CASE REPORT

Emergency cricothyroidotomy following tracheobronchial stenting

Simon Robert Cavinato,¹ Mike Denning,² Brendan P Madden³¹Department of Cardiothoracic Intensive Care, Saint George's Healthcare NHS Trust, London, UK²Saint George's Healthcare NHS Trust, London, UK³Department of Cardiothoracic, ST Georges Hospital NHS Trust, London, UK**Correspondence to**Dr Simon Robert Cavinato, simoncavinato@gmail.com

Accepted 14 February 2017

SUMMARY

A man aged 51 years was referred for tracheobronchial stenting after a poorly differentiated oesophageal carcinoma had progressed to cause stridor. Bronchoscopy revealed a left vocal cord palsy and tumour infiltration into the trachea. A tracheobronchial stent was placed, and after distal migration was endoscopically resited. Returning from theatre, the patient developed severe upper airway obstruction that progressed to cause CO₂ narcosis and loss of consciousness. A rapid sequence induction was initiated, and a Glidescope revealed bilateral vocal cord palsy with severe oedema causing an inability to pass a tube or stylet. Tracheostomy was attempted above the suprasternal notch but was obstructed by the stent. Oxygen saturations dropped steadily, reaching as low as 38%. Emergency cricothyroidotomy was performed, compliant with DAS guidelines, that proved successful. The stent was removed, which was blocked with blood and secretions, and tracheostomy was placed 2 days later. The patient made a full neurological recovery.

BACKGROUND

Stenting is a tool that is increasingly used for airway stenosis in malignant and benign pathologies.¹ Immediate complications from tracheobronchial stenting are rare but can have severe consequences.² We present the case of severe vocal cord oedema and vocal cord palsy following tracheobronchial stenting, leading to a 'can't intubate, can't ventilate' scenario. This is one of the most high-pressure situations that an anaesthetist will encounter and is not commonly seen in practice, affecting ~1 in 50 000 cases.³ Attempt at emergency front of neck access was made more complex in this case by the stent that had recently been placed in the trachea. This case describes two attempts at a surgical airway, one successful and one unsuccessful. Attempts at emergency cricothyroidotomy and surgical tracheostomy were involved in 43% of serious complications in the National Audit Project 4.³ This report reveals the potential pitfalls of a failed surgical airway with a stent in situ, due to the associated bleeding that caused complete blockage of the stent, as well as describing the method that proved to be successful. To the best of our knowledge, emergency cricothyroidotomy has never before been described following tracheobronchial stenting.

This case represents a critical airway incident that was dealt with successfully by anaesthetic trainees, out of hours and under extreme stress. It demonstrates that the 2015 DAS guidelines⁴ give a

clear and unambiguous set of actions when faced with the ultimate anaesthetic emergency. It also highlights the need for adequate simulation training in providing the required competencies.

CASE PRESENTATION

This man aged 51 years initially presented to a district general hospital with a mass in the left of his neck. He was found to have a left thyroid mass and cervical lymphadenopathy, with biopsy showing a poorly differentiated carcinoma. He underwent a total thyroidectomy and left modified radical neck dissection; however, pathology results suggested an adenocarcinoma with a chemical profile consistent with an upper GI origin, though endoscopy revealed no primary. A PET scan revealed rapidly recurrent disease throughout the tumour bed, with extrinsic disease invading into the oesophagus at the level of the thoracic inlet. He was started on broad-spectrum chemotherapy, though this proved to be relatively ineffective, and the patient continued to have progressive disease with worsening dysphagia. Oesophageal stenting was attempted, but he desaturated markedly when the stent was placed, forcing the procedure to be abandoned.

Three months later, he developed stridor, and was referred to a tertiary centre for tracheobronchial stenting. Rigid and flexible bronchoscopy showed left vocal cord palsy with impaired movement of the right vocal cord. The tumour was found to be growing into the trachea for a length of 3 cm, from 3 cm below the vocal cords, with an associated membranous defect of 5 mm diameter. The tumour was debulked prior to stenting by rigid bronchoscopy and Nd-YAG laser therapy.⁵ This was to provide improved symptomatic relief and optimise the airway for stent compatibility. A 6 cm×20 mm Boston Scientific Ultraflex stent was deployed from 1.5 cm below the vocal cords, rendering good airway patency, sealing the defect and covering the tumour. He was given dexamethasone following the procedure.

