ACS Case Reviews in Surgery
Vol. 1, No. 6

Case Report of Endovascular Deployment and Angioplasty of a Stent-Graft for Acute Hemorrhage from a Tracheoinnominate Fistula

AUTHORS:
Jaideep Das Gupta, MD[a]; Sundeep Guliani, MD[a, b]; Muhammad Rana, MD[a, b]; Mark Langsfeld, MD[a, b]; John Marek, MD[a, b]

CORRESPONDENCE AUTHOR:
Dr. Jaideep Das Gupta
1801 Gibson SE Blvd
Apt. #3061
Albuquerque, NM 87106
(509)-308-6132
JDasGupta@salud.unm.edu

AUTHOR AFFILIATIONS:
University of New Mexico School of Medicine
a. *Department of Surgery*
b. *Division of Vascular Surgery*
2211 Lomas Blvd NE
Albuquerque, NM 87106

Background	The patient is a 44-year-old male who is ventilator-dependent with previous cardiac surgeries who presented with a massive hemorrhage from a tracheoinnominate fistula (TIF) that was managed acutely with deployment and angioplasty of an endovascular stent
Summary	TIF is a rare complication of tracheostomy historically reported to have a 0.7 percent occurrence rate; this condition is also associated with high rates of morbidity and mortality. Open surgical repair is the primary treatment of choice, but is also associated with a high mortality risk. Recently, endovascular stenting has been offered as a less invasive option and a potential bridge before definite repair. Our patient, a 44-year-old male who is ventilator-dependent with significant comorbidities, presented with an acute massive tracheostomy site hemorrhage. Computed tomographic angiography (CTA) revealed a TIF. The patient was managed with stent graft insertion via right common femoral artery in a retrograde fashion, with a thoracic angiogram demonstrating irregularity of the innominate artery. The procedure was noted to be technically complicated, as the stent required multiple angioplasties since the largest stent in our institution was too small for the patient's innominate artery. Deployment and angioplasty of the stent was performed across the innominate artery in the region of the tracheostomy balloon.
Conclusion	Previous case reports have demonstrated endovascular stent grafts for TIF as an interventional bridge or immediate hemorrhagic control. Our case presentation demonstrates endovascular stent-graft deployment and angioplasties for TIF. In the literature review, the presented case is the only endovascular deployment and angioplasty of a stent-graft that acutely managed hemorrhagic shock from TIF.
Keywords	Tracheoinnominate fistula, endovascular stent, tracheostomy, angioplasty

DISCLOSURE:
The authors have no conflicts of interest to disclose.

ABBREVIATIONS:
TIF: Tracheoinnominate fistula
CTA: Computed tomography angiogram
POD: Postoperative day
CABG: Coronary artery bypass graft
ICU: Intensive care unit

To Cite: Das Gupta, J, Guliani S, Rana M, Langsfeld M, Marek J. Case Report of Endovascular Deployment and Angioplasty of a Stent-Graft for Acute Hemorrhage from a Tracheoinnominate Fistula. *ACS Case Reviews in Surgery.* 2018;1(6):1-5.

Case Description

The patient is a 44-year-old male with significant past medical history of end-stage renal disease, type 2 diabetes, and coronary artery disease status post-coronary artery bypass grafting (CABG) approximately one-year prior. The patient has a history of multiple hospital readmissions and complicated course that required a tracheostomy and revision of tracheostomy 14 months prior for tracheal stenosis. The patient initially presented to a regional hospital and was noted to have upper-extremity weakness and to be coughing up blood. The tracheostomy site was interrogated and was noted to have copious amounts of bleeding from the site. A cuff tracheostomy tube was inserted, and the patient was transferred to our institution in hemodynamically stable condition.

On presentation, the patient's cuff was deflated and continued to have significant bleeding from the tracheostomy site (Figure 1). The balloon was overinflated and underwent a chest computerized tomography (CT) scan that demonstrated a TIF**.** Due to patient's prior cardiac surgery and high mortality and morbidity risk, a family meeting was conducted. The options presented to the family were open surgery, endovascular stenting, and nonoperative management. Informed consent was signed by the patient's family members for endovascular intervention and no open surgery.

