Tracheal stenosis: Preventable morbidity on the increase in our intensive care units

O W Raynham, D E Lubbe , J J Fagan

To the Editor: Following a marked increase in patients with tracheal stenosis at Groote Schuur Hospital, we re-examined this problem to identify new trends. Practitioners should be aware of the problem and that tracheal stenosis is an avoidable complication of endotracheal (ET) intubation. It is invariably difficult to treat and carries a heavy treatment burden, and has an associated significant morbidity and reduction in quality of life. A 10-year retrospective review of patients who presented, or were referred to our service, with tracheal stenosis showed no new patterns to be responsible for the increased incidence of stenosis. We therefore conducted a survey of endotracheal tube (ETT) cuff pressures and cuff monitoring practices in local intensive care units (ICUs) which revealed that cuff pressures were dangerously elevated in 30% of all intubated patients surveyed in the ICUs. We are concerned that poor cuff pressure monitoring practices may be responsible for the increase in tracheal stenosis.

Tracheal stenosis occurs because of damage to endotracheal tissue that causes cicatricial stenosis.[1] The incidence of tracheal stenosis following tracheostomy is as high as 17.5%.[2] The cuff of the ETT has been implicated as the main cause of tracheal injury.[1,3,4] Cuff-related damage is proportional to the duration of mechanical ventilation or intubation.[1] When the pressure of the cuff against the tracheal wall mucosa exceeds 30 cm H_20, mucosal capillary perfusion ceases and ischaemic damage ensues.[3,5] Mucosal injury occurs within 15 minutes when lateral tracheal wall pressures exceed 27 cm H_20.[3] There is a consistent pattern of tracheal damage,[1] the mildest of which is superficial tracheitis; next, shallow ulcerations occur, particularly of the mucosa lining the anterior parts of the cartilagenous rings. With more severe injury, the cartilagenous tracheal rings become exposed and are destroyed.[1,5] Mature lesions consist of dense scar tissue.[1]

To prevent tracheal injury, ETT cuff inflation pressures of 30 cm H_20 should not be exceeded.[3] Measures to prevent high cuff pressures include inflation of cuffs with an attached in-line pressure gauge, continuous monitoring of cuff pressures, and the use of soft ETT tubes.[3,6] Other factors contributing to post-intubation tracheal stenosis include cardiovascular status, age, gender, presence of contaminated material at the cuff site,[4] hypotension and airway infection.[2]

Tracheal stenosis can be very difficult to treat, often presenting as an airway emergency, weeks or months following extubation or decannulation. Immediate management usually involves securing the airway by means of a tracheostomy and/or bronchoscopic assessment, and dilatation of the stenosis. Repeated dilatation is often required. Persistent stenosis may require silicone T-tube placement, or segmental tracheal resection.[7] In the developing world, resection may not be possible owing to resource limitations, and many patients have a permanent tracheal T-tube or tracheostomy;[7,8] which has significant implications in terms of morbidity, mortality and quality of life.

One of the authors (OWR) undertook the survey of cuff pressures and monitoring practices at ICUs in Groote Schuur, Tygerberg and two private hospitals in Cape Town. Visits were unannounced to record true clinical practice. Cuff pressures were measured with a Mallinckrodt cuff pressure gauge (Mallinckrodt Medical, Athlone, Ireland). The availability and use of cuff pressure monitors was also noted.

Of 135 ICU patients surveyed, 46 (35%) were intubated. Cuff monitors were available at 29% of ICU beds, with a further 16% of beds having access to a cuff monitor kept elsewhere in the unit. Cuff pressure monitors were in use with 18 (38%) of the intubated patients surveyed. One teaching hospital had cuff monitors available at 53% of ICU beds; at the other were no bedside cuff monitors in the ICUs, although 7 ICU beds (15%) had cuff pressures monitored twice daily.

Table I summarises the cuff pressures recorded at the hospitals surveyed. Notably, 30% of intubated patients had excessive and potentially damaging cuff pressures. In the group with high cuff pressures, 4 patients (9%) had cuff monitors available that were not in use. Despite active monitoring, pressures were above the recommended limit in 3 patients (6%).

