Fankhauser GT, J Surg Curr Trend Innov 2018, 2: 009
DOI: 10.24966/SCTI-7284/100009

HSOA Journal of Surgery: Current Trends & Innovations

Mini Review

Increasing Role of Endovascular Techniques in the Management of Vascular Trauma

Grant T Fankhauser*

Department of Vascular Surgery, University of Texas Medical Branch, Galveston, USA

Abstract

Just as minimally invasive surgical techniques have flourished in general surgery, so too have less invasive techniques become more widespread in vascular surgery. Endovascular techniques are now first-line treatment for many vascular pathologies. Endovascular techniques have been more slowly adopted for vascular injury in trauma surgery, but the trend is starting to change, largely due to the advent of resuscitative endovascular balloon occlusion of the aorta.

Introduction

Recently there has been a lot of attention on Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) for non-compressible torso hemorrhage and resuscitation in trauma [1-3]. This is not the first time that endovascular techniques have been explored for acute trauma care, but REBOA has been the first widely accepted endovascular acute trauma intervention. The excitement over REBOA has opened the door to further discussion regarding other uses of endovascular intervention in trauma patients. Here the techniques used in trauma settings and some of the reported experiences are reviewed.

***Corresponding author:** Grant T Fankhauser, Department of Vascular Surgery, University of Texas Medical Branch, Galveston, USA, Tel: +1 4097726366; E-mail: gtfankha@utmb.edu

Citation: Fankhauser GT (2018) Increasing Role of Endovascular Techniques in the Management of Vascular Trauma. J Surg Curr Trend Innov 2: 009.

Received: June 19, 2018; **Accepted:** July 27, 2018; **Published:** August 10, 2018

Blunt thoracic aortic trauma, including aortic transection, has a high mortality and survivors often have numerous other injuries [4]. Several studies have demonstrated that endovascular thoracic aortic repair for trauma has a better outcome than open aortic repair [5-7]. Endovascular repair offers lower morbidity and mortality, reducing the combined rates from around 19% to 9% [8]. The guidelines for treating traumatic aortic injury from the Society for Vascular Surgery now recommend endovascular repair as first-line therapy [9]. Clearly this technique has been demonstrated as effective and safe for the acute care of thoracic aortic injuries and most centers have embraced such practices. Still, such techniques require advanced endovascular skills. While endovascular repair of thoracic aortic injuries are often relatively straightforward, such repairs may require transporting the patient to a catheterization lab or radiology suite if an operating room with specialized fluoroscopy equipment is not available. Fortunately, many centers have constructed 'hybrid' operating rooms with complete fluoroscopy equipment that can be utilized for both endovascular intervention as well as open surgical exploration.

Further studies have looked at the growing use of endovascular techniques to treat traumatic injuries to other vessels. The vessels of the thorax were some of the earliest treated endovascularly due to their difficult and morbid exposures. Several series looked at penetrating injuries to these vessels, along with the proximal common carotid arteries [10,11]. Because immediate endovascular treatment has not been readily available at most trauma centers, many of these patients were hemodynamically stable and treated sub-acutely. Pseudoaneurysms were one of the most common pathologies treated in the South African experience, where the majority of the victims had been stabbed [11]. Initial procedural success was 100% but a 5% short-term failure rate of covered stents was noted. Long-term follow-up was difficult to obtain in the study, as it tends to be with many trauma patients. The thoracic and proximal cervical vessels are especially amenable to endovascular techniques, especially the use of covered stents, as these vessels are mainly large caliber with few important branches. Branches such as the vertebral and internal thoracic arteries can often be excluded by a covered stent when necessary, but imaging should be performed first to determine which vertebral artery is dominant and if the internal thoracic artery has been used for coronary bypass.

Avery et al., looked more broadly at the growing use of endovascular techniques in trauma from 2002-2006 and again in 2008 by analyzing the National Trauma Data Bank [4]. They found that there was a growing use of endovascular techniques in the treatment of all arterial injuries they analyzed. They also noted that endovascular techniques were used more often in both blunt and penetrating injury. Importantly, there was a growing use of endovascular techniques in the early time period and in hypotensive patients. The use of endovascular techniques was an independent factor in reduced mortality in this study. This study not only shows an increasing willingness to use endovascular techniques in the acute trauma setting but a survival advantage to doing so. It may also speak to the more immediate availability of interventionalists with endovascular skills.

While not specifically discussed, the availability of a hybrid operating room where both endovascular and open surgical techniques can be performed may be a factor in the willingness to attempt endovascular intervention in hypotensive trauma patients. These hybrid operating rooms afford the ability to convert to an open procedure if the patient suddenly deteriorates or endovascular techniques prove unsuccessful.