At 2:30 am, following insertion of the tracheal stent, the patient developed acute upper airway obstruction and was urgently rushed back to theatre. Repeat rigid and flexible bronchoscopy revealed his known left vocal cord palsy and significant impairment of right vocal cord function with superadded bilateral vocal cord oedema. The stent had migrated 7.5 mm distally, causing a portion of the proximal tumour to obstruct the airway. This was removed and the stent repositioned, after which he was extubated and returned to intensive care. He initially maintained good airway function;

CrossMark

To cite: Cavinato SR, Denning M, Madden BP. *BMJ Case Rep* Published online: [please include Day Month Year] doi:10.1136/bcr-2016-218948

however, he developed stridor and airway obstruction that rapidly progressed to an emergency situation, at which point the emergency airway team were called. The patient became drowsy and lost consciousness due to CO₂ narcosis, and a rapid sequence induction was started using fentanyl, propofol and rocuronium. A Glidescope was used, which revealed significant vocal cord oedema and swelling, causing inability to ventilate or oxygenate. A tube and stylet, used in conjunction with the Glidescope, were unable to bypass the vocal cords. The patient's oxygen saturations were dropping, passing below 75%, at which point the decision was made to attempt access through the front of neck. As the kit was assembled for front of neck access, bag-mask ventilation and insertion of a laryngeal mask airway (LMA) were attempted, but were ineffective to overcome the stenosis. To avoid the tracheobronchial stent, an initial incision was made at the suprasternal notch and surgical tracheostomy attempted. It proved not possible to pass the bougie in this position due to obstruction by the stent, and caused minor bleeding into the site. The oxygen saturations continued to fall, reaching as low as 38%. A transverse scalpel incision was made at the cricothyroid membrane, and a bougie and size 6.0 endotracheal tube (ETT) were successfully passed into the aperture. Once the airway was established, the patient was ventilated with rapid improvement in oxygen saturations. The low oxygen saturations that the patient suffered were below 50% for a matter of around 2–3 min.

OUTCOME AND FOLLOW-UP

Following the acute episode, the ETT was kept in position. Tranexamic acid was prescribed to prevent further bleeding at the incision site, and further dexamethasone prescribed to reduce swelling.

Rigid bronchoscopy was performed 2 days later that showed resolution of the oedema, but ongoing bilateral vocal cord palsy. The stent was removed, which was completely obstructed with blood and secretions (figure 1). Following stent removal, a

Figure 1 Self-expandable metallic stent after removal from the trachea, showing blockage with blood and secretions.

percutaneous tracheostomy was placed with rigid bronchoscope guidance.⁶

The patient developed chest sepsis with a Gram-negative bacteraemia, thought to be secondary to aspiration. He was treated with a course of meropenem with good recovery, and was discharged back to his base hospital for continuation of radiotherapy.

DISCUSSION

Stents are commonly used to provide palliation of symptoms in malignant and benign airway pathologies. Surgical placement of stents to provide relief for airway stenosis was first described at the end of the 19th century by Trendelenburg,⁷ and later by Bond.⁸ Endoscopic placement of stents has now been in use for over 100 years, first used by Brunings and Albrecht⁹ in 1915. Self-expandable metallic stents have been in use since the 1990s, with more recent development of fully covered metallic stents designed to reduce the growth of granulation tissue and ease removal.

The initial method of treatment for tracheobronchial stenosis caused by either malignant or benign pathology is surgical resection; however, this may not be possible in certain patients due to progression of disease or comorbidities. In these cases, endoscopic placement of stents can provide relief of symptoms in reducing work of breathing,¹⁰ can allow for physiological stability enabling treatment with chemotherapy and radiotherapy and can aid in weaning from mechanical ventilatory support.¹¹

Immediate complications for tracheobronchial stenting are relatively rare, but can result in significant consequences. Complications include stent fracture in deployment, dislocation and failure to deploy.^{2 12} Long-term use of stents results in increased incidence of complication, most commonly the development of granulation tissue over the stent, stent migration, lower respiratory tract inflammation and infection, mucus plugging and halitosis.^{2 11–13} Other serious complications have involved erosion of metallic stents to other structures, leading to airway perforation, and fistulisation of the aorta and pulmonary artery to the bronchus.^{14–16} Though not a common complication of stent placement, laryngospasm and vocal cord oedema are a known complication of bronchoscopy, occurring in around 0.3% of patients in one large retrospective single-centre review.¹⁷ In the current case, left vocal cord paralysis and right vocal cord impairment were known previous to stent placement, thought to be caused by the disease process and thyroidectomy with radical neck dissection. Postcricothyroidotomy, bronchoscopy revealed that the vocal cord palsy, in combination with the superadded oedema, had resulted in complete occlusion of the airway. The vocal cord palsy prior to bronchoscopy and the requirement for two bronchoscopies indicated the potential for a difficult airway. Unfortunately, it was not possible to overcome this difficulty pre-emptively by performing percutaneous tracheostomy with the stent in situ. This was due to the physical barrier of the stent, as was exhibited during attempted emergency surgical tracheostomy.

