

**PRACTICE MANAGEMENT GUIDELINES FOR
THE TIMING OF TRACHEOSTOMY**

The EAST Practice Management Guidelines Work Group

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PRACTICE MANAGEMENT GUIDELINES FOR TIMING OF TRACHEOSTOMY

I. STATEMENT OF THE PROBLEM

The ideal time for performing a tracheostomy has not been clearly established. Periods ranging from three days to three weeks have been suggested in the literature. With current operative methods, it has been established that tracheostomy can be performed with a low rate of complications. In a review of 281 tracheostomies as well as another 2862 cases in the literature, Zeitouni et al reported a 0% mortality in their series and a 0.3% mortality in the other series since 1973²⁵. The risks of prolonged endotracheal intubation, such as patient discomfort necessitating increased sedation, sinusitis, inadvertent extubation, and laryngeal injury, have become increasingly apparent.

Selection of patients who might benefit from conversion of translaryngeal tube to a tracheostomy tube is a complex medical decision. Furthermore, different subgroups may benefit from tracheostomy at different times in their hospital course. Management of patients with a single organ failure (head injury or respiratory failure) may differ from that of the multiply-injured trauma patient. With the lack of clear guidelines for selecting patients for tracheostomy, considerable variability exists in the timing of the procedure, with local practice preferences guiding care, rather than patient considerations.

We initiated our review by converting the need for information about optimal timing of tracheostomy into several answerable questions:

- 1) Does performance of an "early" tracheostomy provide a survival benefit for the recipients?
- 2) What patient populations benefit from an "early" tracheostomy?
- 3) Does "early" tracheostomy reduce the number of days on mechanical ventilation and ICU length of stay?
- 4) Does "early" tracheostomy influence the rate of ventilator-associated pneumonia?

II. PROCESS

A. IDENTIFICATION OF REFERENCES

A computerized search was undertaken using Medline with citations published between the years of 1966 and 2004. Using the search words "tracheostomy" and "timing", and by limiting the search to citations dealing with human subjects and published in the English language, we identified 87 articles. From this initial search, case reports, review articles, editorials, letters to the editor, and pediatric series were excluded prior to formal review. Additional references, selected by the individual subcommittee members, were then included to compile the master reference list of 24 citations.

Articles were distributed among the subcommittee members for formal review. A data sheet was completed for each article reviewed which summarized the purpose of the study, hypothesis, methods, main results, and conclusions. The reviewers classified each reference by the methodology established by the Agency for Health Care Policy and Research (AHCPR) of the U.S. Department of Health and Human Services.

B. QUALITY OF THE REFERENCES

Class I: Prospective randomized controlled trials, **(7 references)**

Class II: Clinical studies in which the data was collected prospectively, and retrospective analyses which were based on clearly reliable data. Types of studies so classified include: observational studies, cohort studies, prevalence studies, and case control studies. **(5 references)**

Class III: Studies based on retrospectively collected data. Evidence used in this class includes clinical series and database or registry review. **(12 references)**

An evidentiary table was constructed using the remaining 24 references. Additionally, a meta-analysis including the seven Class I articles was done by the Vice-Chairman of the Committee, Michael Dunham. Recommendations were based on studies included in the evidentiary tables.

III. RECOMMENDATIONS

A. Level I

There is no mortality difference between patients receiving early tracheostomy (3 to 7 days) and late tracheostomy or extended endotracheal intubation.

B. Level II

Early tracheostomy decreases the total days of mechanical ventilation and ICU LOS in patients with head injuries. Therefore, it is recommended that patients with a severe head injury receive an early tracheostomy.

C. Level III

Early tracheostomy may decrease the total days of mechanical ventilation and ICU LOS in trauma patients without head injuries. Early tracheostomy may decrease the rate of pneumonia in trauma patients. Therefore, it is recommended that early tracheostomy be considered in all trauma patients anticipated to require mechanical ventilation for > 7 days.

