Microvascular Reconstruction and Tracheotomy Are Significant Determinants of Resource Utilization in Head and Neck Surgery

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Background: Successful “critical pathway” design and implementation are dependent on appropriate patient stratification according to those factors that are primary determinants of resource utilization.

Objectives: To test the validity of our previously reported critical pathway design and to determine whether tracheotomy and microvascular reconstruction (MR) are primary determinants of resource utilization.

Design: Cost-effectiveness analysis.

Setting: Tertiary referral academic institution.

Methods: Retrospective analysis of data from 133 head and neck surgery cases in which the treatment regimen was based on critical pathways over a 26-month period.

Outcome Measures: Length of stay and total patient charges were used as indices of resource utilization. One-way analysis of variance and t tests were used for statistical analysis of significance.

Results: Ninety patients (67.7%) underwent MR; 43 (32.3%) did not. Seventy-five patients (56.4%) underwent tracheotomy; 58 (43.6%) did not. Four patient groups were constructed in decreasing order of complexity as follows: group 1, patients who underwent both tracheotomy and MR (n = 58); group 2, patients who underwent MR alone (n = 32); group 3, patients who underwent tracheotomy alone (n = 17); and group 4, patients who did not undergo either procedure (n = 26). Both tracheotomy and MR were found to be independent determinants of resource utilization and were additive when both were present. The length of stay varied from 8.4 days (in patients who underwent both procedures) to 6.7 days (in patients who did not undergo either procedure), with intermediate values in cases in which only 1 procedure was performed. The total charges varied in a similar manner from a high of $33,371 to a low of $19,994. Subanalysis with respect to intensive care unit, ward, and operating room charges showed a similar stratification.

Conclusion: Tracheotomy and MR are both significant determinants of charges and length of stay in head and neck surgery cases and must be considered in the design of strategies to promote efficient resource utilization.

PATIENTS AND METHODS

In December 1995, four critical pathways designed to cover the vast majority of elective admissions on the 24-bed head and neck unit at Oregon Health Sciences University (OHSU), Portland, were implemented, and all appropriate patients were entered into them. The patients who were entered into 2 of the following pathways from December 1995 through February 1998 form the basis of this report: MR refers to patients who underwent clean contaminated operations involving entry into the upper aerodigestive tract but without flap reconstruction (eg, laryngectomy), and MR+ refers to those who underwent clean contaminated operations involving entry into the upper aerodigestive tract but with flap reconstruction.2 Identification of the subset of tracheotomy admissions (TR+ vs TR−) from this group was done using fiscal services records and the International Classification of Diseases, Ninth Revision, codes 31.1 (temporary tracheotomy), 31.29 (other permanent tracheotomy), 30.4 (radical laryngectomy), and 30.3 (completion laryngectomy). A previous, separate review of 301 admissions on our service verified the validity and completeness of this approach.

Charge and LOS data were obtained from OHSU Fiscal Services. Subclassification of charges was determined using the categories of intensive care unit (ICU) (cost per day), ward (cost per day), operating room (OR) (actual charges), respiratory therapy (RT) (actual charges), and other (all other charges not otherwise accounted for in the other classifications). There was no dominant expense in this latter category. Respiratory therapy charges were considered separately because it was thought that such charges might be a source of significant differences in cases involving patients who underwent tracheotomy compared with those who did not.

Statistical analysis was performed using the t test or the 1-way analysis of variance testing the null hypothesis that group means were equal.

RESULTS

There were a total of 133 admissions for 130 different patients over the study period. Ninety patients (67.7%) underwent MR (MR+); 43 (32.3%) did not (MR−). Seventy-five patients (56.4%) underwent tracheotomy (T+); 58 (43.6%) did not (T−).

Table 1 and Table 2 list the means and SDs for LOS and charges by procedure type and the t test results.

COMMENT

On all variables except RT, the mean values for the flap admissions were significantly higher than for the no-flap admissions. The mean values for tracheotomy admissions were significantly higher for ward, OR, other, and total charges. In general, the differences between flap and no-flap admissions were greater than the differences between tracheotomy and no-tracheotomy admissions.