Discussion

Tracheal stenosis can occur in intubated patients irrespective of whether or not a tracheostomy is performed. Our study had insufficient data to attribute the increased incidence of tracheal stenosis to the introduction of the percutaneous dilatational tracheostomy technique that has gained recent popularity.

We found very poor compliance with cuff pressure monitoring at the teaching hospitals. Almost a third of

Division of Otolaryngology, University of Cape Town Medical School
O W Raynham, MB ChB, MRCS (Eng), FCORL (SA)
D E Lubbe, MB ChB, FCORL (SA)
J J Fagan, MB ChB, FCS (SA), MMed

Corresponding author: *O Raynham (oliver_raynham@hotmail.com)*

Table I. Endotracheal cuff pressures recorded at four hospitals

	Cuff pressures		
	Average	Range	Cuff pressures at dangerously high level (>30 cm H_20)
Overall	27.3 cm H_20	6 - 80 cm H_20	14/47 (30%)
Teaching hospital A	24.5 cm H_20	34 - 50 cm H_20	5/24 (21%)
Teaching hospital B	33.9 cm H_20	35 - 80 cm H_20	9/21 (43%)
Private hospitals	20.0 cm H_20	12 - 28 cm H_20	Nil

ventilated patients had cuff pressures >30 cm H_20, which are known to cause mucosal ischaemia.[3,5] Another study reported a poor level of understanding among ICU staff about the importance of monitoring cuff pressures, and that cuff pressure monitoring had not been routine practice in the surveyed units.[9]

Conclusions

The marked increase in tracheal stenosis cases seen at Groote Schuur Hospital, and the poor monitoring of ETT cuff pressures in ventilated patients, identifies a breakdown in correct management of intubated patients. It raises questions about adequate ICU funding for equipment such as cuff pressure monitors, and indicates poor compliance with standard ICU cuff pressure monitoring protocols. It further raises the spectre of medico-legal action by patients who develop tracheal stenosis following intubation and ventilation when ETT cuff pressures have been inadequately monitored.

References

1. Cooper JD, Grillo HC. The evolution of tracheal injury due to ventilatory assistance through cuffed tubes: a pathologic study. *Ann Surg* 1969; 169: 334-348.
2. Andrews MJ, Pearson FG. Incidence and pathogenesis of tracheal injury following cuffed tube tracheostomy with assisted ventilation: analysis of a two-year prospective study. *Ann Surg* 1971; 173: 249-263.
3. Seegobin RD, van Hasselt GL. Endotracheal cuff pressure and tracheal mucosal blood flow: endoscopic study of effects of four large volume cuffs. *Br Med J* (*Clin Res Ed*) 1984; 288: 965-968.
4. Mathias DB, Wedley JR. The effects of cuffed endotracheal tubes on the tracheal wall. *Br J Anaesth* 1974; 46: 849-852.
5. Knowlson GT, Bassett HF. The pressures exerted on the trachea by endotracheal inflatable cuffs. *Br J Anaesth* 1970; 42: 834-837.
6. Brimacombe J, Keller C, Giampalmo M, Sparr HJ, Berry A. Direct measurement of mucosal pressures exerted by cuff and non-cuff portions of tracheal tubes with different cuff volumes and head and neck positions. *Br J Anaesth* 1999; 82: 708-711.
7. Bernhard WN, Yost L, Joynes D, Cothalis S, Turndorf H. Intracuff pressures in endotracheal and tracheostomy tubes. Related cuff physical characteristics. *Chest* 1985; 87: 720-725.
8. Hotchkiss KS, McCaffrey JC. Laryngotracheal injury after percutaneous dilational tracheostomy in cadaver specimens. *Laryngoscope* 2003; 113: 16-20.
9. Mol DA, De Villiers Gdu T, Claassen AJ, Joubert G. Use and care of an endotracheal/tracheostomy tube cuff – are intensive care unit staff adequately informed? *S Afr J Surg* 2004; 42: 14-16.

Accepted 19 June 2009.