The data from the PROOVIT trial provides some of the most recent evidence that endovascular techniques are being used more often in trauma [12]. This study analyzed the usage patterns of endovascular techniques for trauma from 2013-2016. The data showed an increasing use of endovascular techniques in trauma, mainly in blunt trauma. Overall, 16% of vascular injuries were treated with endovascular techniques [13]. Patients with penetrating injuries were still more likely to be treated with open surgery. Those with vascular injures to the extremities were also more likely to be treated with open surgery. Those with thoracic vascular injures and those with blunt-force injuries were more likely to be treated by endovascular techniques. Those treated by endovascular techniques had lower mortality and requirements for transfusion, but had longer lengths of stay. The increased length of stay is postulated to be attributable to the increased survival. This large and recent study is good evidence that endovascular techniques are being consistently utilized in the treatment of traumatic injuries and are lowering mortality. It is still unknown if there is a selection bias in treatment secondary to unstable patients undergoing more open surgery and hemodynamically stable patients preferentially receiving endovascular treatment. The immediate availability of vascular interventionalists and fluoroscopy in the operating room might favor attempting endovascular intervention in unstable patients.

There have been training programs to attempt to teach endovascular skills to those taking Level I trauma call [13,14]. Much of this training is focused on REBOA, either using a wire-based occlusion balloon, or inserting a balloon without a guide wire [15-17]. Groups including Baltimore's Shock Trauma center and the Tokyo Medical University have looked at teaching other endovascular skills to Level I trauma providers [13,18,19]. These studies found that Level I trauma providers can learn endovascular skills and apply them in trauma situations with acceptable outcomes. Training programs differ and each provider will have different comfort levels dealing with various injuries, but endovascular techniques can be an important tool to add to the armamentarium for acute vascular injures. More advanced endovascular techniques, such as selective angiography or deploying covered stents, coils, or occlusion devices, are typically not part of trauma surgery training. Unless these techniques are to be added to trauma surgery training, advanced vascular interventionalists will still be necessary for endovascular intervention in the trauma patient.

There is no substitute for an expert in endovascular techniques for treating acute vascular trauma. While interventional radiologists and cardiologists have experience with catheter-based interventions, they will never be able to care for vascular injures in the way vascular surgeons do with their vast expertise in open and endovascular surgery. At our institution over the last several years, surgeons with dual board certification in vascular and general surgery have taken between 30-40% of the Level I trauma call. This has allowed various vascular injuries to be treated acutely by either open or endovascular techniques, depending on which was more appropriate, and what other injuries may have been present. The increasing use of computed tomography among trauma patients has helped to identify and localize vascular injures, further enabling less invasive treatment [20-23]. Endovascular techniques by our vascular surgeons have been used to treat injures to the brachial, subclavian, common carotid, and superficial femoral arteries, iliac veins, and thoracic aorta. Endovascular techniques have also been used in the acute treatment of liver, splenic, and renal parenchymal injures. At other times diagnostic angiography was used to demonstrate an absence of on-going bleeding in the pelvis, liver, spleen, and retroperitoneum. These endovascular techniques employed by the acting trauma surgeon prevented more invasive procedures and delays from calling in other consultants.

The immediate availability of an expert in endovascular techniques does not preclude the need for open surgery. Our vascular surgeons taking trauma call have had to perform thoracotomies, laparotomies, neck, and limb explorations. The advanced vascular skills these surgeons have permit an expert handling of these injuries during the acute injury management. Hybrid techniques using both open and endovascular techniques have also been used when needed, especially in obtaining inflow control for vascular injuries of the proximal limbs.

Conclusion

Endovascular techniques are being used more frequently in the setting of acute traumatic vascular injuries. Both vascular experts and trauma surgeons are utilizing these techniques with good results. There is a role for vascular surgeons trained in general surgery to take Level I trauma call, as their skills are uniquely applicable in this patient population. Even when a vascular surgeon is not available in the trauma bay, consultation with vascular surgeon should be considered for an expanding number of traumatic vascular injures that may be amenable to less invasive, endovascular techniques.

References

1. DuBose JJ, Scalea TM, Brenner M, Skiada D, Inaba K, et al. (2016) The AAST prospective Aortic Occlusion for Resuscitation in Trauma and Acute care surgery (AORTA) registry: Data on contemporary utilization and outcomes of aortic occlusion and Resuscitative Balloon Occlusion of the Aorta (REBOA). The Trauma Acute Care Surg 81: 409-419.

2. Sadeghi M, Nilsson KF, Larzon T, Pirouzram A, Toivola A, et al. (2017) The use of aortic balloon occlusion in traumatic shock: First report from the ABO trauma registry. Eur J Trauma Emerg Surg 11.

3. Brenner M, Teeter W, Hoehn M, Pasley J, Hu P, et al. (2018) Use of resuscitative endovascular balloon occlusion of the aorta for proximal aortic control in patients with severe hemorrhage and arrest. JAMA Surg 153: 130-135.

4. Avery LE, Stahlfeld KR, Corcos AC, Scifres AM, Ziembicki JA, et al. (2012) Evolving role of endovascular techniques for traumatic vascular injury: A changing landscape? J Trauma Acute Care Surg 72: 41-46.