IV. SCIENTIFIC FOUNDATIONS

The optimal timing for tracheostomy has been controversial. Laryngeal complications were common prior to the widespread use of endotracheal tubes with low-pressure, high-volume cuffs. With modern endotracheal tubes, it has been established that patients can be safely intubated for at least fourteen days³. In a prospective, randomized controlled trial of 74 trauma patients who received a tracheostomy at either three days or 14 days, there was no significant difference in the incidence of major laryngotracheal pathology between the early and late tracheostomy groups. Significantly, since the perfusion pressure of the tracheal mucosal capillaries is approximately 20 to 30 mm Hg, the authors were careful to limit cuff pressures to 25 mm Hg whenever possible.

There have been many advantages attributed to converting a translaryngeal endotracheal tube to a tracheostomy tube in the critically ill or injured patient, although not all of these are supported in the literature. Among these are improved patient comfort, facilitation of nursing care such as airway suction and oral hygiene, and psychological benefit. These statements have never been tested with a large-scale prospective, randomized study. Astrachan surveyed sixty critical care nurses, the majority of who felt that tracheostomy simplified airway care²⁶. They also thought that patients were more comfortable and, therefore, required less sedation and restraints. Unfortunately, there is no data available from either patients or their families as to the preferred method of airway support.

A common perception among critical care providers is that early tracheostomy may reduce the necessity for mechanical ventilation. One possible mechanism is that mobilization of the patient might allow improved pulmonary toilet and functional residual capacity, as well as avoidance of oversedation. Decreased airflow resistance and reduced dead space following tracheostomy may also contribute to accelerated weaning. In a study of 20 patients, Davis et al found decreased work of breathing per minute (8.9 ± 2.9 vs 6.6 ± 1.4 J/min, $p < 0.04$) and airway resistance (9.4 ± 4.1 vs 6.3 ± 4.5 cm H₂O/L per second, $p < 0.07$) after conversion of a translaryngeal tube to tracheostomy²⁷.

A number of retrospective and a few prospective outcome studies have examined the effect of tracheostomy on weaning from mechanical ventilation. These studies have compared patients undergoing "early" tracheostomy to patients either continuing with translaryngeal intubation or undergoing "late" tracheostomy. There is a great deal of variability in the definition of "early" tracheostomy, varying from two days to 10 days from the time of initial intubation. Furthermore, some of these studies have used quasirandomization methods (even/odd admission day, even/odd medical record number) or assigned patients to groups based on physician preference.

Rodriguez et al prospectively randomized (by day of admission) 106 multiple trauma patients to receive either an early tracheostomy (within 7 days) or late tracheostomy (greater than 7 days). They found a reduction in duration of mechanical ventilation favoring the early tracheostomy group (12 vs. 32 days, $p < 0.05$). Not surprisingly, Intensive Care Unit Length of Stay (ICU LOS) was also reduced (16 vs. 37 days, $p < 0.05$) as was overall hospital LOS (34 vs. 51 days, $p < 0.05$). Their conclusion was that early tracheostomy shortens days on the ventilator, as well as ICU and hospital LOS.

They advised considering tracheostomy for patients in the ICU at risk for more than seven days of intubation².

In a cohort study of 136 trauma ICU patients entered prospectively into an ICU database, Arabi et al found that the duration of mechanical ventilation was significantly shorter (9.6 vs. 18.7 days, $p < 0.0001$) when tracheostomy was performed within 7 days, as was ICU LOS (10.9 vs. 21 days, $p < 0.0001$)¹⁰. These results were supported by Van Boerum's review of 94 trauma patients who required tracheostomies. In this study, tracheostomy within seven days of intubation resulted in a significant reduction in ventilator days (9.6 vs. 18.7 days, $p < 0.0001$) as well as a reduction in ICU LOS (10.9 vs. 21 days)²².

Lesnik et al retrospectively reviewed 101 blunt trauma patients who underwent tracheostomy. Patients who underwent tracheostomy within four days of injury had significantly fewer days of mechanical ventilation compared to those who underwent tracheostomy at five or more days (6.0 vs. 20.6, $p < 0.001$). The selection criteria for performing early tracheostomy were not given²³.

In a prospective, randomized trial of 62 patients with isolated head injury, Boudierka et al randomized patients on the fifth day to receive either a tracheostomy or prolonged translaryngeal intubation. The total ventilation days were significantly less in the early tracheostomy group (14.5 days vs. 17.5 days, $p < 0.02$)¹².

