The Incidence of Tracheoarterial Fistula in Patients With Chronic Tracheostomy Tubes

A Retrospective Study of 544 Patients in a Long-term Care Facility

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Objective: The incidence of tracheoarterial fistula (TAF) in patients with short-term tracheostomy tubes has been reported between 0.6% and 0.7%. The purpose of this study was to determine the incidence of TAF in patients with long-term tracheostomy tubes used for the management of chronic respiratory failure.

Setting: Long-term ventilator facility.

Design: Retrospective.

Methods: Medical records of 544 patients admitted to our institution between January 1981 and December 2002 were reviewed. All patients underwent tracheostomy prior to admission to our facility. Patient age, length of stay (LOS), duration of tracheostomy, and serum albumin levels were compared between patients with and without TAF; p values were obtained using the Student unpaired t test for equal variances.

Results: TAF was diagnosed in five patients. The incidence of TAF in our population was 0.7%. The average age of these patients was significantly less than the study population (31.20 years vs 68.27 years). When one patient outlier was eliminated, LOS was not significant.

Conclusion: TAF is an uncommon complication of tracheostomy tubes. The incidence of TAF in patients with long-term tracheostomy tubes is similar to that reported in short-term tracheostomy tubes.

Key words: chronic; tracheoarterial fistula; tracheostomy

Abbreviations: LOS = length of stay; TAF = tracheoarterial fistula

The long-term care of chronically ill patients with respiratory failure often requires prolonged mechanical ventilation via tracheostomy tube. The complications associated with tracheostomy tube placement and maintenance are well recognized. However, as the population of chronically ill patients increases, the potential for an increased prevalence of these complications also increases.1

The majority of articles regarding tracheostomy tube complications have addressed the acute period (up to 4 weeks) after tracheostomy tube placement. Arola2 reported a 46% mortality rate over a 12-year period in 794 tracheostomy patients, with the majority of the deaths occurring within the first 2 weeks.

Massive hemorrhage as a result of tracheoarterial fistula (TAF) is the most devastating complication. Arola2 reported a 0.6% incidence (5 of 794 patients), and Jones et al3 reported a 0.7% incidence of TAF in their study of 1,501 patients. Four of five patients who experienced massive hemorrhage had their tracheostomy tube in place for < 2 weeks, as did the majority of all patients in their report. The literature is sparse regarding the incidence and risk of this complication in the patient with long-term tracheostomy.

Materials and Methods

After institutional review board approval for the study was obtained, a retrospective review of the medical records was performed on all patients with long-term tracheostomy tubes.
admitted to our facility from January 1, 1981, to December 31, 2002. All patients with long-term tracheostomy tubes were included. Patients with TAF were compared to the “normal” population of patients (those without TAF). TAF was defined as sudden, unanticipated, massive hemoptysis (> 400 mL of frank blood) causing death from respiratory failure and/or exanguination or by autopsy-proven TAF. Age, length of stay (LOS), duration of tracheostomy tube, and serum albumin levels were compared between the TAF group and the normal group. Below are the case reports of the five patients.

Case 1
A 37-year-old man with a 12-year history of tetraplegia as a result of a traumatic C5-C6 fracture was admitted to an acute care facility with acute respiratory failure secondary to aspiration pneumonia. Tracheostomy was performed as a result of failure to wean, and the patient was subsequently transferred to our facility. On the day of admission, it was difficult to pass a suction catheter through the tracheostomy tube. Bronchoscopy via tracheostomy tube revealed a superficial erosion of the tracheal cartilage and a large amount of granulation tissue at the tip of the tracheostomy tube, but no obvious bleeding. A longer tracheostomy tube was placed, and his condition improved. He was successfully liberated from mechanical ventilation but still required a tracheostomy tube for airway management. Follow-up bronchoscopy showed an improvement in the tracheal erosions. His hospital care was remarkable for one episode of bronchitis that required treatment with enteral antibiotics. He also received 27 days of systemic corticosteroids for treatment of bronchospasm. He had two uneventful tracheostomy tube changes, and the remainder of his hospital course was unremarkable. Seventy days after the tracheostomy was performed, he had an acute episode of massive hemoptysis and died. An autopsy showed a fistulous tract between the trachea and the right branchiocephalic artery.

Case 2
A 21-year-old man with profound mental retardation was admitted to an acute care facility with acute respiratory failure. He underwent tracheostomy tube placement in anticipation of the need for long-term mechanical ventilatory support. He was transferred to our facility for long-term ventilatory management. He had three documented respiratory tract infections that required treatment with parenteral antibiotics. He received 18 days of systemic corticosteroids and had nine uneventful tracheostomy tube changes during his stay. One hundred forty-four days after the tracheostomy was performed, he expectorated a large quantity of blood and died. An autopsy showed a fistulous tract between the trachea and the branchiocephalic trunk at the base of the bifurcation.

Case 3
A 48-year-old woman with myotonic dystrophy was admitted to an acute care facility with progressive weakness. She had a cardiopulmonary arrest and was intubated. A tracheostomy was performed, and she was subsequently transferred to our facility. She had two episodes of respiratory tract infections that were treated with enteral antibiotics. One episode required the addition of systemic corticosteroids that were tapered over 2 weeks. She had 14 uneventful tracheostomy tube changes. On hospital day 142, massive hemoptysis suddenly developed. She failed to respond to resuscitation efforts and died. An autopsy revealed a fistulous tract between the trachea and the right common carotid artery.