5. Xenos ES, Bietz GJ, Davenport DL (2011) Endoluminal versus open repair of descending thoracic aortic rupture: A review of the National Trauma Databank. Ther Adv Cardiovasc Dis 5: 221-225.

6. Xenos ES, Minion DJ, Davenport DL, Hamdallah O, Abedi NN, et al. (2009) Endovascular versus open repair for descending thoracic aortic rupture: Institutional experience and meta-analysis. Eur J Cardiothorac Surg 35: 282-286.

7. Carmona AF, Redondo AD, Pareja JC, Maldonado LP (2012) Endovascular treatment of descending thoracic aortic rupture: Mid- to long-term results in a single-centre registry. J Cardiovasc Med (Hagerstown) 13: 266-268.

8. Demetriades D, Velmahos GC, Scalea TM, Jurkovich GJ, Karmy-Jones R, et al. (2008) Operative repair or endovascular stent graft in blunt traumatic thoracic aortic injuries: Results of an American Association for the surgery of trauma multicenter study. J Trauma 64: 561-570.

9. Lee WA, Matsumura JS, Mitchell RS, Farber MA, Greenberg RK, et al. (2011) Endovascular repair of traumatic thoracic aortic injury: Clinical practice guidelines of the society for vascular surgery. J Vasc Surg 53: 187-192.

10. Danetz JS, Cassano AD, Stoner MC, Ivatury RR, Levy MM (2005) Feasibility of endovascular repair in penetrating axillosubclavian injuries: A retrospective review. J Vasc Surg 41: 246-254.

11. du Toit DF, Coolen D, Lambrechts A, de V Odendaal J, Warren BL (2009) The endovascular management of penetrating carotid artery injuries: Long-term follow-up. Eur J Vasc Endovasc Surg 38: 267-272.

12. Faulconer ER, Branco BC, Loja MN, Grayson K, Sampson J, et al. (2018) Use of open and endovascular surgical techniques to manage vascular injuries in the trauma setting: A review of the American Association for the surgery of trauma prospective observational vascular injury trial registry. J Trauma Acute Care Surg 84: 411-417.

13. Brenner M, Hoehn M, Pasley J, Dubose J, Stein D, et al. (2014) Basic endovascular skills for trauma course: Bridging the gap between endovascular techniques and the acute care surgeon. J Trauma Acute Care Surg 77: 286-291.

14. Villamaria CY, Eliason JL, Napolitano LM, Stansfield RB, Spencer JR, et al. (2014) Endovascular Skills for Trauma and Resuscitative Surgery (ESTARS) course: Curriculum development, content validation, and program assessment. J Trauma Acute Care Surg 76: 929-935.

15. Matsumura Y, Matsumoto J, Kondo H, Idoguchi K, Ishida T, et al. (2018) Early arterial access for REBOA is related to survival outcome in trauma. J Trauma Acute Care Surg 12.

16. Romagnoli AN, Teeter W, Wasicek P, Gamble WB, Hu FPM, et al. (2018) No wire? No problem: Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) can be performed effectively and more rapidly with a wire-free device. J Trauma Acute Care Surg 12.

17. Strauss S, Engels P, Harlock J (2018) Distal placement of Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) to restore hemodynamic stability in a patient with proximal aortic rupture. J Endovasc Ther 25: 257-260.

18. Tsurukiri J, Ohta S, Mishima S, Homma H, Okumura E, et al. (2017) Availability of on-site acute vascular interventional radiology techniques performed by trained acute care specialists: A single-emergency center experience. J Trauma Acute Care Surg 82: 126-132.

19. Brenner M, Hoehn M, Teeter W, Stein D, Scalea T (2016) Trading scalpels for sheaths: Catheter-based treatment of vascular injury can be effectively performed by acute care surgeons trained in endovascular techniques. J Trauma Acute Care Surg 80: 783-786.

20. Hogan AR, Lineen EB, Perez EA, Neville HL, Thompson WR, et al. (2009) Value of computed tomographic angiography in neck and extremity pediatric vascular trauma. J Pediatr Surg 44: 1236-1241.

21. Marovic P, Beech PA, Koukounaras J, Kavnoudias H, Goh GS (2017) Accuracy of dual bolus single acquisition computed tomography in the diagnosis and grading of adult traumatic splenic parenchymal and vascular injury. J Med Imaging Radiat Oncol 61: 725-731.

22. Martí de Gracia M, Artigas Martin JM, Soto JA (2012) Evaluation of thoracic vascular trauma with multidetector computed tomography. Semin Roentgenol 47: 342-351.

23. White PW, Gillespie DL, Feurstein I, Aidinian G, Phinney S, et al. (2010) Sixty-four slice multidetector computed tomographic angiography in the evaluation of vascular trauma. J Trauma 68: 96-102.