Results in the Medical Intensive Care Unit (MICU) population mirror those in the trauma patient population. In a prospective, randomized, controlled trial of 120 MICU patients projected to require mechanical ventilation for greater than 14 days, patients received either early percutaneous tracheostomy within 48 hours of intubation or late tracheostomy at days 14 to 16. Early tracheostomy was associated with reduced duration of mechanical ventilation (7.6 vs. 17.4 days, $p < 0.001$) as well as decreased ICU LOS (4.8 vs. 16.2 days, $p < 0.001$)⁷.

Brook and colleagues added financial information to the clinical data in their retrospective cohort study of 90 MICU patients who underwent either early (< 10 days, mean 5.9 days) or late (> 10 days, mean 16.7 days) tracheostomy. Both duration of mechanical ventilation (28.3 vs. 34.4 days, $p = 0.005$) and ICU LOS (15.6 vs. 29.3 days, $p < 0.001$) were reduced, which was reflected in a lower cost of hospitalization (\$86,189 vs. \$124,649, $p = 0.001$) for the patients who received tracheostomy within 10 days⁵.

Therefore, it appears that tracheostomy performed earlier rather than later will reduce days of mechanical ventilation and therefore ICU LOS and overall cost. Whether early tracheostomy affects the frequency of pneumonia is less well elucidated. The studies that report frequency of pneumonia utilize the CDC criteria, which are notoriously inaccurate in intubated ICU patients.

In the PRCT of multiple trauma patients by Rodriguez, early tracheostomy resulted in a statistically significant lower incidence of pneumonia (78% vs. 96%, $p < 0.05$)². In Rumbak's PRCT of 120 MICU patients, early tracheostomy was again associated with a

lower rate of pneumonia (5% vs. 25%, $p < 0.05$)⁷. This conclusion was supported by retrospective reviews by Lesnik, who also demonstrated a reduced incidence of pneumonia after early tracheostomy (19% vs. 59%, $p < 0.001$)²³ and Kluger (14% Early, 23% Intermediate & 43% Late, $p = 0.0034$)²⁴. Although Sugerman et al failed to find a difference in mortality in their PRCT of trauma and ICU patients, a difference in Apache scores between the tracheostomy and nontracheostomy groups may account for this finding¹. In a PRCT of 74 trauma patients who received either an early or late tracheostomy, Dunham et al also failed to find a difference in pulmonary septic complications. In their study, however, all types of respiratory sepsis (tracheitis, pneumonia, lung abscess, & peristomal infection) were combined for analysis, which may explain their differing results³.

Unfortunately, early tracheostomy has not been found to provide a survival benefit for its recipients. Of six prospective, randomized, controlled trials^{1,2,4,5,6,7}, only one has demonstrated a reduction of mortality. In a study of 120 MICU patients projected to need ventilation beyond fourteen days, patients randomized to early percutaneous tracheostomy within 48 hours had a lower mortality rate than those receiving delayed tracheostomy at days 14 to 16 (31.7% vs. 61.7%, $p < 0.05$)⁷. Therefore, although early tracheostomy may reduce ventilator days and pneumonia rates, an effect on mortality remains to be seen.

V. FUTURE INVESTIGATIONS

Future investigations should be carried out in a prospective, randomized manner with a sufficient number of patients to enable clinicians to draw valid, concrete conclusions as to the optimal methods of evaluating these patients. Prospective randomization will decrease the baseline differences between groups and allow more concrete conclusions to be drawn. Quasi-randomization methods (e.g., hospital record number, even-odd days) should be avoided. Consensus as to what constitutes "early" versus "late" tracheostomy should be established so that various studies can be compared. As blinding is unrealistic, systematic weaning protocols should be used to reduce the effect of different approaches toward weaning. It remains unclear as to which patients will need prolonged ventilation. Multi-institutional studies of sufficient sample sizes of specific patient populations, such as the head-injured, should identify objective criteria to aid the individual physician in determining which subgroups of patients are likely to require prolonged ventilation and might subsequently benefit from an early tracheostomy. Given the current condition of shrinking resources, future studies should also routinely include cost-effectiveness analysis.

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