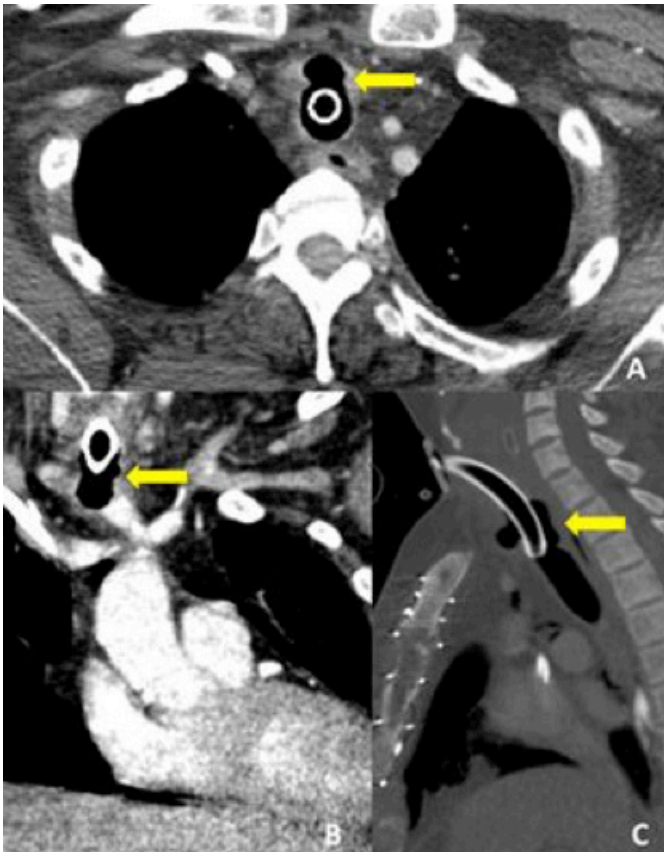

Figure 1. CT angiogram showing a TIF depicted by the yellows arrows. A) Axial; B) Coronal; C) Sagittal

An 8 French sheath and a pigtail catheter were advanced in a retrograde fashion via the right common femoral artery (Figure 2). A thoracic aortogram was performed and demonstrated irregularity of the innominate artery in the region of the tracheostomy balloon prior to stent placement**.** The innominate artery was engaged with an Amplatz wire, and a 12 French sheath was then advanced to the proximal innominate artery. A 13mm x 5mm Viabahn stent was then deployed across the innominate artery in the region of the tracheostomy balloon. Intraoperatively, it was noted the size of the largest stent was too small for the patient's innominate artery. Therefore, the decision was made to perform an angioplasty. A 12mm balloon was subsequently advanced within the stent. The stent was ballooned while simultaneously anesthesia deflated the tracheostomy cuff. The patient immediately desaturated to the mid-70s, with vigorous amounts of bleeding from the

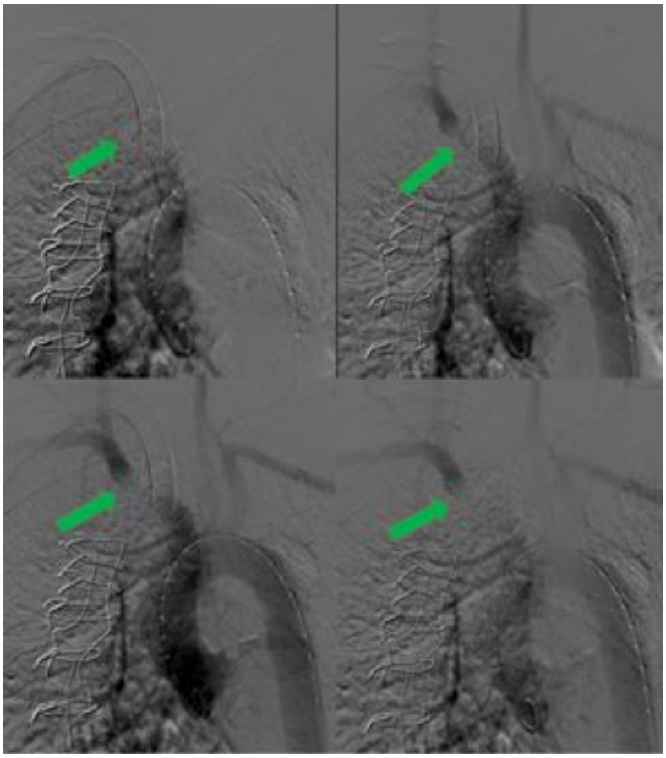

Figure 2. Thoracic angiogram showing sluggish flow of the innominate artery near the region of the tracheostomy cuff prior to stent placement depicted by the green arrows.

tracheostomy sites. The tracheostomy cuff was inflated and the bleeding stopped. Once the patient was stabilized, we then advanced a 14mm balloon within the stent. We proceeded again to balloon the stent while anesthesia deflated the tracheostomy cuff. The tracheostomy site was noted to be hemostasis, and the patient's oxygen saturations were stabilized in the mid-80s (Figure 3). The placement of the stent after the angioplasty was noted in the proximal innominate artery.