The 133 admissions were classified into 4 groups. Table 3 lists the means for the 4 groups. The P values are for a 1-way analysis of variance testing the null hypothesis that the group means are equal. All group means other than those for RT charges were either significantly different or marginally significantly different (Table 3). In general, flap admissions involved a longer LOS and higher charges. Pairwise comparisons showed that the means for flap admissions were significantly higher than for no-flap admissions for ICU, OR, other, and total charges.

The success and acceptance of critical pathways for patient care is dependent on their ability to properly organize complex patient care issues in a logical manner. If patients are grouped in a cohesive manner, so that complexity of their care requirements and their pathway match, appropriate planning for resource allocation can occur. This analysis would suggest that from the stand-
To properly interpret these results, it is important to understand that at OHSU virtually all patients return to the head and neck unit the night of surgery, regardless of whether they underwent MR or tracheotomy. Only complex medical issues mandate ICU admission, as is the case in other major head and neck units.3 The existence of an experienced head and neck unit explains the low overall ICU charges that were observed in our analysis. If either MR or tracheotomy mandates ICU admission at a given institution, then the results of the analysis might be different. Similarly, feeding tube removal rarely serves as a primary end point for hospital stay at OHSU. Planned hospital discharge with a feeding tube in place is routine after major head and neck surgery at our institution, with swallowing rehabilitation occurring in the outpatient setting at follow-up. Our experience with this approach would suggest that it results in both a more stable nutritional intake and better swallowing rehabilitation, as it allows patients to participate in swallowing rehabilitation after the immediate postoperative issues have been settled and at a point where they can better focus on it.

The issues that surround LOS and tracheotomy are more complex, in our experience. Patients generally fall into 1 of 3 categories. In a patient in whom it is anticipated that the tracheotomy will be in place for longer than 3 to 7 days, a decision is made preoperatively as to whether the patient is a candidate for home tracheotomy management. If so, instruction and equipment discharge planning are begun on postoperative day 1, so discharge is usually possible by day 5 or 6. If not, skilled nursing facility placement is planned for approximately the same time. The situation is less predictable, however, if rapid decannulation is anticipated, as this event often becomes the end point for hospitalization. In our experience, 1 or 2 days more than expected are often required, and hospitalization must be extended to allow for this.

The fact that RT charges were not significantly different between the groups is more difficult to explain. Of the 2 procedure categories, MR appears to play a more dominant role than tracheotomy, but both have significant independent and synergistic effects. The stratification reflected in Table 3 reflects a decreasing case complexity from the standpoint of these 2 factors, and LOS and cost data stratify out along the same lines. While the increased OR charges that are attributable to the additional time involved are clearly a major source of the increased cost associated with MR, the effect of both tracheotomy and MR was seen in nearly all areas studied. The reason for this effect may lie in the fact that the need for either tracheotomy or MR reflects a situation in which there is more advanced disease and/or perhaps increased medical comorbidities. This issue was not addressed in our study, but could be the subject of future analyses, as significant literature already exists regarding medical comorbidities and their association with perioperative complications and prolonged hospital stay. However, whether the tracheotomy and/or MR reflects cause or effect, both procedures appear to represent valid objective preoperative criteria of complexity that can be used to predict overall resource utilization in cases of head and neck surgery.

In cases in which there was a significant concern about airway edema, an earlier analysis at our institution of the relative cost of short-term tracheotomy vs intubation overnight in the ICU the night after surgery had shown us that the overall RT charges were equivalent. Some of the similarities in charges would be explained by this, but certainly not all. Also, at our institution, RT is responsible for the setup of airway humidifiers and supplemental oxygen, regardless of whether it is administered by face mask, nasal cannula, or tracheotomy collar. Since most patients use 1 of these forms postoperatively, charges are likely to be similar.

Tracheotomy and MR are both significant determinants of charges and LOS in cases of head and neck surgery and should be considered as such in the design of strategies such as critical pathways that seek to promote efficient resource utilization.

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