To the best of our knowledge, this is the first described case of emergency cricothyroidotomy following tracheobronchial stenting. Previous case reports have described airway stenosis following tracheobronchial stenting that required emergency tracheostomy;¹ however, this was performed as an emergency case in theatre as opposed to emergency cricothyroidotomy on the intensive care unit.

The order in which a secure airway was attempted was according to the Difficult Airway Society (DAS) guidelines.⁴ In this case, after failure at Plan A (facemask ventilation and tracheal intubation), preparations for plan D (emergency front of

neck access) were started immediately. Plans B and C (bag-mask ventilation and LMA insertion) were attempted during this transition, but no time was lost in the preparation for front of neck access. This was due to the nature in which intubation was not possible, in that the swelling and oedema of the vocal cords had prevented the passage of air and physical instruments, making it unlikely that bag-mask ventilation and LMA insertion would be successful. The benefit of having the emergency airway team in addition to the ITU anaesthetist was that plans B and C could be attempted while preparing for front of neck access. The DAS guidelines are most commonly used in the operating theatre and are not person-specific. Airway management should be 'context-sensitive',¹⁸ and deviations can be made from guidelines in situations where they are predicted to have a low chance of success.

In the first attempt at tracheostomy, access to the trachea was prevented by the metal stent, which precluded tracheostomy as distal as the suprasternal notch. This initial attempt to provide a surgical airway differed from the DAS guidelines, which recommends scalpel cricothyroidotomy.⁴ The logic was to attempt airway placement distal to the stent, so as to avoid a potential barrier to the ETT. This attempt was unsuccessful and led to bleeding into the wound site over the position of the stent. After the stent was removed, the degree of blockage with congealed blood and secretions was clearly visible (figure 1). The stent was visualised via bronchoscopy as clear prior to attempted surgical tracheostomy and cricothyroidotomy, making it likely that the subsequent blockage was caused by bleeding from the surgical airway.

The scalpel cricothyroidotomy followed the DAS guidelines,⁴ but was made more complicated by the potential barrier of the stent, and blood from the previous attempted surgical airway. Despite the difficult environment, clear guidance by the DAS guidelines to use only the scalpel, bougie and size 6.0 ETT removed the decision-making element from the process, and provided a clear method that proved successful. This is an advancement from the 2004 DAS guidelines¹⁹ that recommended a choice between needle cricothyroidotomy and surgical cricothyroidotomy. Meta-analysis of airway success rates has shown surgical cricothyroidotomy to be more effective than needle cricothyroidotomy in prehospital patients (65.8% vs 90.0% success rate, respectively).²⁰ High failure rate was seen in needle cricothyroidotomy in the National Audit Project 4³ for numerous reasons, including kinking of the cannula, poor equipment design and incorrect use of equipment.

Learning points

- ▶ Cricothyroidotomy can successfully provide an emergency airway with a tracheobronchial stent in situ.
- ▶ The DAS guidelines, 2015, provide clear instructions for the 'can't intubate, can't ventilate' scenario, that proved successful in this complicated case.
- ▶ Bronchoscopy on a background of vocal cord impairment can lead to superadded oedema that can cause complete airway obstruction.
- ▶ Attempts at a surgical airway over the site of a tracheobronchial stent can lead to complete blockage of the stent due to bleeding into the site.
- ▶ Regular simulation training can provide necessary skills and competency for this emergency situation that is rarely seen in clinical practice.

This was the first cricothyroidotomy performed by the anaesthetist, who had previously only received training on porcine and manikin models. Emergency airway management is infrequently seen, making it difficult to train for in scenarios with equivalent levels of stress. Simulation training has been shown to improve speed and skill in cricothyroidotomy,²¹ and skill retention has been shown to decline 6–9 months following training.²² It is our opinion that regular simulation training should be used to provide the competencies required in this rarely seen clinical emergency.

Contributors MD helped to plan the report, cowrote sections of both the background and discussion, provided opinion on details, and edited the paper. BPM helped to plan the report, provided expert opinion and clarification of details, and edited the paper.

Competing interests None declared.

Patient consent Obtained.

Provenance and peer review Not commissioned; externally peer reviewed.