Case 4
A 27-year-old man with a history of anoxic encephalopathy and spastic quadriplegia since the age of 6 years was admitted to an acute care facility for severe pneumonia requiring ventilatory support. He was transferred to our facility for long-term mechanical ventilation management. He required multiple courses of systemic corticosteroids for the management of a previous reactive airway disease. He had four respiratory tract infections that were successfully treated with antibiotics. He had 17 uneventful tracheostomy tube changes. Difficulty passing a suction catheter through his tracheostomy tube was observed 2 days prior to his death. Approximately 660 days after initial tracheostomy tube placement, massive uncontrollable hemoptysis developed and the patient died. Autopsy revealed a large tracheal ulceration extending into an artery. The specific vessel could not be determined due to a large concomitant area of inflammation.

Case 5
A 24-year-old woman born with hydrocephalus had a prolonged episode of status epileptics at age 3 years with subsequent chronic encephalopathy. Shortly after this event, the patient had an initial tracheostomy placed for management of chronic respiratory failure. She lived in a home for children receiving long-term ventilation for 8 years before coming to our facility. The patient had multiple respiratory tract infections but had no other significant chronic medical issues. Approximately 5 months prior to her death, a nonobstructing ridge of granulation tissue developed at the tip of the tracheostomy tube. She had 114 tracheostomy tube changes during her hospital care. On the day of her death, a massive hemoptysis developed through the tracheostomy. She quickly desaturated and died. At that time, she had had a tracheostomy in place for 20 years and 6 months. A clinical diagnosis of TAF was made since an autopsy was not performed.

Statistical Analysis
The Student unpaired t test for equal variances was used to compare the differences in age, LOS, duration of tracheostomy tubes, and serum albumin levels between the two groups.

RESULTS
A total of 544 patients with long-term tracheostomy tubes were identified during the length of the study (Tables 1, 2). There were 539 patients with long-term tracheostomy tubes in whom TAF did not develop. TAF was diagnosed in a total of five patients. Four patients had autopsy proven TAF, while one patient received a clinical diagnosis of TAF as defined above. The incidence of TAF in this patient population was 0.7%.

Those patients with TAF were significantly younger (mean age, 31.20 years) than the normal group (mean age, 68.27 years). Length of stay was longer in the TAF group (mean, 1,707.20 days vs 370.62 days). However, there was only one patient in the TAF group with a significantly longer LOS that skewed the results (Table 4). If this patient is excluded from LOS calculations, then no significant difference in LOS between the two groups was seen.
Albumin levels were not consistently checked in patients admitted between 1981 and 1996. There were 458 patient charts containing albumin levels and 86 patient charts that did not contain albumin levels. There was no significant difference in the albumin levels between the normal group (2.81 g/dL) and the TAF group (3.10 g/dL) groups (Table 3).

### Discussion

To our knowledge, this is the first report of this size in the English literature to review the incidence of TAF as a complication in chronic tracheostomy tubes. We found its incidence (0.7%) to be surprisingly low in our population. This is similar to the incidence in previously published reports in the acute setting, and thus would appear that the duration of the tracheostomy tube does not have a significant influence on the incidence of TAF.

Tracheal mucosal ischemia is a well-known complication associated with elevated endotracheal tube cuff pressures and has been reported to occur with cuff pressure as low as 25 mm Hg.7 Additionally, Stiles8 noted that tracheal mucosa erosion due to a cuffed tracheostomy tube can occur as early as 24 to 48 h after placement. We have not observed this finding since we do not routinely inspect our patients for this occurrence. The use of low-pressure cuff tracheostomy tubes in our population, which were not available at the time of the report by Stiles,8 may...
help to prevent mucosal ischemia. Furthermore, in our experience the monitoring of tracheostomy tube cuff pressures in patients with long-term tracheostomies is an unreliable indicator of tracheal mucosa integrity and is not routinely monitored. Many of our patients have concomitant tracheomalacia that often requires an increase in tracheostomy tube cuff inflation volumes to allow for effective ventilation.

The nutritional status of our long-term tracheostomized patients is often impaired. Their protein stores may be depleted as a result of a chronic inflammatory process associated with their acute illness or perhaps as a result of recurrent infections. This impairment may compromise the tracheal mucosa integrity and possibly lead to weakness and ulceration in the tracheal wall. Our review did not find a statistical difference in the serum albumin levels in our study group compared to our control group; however, there were 86 patients in the normal group with unavailable albumin levels (Table 3). It is possible but unlikely that this missing data may have changed the outcome.

The age of our study group was significantly younger than our general population. We do not have a satisfactory explanation for this finding since all were adults and none of the tracheostomy tubes were emergently placed or were necessitated by trauma.

We did note that four of five patients had bronchoscopic evidence of significant granulation tissue. Intratracheal granulation tissue is a common finding in our patient population. The size of the granulation tissue appeared to be greater in our study group; however, size was not quantified in this retrospective study. This finding may be the result of an enhanced immune response to a foreign body (tracheostomy tube) associated with younger patients. Future prospective studies investigating any causal relationship between granulation tissue, age, and TAF formation would be interesting to see.

Additionally, the LOS in our study group was significantly longer than our general population, suggesting that the duration of tracheostomy tube placement may be a significant risk factor for TAF. However, when the data are further analyzed after removal of patient 1, LOS is no longer a significant finding (Table 4).

In our 19-year retrospective review of a population with long-term tracheostomy tubes, it appears that the length of time that the tracheostomy tube is in place is not a significant risk factor for the development of TAF. This complication is not more likely to occur in this long-term population than in the acute population. Young age was associated with an increased risk. The significance of this finding is unclear and needs further evaluation.

References

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