauma patients. In particular, its long-term outcome may be exacerbated in brain injury patients.

TTAI has a unique and different pathology. According to our experience, the injury is focal and often not even circumferential compared with degenerative aortic pathologies. Additionally, most have a relatively young and healthy aorta. Thus, primary closure was possible via clamp-and-sew techniques, and other surgeries could be performed consecutively without leading to coagulopathy. In patients with multiple trauma requiring ongoing resuscitation, the clamp-and-sew technique is still a viable procedure.

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