REFERENCES

- 1 Davis N, Madden BP, Sheth A, *et al.* Airway management of patients with tracheobronchial stents. *Br J Anaesth* 2006;96:132–5.
- 2 Zakaluzny SA, Lane JD, Mair EA. Complications of tracheobronchial airway stents. *Otolaryngol Head Neck Surg* 2003;128:478–88.
- 3 Cook TM, Woodall N, Frerk CO. Major complications of airway management in the UK: results of the Fourth National Audit Project of the Royal College of Anaesthetists and the Difficult Airway Society. *Br J Anaesth* 2011;106:617–31.
- 4 Frerk C, Mitchell VS, McNarry AF, *et al.* Difficult Airway Society 2015 guidelines for management of unanticipated difficult intubation in adults. *Br J Anaesth* 2015;115:827–48.
- 5 Du Rand IA, Barber PV, Goldring J, *et al.* Summary of the British Thoracic Society guidelines for advanced diagnostic and therapeutic flexible bronchoscopy in adults. *Thorax* 2011;66:1014–5.
- 6 Grigo AS, Hall ND, Crerar-Gilbert AJ, *et al.* Rigid bronchoscopy-guided percutaneous tracheostomy. *Br J Anaesth* 2005;95:417–9.
- 7 Trendelenburg F. Beiträge zu den Operationen an den Luftröhren. *Langenbecks Arch Chir* 1871;163:335. German.
- 8 Bond CJ. Treatment of tracheal stenosis by a new T-shaped tracheotomy tube. *Lancet* 1891;137:539.
- 9 Brunings W, Albrecht W. *Direkte Endoskopie der Luft—und Speisewege*. Stuttgart: Enke, 1915:134–8.
- 10 Felix J, Herth F, Eberhardt R, *et al.* Effects of self-expanding metal stents on work of breathing in patients with tracheobronchial stenosis. *J Bronchol* 2004;11:233–6.
- 11 Madden BP, Park JES, Sheth A. Medium-term follow-up after deployment of ultraflex expandable metallic stents to manage endobronchial pathology. *Ann Thorac Surg* 2004;78:1898–902.
- 12 Marchese R, Poidomani G, Paglino G, *et al.* Fully covered self-expandable metal stent in tracheobronchial disorders: clinical experience. *Respiration* 2015;89:49–56.
- 13 Dahlqvist C, Ocak S, Gourdin M, *et al.* Fully covered metallic stents for the treatment of benign airway stenosis. *Can Respir J* 2016;2016:8085216.
- 14 Urschel JD. Delayed massive hemoptysis after expandable bronchial stent placement. *J Laparoendosc Adv Surg Tech* 1999;(2):155–8.
- 15 Alazemi S, Chatterji S, Ernst A, *et al.* Mediastinal migration of self-expanding bronchial stents in the management of malignant bronchoesophageal fistula. *Chest* 2009;135:1353–5.
- 16 Nouraei SM, Pillay T, Hilton CJ. Emergency management of aorto-bronchial fistula after implantation of a self-expanding bronchial stent. *Eur J Cardiothorac Surg* 2001;20:642–4.
- 17 Jin F, Mu D, Chu D, *et al.* Severe complications of bronchoscopy. *Respiration* 2008;76:429–33.
- 18 Hung O, Murphy M. Context sensitive airway management. *Anaesth Analg* 2010;110:982–3.
- 19 Henderson JJ, Popat MT, Latta IP, *et al.* Difficult Airway Society guidelines for management of the unanticipated difficult intubation. *Anaesthesia* 2004;59:675–94.
- 20 Hubble MW, Wilfong DA, Brown LH, *et al.* A meta-analysis of prehospital airway control techniques part II: alternative airway devices and cricothyrotomy success rates. *Prehosp Emerg Care* 2010;14:515–30.
- 21 Jayaraman V, Feeney JM, Brautigam RT, *et al.* The use of simulation procedural training to improve self-efficacy, knowledge, and skill to perform cricothyroidotomy. *Am Surg* 2014;80:377–81.
- 22 Wong DT, Prabhu AJ, Coloma M, *et al.* What is the minimum training required for successful cricothyroidotomy? A study in mannequins. *Anesthesiology* 2003;98:349–53.

Copyright 2017 BMJ Publishing Group. All rights reserved. For permission to reuse any of this content visit <http://group.bmj.com/group/rights-licensing/permissions>.
BMJ Case Report Fellows may re-use this article for personal use and teaching without any further permission.

Become a Fellow of BMJ Case Reports today and you can:

- ▶ Submit as many cases as you like
- ▶ Enjoy fast sympathetic peer review and rapid publication of accepted articles
- ▶ Access all the published articles
- ▶ Re-use any of the published material for personal use and teaching without further permission

For information on Institutional Fellowships contact consortiasales@bmjgroup.com

Visit casereports.bmj.com for more articles like this and to become a Fellow