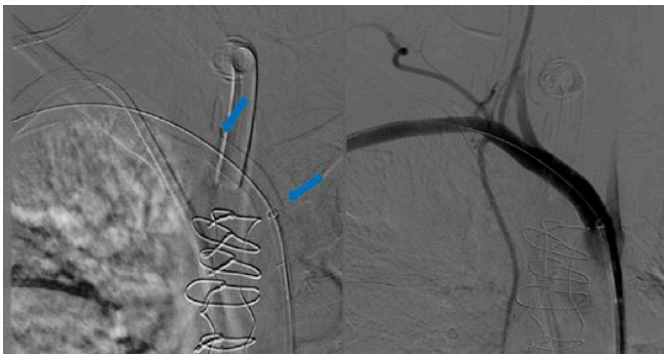

Figure 3. Thoracic angiogram showing the deployed and post angioplasty stent in the proximal innominate artery. The blue arrows illustrate the proximal and distal landing zones of the stent. A) Angiogram without contrast B) Angiogram with contrast

Repeat intraoperative angiography and right carotid angiogram demonstrated sluggish flow and concerns for an acute clot within the distal right common carotid. Due to the patient's respiratory distress and difficulty to ventilate, it was deemed not feasible to perform a carotid cut-down. A percutaneous thrombectomy with repeat arteriogram was performed and demonstrated improved flow with a clot in the carotid bulb. Due to the patient's hemodynamic instability, the patient was started on a heparin drip and transferred to the intensive care unit (ICU). Postoperatively, the patient was noted to have left sided neurologic deficits and the MRI showed a right middle cerebral artery stoke. The patient on postoperative day (POD) 2 was noted to have mild hemorrhaging from the tracheostomy site with the cuff deflated. The palliative care team had a meeting with the patient's family to discuss the goals of care. The patient at this time was able to express his wishes to transition to comfort care and was surrounded by family members. The patient's code status was changed to do not resuscitate and the patient died on POD 3 with a non-perfusing cardiac rhythm.

Discussion

TIF is a rare, life-threatening complication of a tracheostomy that is fatal unless treated immediately. Although the pathophysiologic mechanism of a TIF is unclear, several factors are known to predispose patients to fistula formation, including low positioning of tracheostomy stoma, high riding innominate artery, overinflation of cuff, and infection.[1–2,4] Our patient developed the condition 14 months after a tracheostomy revision, which is an unusual presentation. An estimated 72 percent of patients develop a TIF within the first three weeks after a tracheostomy.[2]

If a patient presents with significant hemorrhage from the tracheostomy site, the cuff should be overinflated to tamponade the bleed, which was performed for our patient. After overinflating the cuff, the patient underwent a CTA scan that showed the TIF; however the diagnosis can be established by clinical scenario.[2] After temporary hemostasis is achieved, definitive treatment of a TIF is by invasive intervention. Definitive treatment is a traditional approach via median sternotomy and ligation of the innominate artery or extra-anatomic bypass.[7] However, survival with open repair is approximately 25 percent, and survival greater than two months is 57 percent.[4,8] Our patient was noted to have had a CABG approximately one year prior, which carries a significantly high mortality and morbidity risk as well as a being a technically complicated surgical procedure. A family discussion was vital, as it gave the family and the medical team an understanding of the patient's wishes and led to the decision that open surgery was not the best course.

Due to patient's comorbidities, presentation, and his family's wishes, a minimally invasive intervention technique was chosen. Endovascular stent-grafting has been effective in arterial hemorrhage, large vessel fistula formation, and has been demonstrated in case reports of TIF management.[5–6,9–10] The first reported endovascular stent-graft for TIF management was reported in 2001.[5] More recent case reports have noted covered stents becoming infected and eroding into the trachea.[10] However, stent grafting, as a potential bridge before definitive repair or for poor surgical candidates, is an effective temporizing measure during acute hemorrhagic presentation.

Our patient had a technically complicated procedure: the stent required multiple angioplasties because the largest stent in our institution was too small for the patient's innominate artery. Coordinating the deflation of the tracheostomy cuff and angioplasty of the stent graft demonstrated excellent teamwork and communication between the surgical and anesthesia teams for unique acute hemorrhagic and respiratory failure management. Previous case reports have noted embolization as an adjunct for stent-graft management for TIF.[6] However, it is important to note that previous case reports of endovascular stent-graft for TIF did not require the multiple angioplasties that this patient required. Based on case report reviews, the presented case is the only endovascular deployment and angioplasty of a stent graft that acutely managed hemorrhagic shock for a TIF.

The patient did suffer a complication of an embolism to the right carotid with postoperative neurologic motor deficits. During the postoperative course, the patient and family met with the surgical intensive care team, vascular team, and palliative care team; a group decision was made to transition the patient to comfort care. Palliative care at our institution is led by a surgical oncologist, and family meetings with surgical patients is quite common. All surgical intensive care patients, based upon inclusion criteria, will be seen by our palliative care team; and our patient clearly met the criteria.[11] Ongoing conversations with multiple teams and family members during the patient's hospital course was instrumental in understanding the family's goals of care and how these goals adjusted with the patient's deteriorating condition. During the patient's initial presentation, the vascular surgery team had an in-depth discussion with the family regarding intervention. Due to the patient's young age, the goals were to proceed with intervention; however, the patient had had a complicated open cardiac surgery course in the past, and the family expressed the goal to avoid any invasive measures. Postoperatively, the palliative care team had multiple family meetings regarding the short- and long-term outcomes that the patient faced. After hearing the outcomes, the family and the patient decided that this was not the life that the patient desired, and the patient was transitioned to comfort care.

Because we acted as a cohesive institution in gaining an understanding of patient and family goals, we were able to avoid additional interventions and a lengthy ICU hospital course. Studies have analyzed the importance of family meetings in the ICU, how proactive meetings with multiple care teams and palliative care teams can help reduce the ICU length of stay, and how to optimize the utilization of expensive resources without increasing ICU mortality or morbidities.[12] As a result, we were able to meet the family and patient goals of care even as those goals transitioned from intervention to comfort care.

Conclusion

Previous case reports have demonstrated the effectiveness of endovascular stent grafts as an interventional bridge or as an immediate hemorrhagic control modality for a TIF. Our case presentation demonstrates endovascular stent-graft deployment and angioplasty for a TIF. In the literature review, our presented case is the only endovascular deployment and angioplasty of a stent-graft that acutely managed hemorrhagic shock of a TIF.

Lessons Learned

TIF is a rare and life-threatening complication of a tracheostomy that is fatal unless treated immediately; however, a patient's comorbidities, surgical history, and family wishes should factor into open repair versus minimally invasive interventions. Endovascular stenting is a minimally invasive approach as a temporizing measure or for poor surgical candidates during acute hemorrhagic TIF.

References

1. Utley JR, Morley MS, Benson BR. Definitive management of innominate artery hemorrhage complicating tracheostomy. *JAMA. 1972;* 220(4): 577-579.
2. Jones JW, Reynolds M, Hewitt RL, Drapanas T. Tracheo-innominate artery erosion: Successful surgical management of a devastating complication, *Ann Surg. 1976;* 184(2): 194-204.
3. Wright CD. Management of tracheoinnominate artery fistula. *Chest Surg Clin N Am.* 1996;6(4): 865-873.
4. Gelman JJ, Aro M, Weiss SM. Tracheo-innominate artery fistula. *J Am Coll Surg.* 1994; 179(5): 626 -634.
5. Deguchi J, Furuya T, Tanaka N, et al. Successful management of tracheo-innominate artery fistula with endovascular stent graft repair. *J Vasc Surg.* 2001; 33(6): 1280-1282.
6. Hamaguchi S , Nakajima Y. Two cases of tracheoinnominate artery fistula following tracheostomy treated successfully by endovascular embolization of the innominate artery. *J Vasc Surg.* 2012; 55(2): 545-547.
7. Allan JS, Wright CD. Tracheoinnominate fistula: diagnosis and management. *Chest Surg Clin N A.* 2003; 13(2): 331-341.

8. Black MD, Shamji FM, Todd TRJ. Trachea-innominate artery fistula and concomitant critical cerebrovascular disease. *Ann Thorac Surg.* 1996; 62(1):286-288.
9. Sessa C, Costache V, Porcu P, et al. Tracheoinnominate artery fistula: combined endovascular and surgical management by emergency stent-graft placement followed by cryopreserved arterial allograft repair. *Ann Vasc Surg.* 2006; 20(6): 731-735.
10. Wall LP, Gasparis A, Criado E. Endovascular therapy for tracheoinnominate artery fistula: a temporizing measure. *Ann Vasc Surg.* 2005; 19(1): 99-10.
11. Bradley CT, Brasel KJ. Developing guidelines that identify patients who would benefit from palliative care services in the surgical intensive care unit. *Crit Care Med.* 2009; 37(3): 946-50.
12. Gay EB, Pronovost PJ, Bassett RD, Nelson JE. The Intensive care unit family meeting: Making it happen. *J Crit Care.* 2009. 24(4); 629.e1. 629.12.