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BRIEF REPORT

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Ward mortality in patients discharged from the ICU with tracheostomy may depend on patient's vulnerability

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Abstract *Objective:* To determine the effect of discharge from the ICU with a tracheostomy tube on ward mortality and its relation to patient vulnerability. *Design and setting:* Retrospective single-center cohort study. *Methods:* Database (2003–2006) review of patients undergoing mechanical ventilation (MV) > 24 h and discharged from the ICU with or without tracheostomy tube in place and followed up to hospital discharge or death. We recorded clinical characteristics, complications, major ICU procedures, subjective prognosis at ICU discharge (Sabadell score), and hospital outcome. Factors associated with ward mortality were analyzed by multiple logistic regression. *Results:* From 3,065 patients admitted to the ICU, 1,502 needed MV > 24 h. Only 936 patients (62%) survived the ICU and were transferred to the ward; of these, 130 (13.9%) had a tracheostomy tube in place. Ward mortality was higher in patients with a tracheostomy tube in place than in those without (26 vs. 7%, $P < 0.001$). Increased ward mortality among cannulated patients was seen only in those with intermediate Sabadell score (24 vs. 9% in score 1, $P = 0.02$, and 38 vs. 24% in score 2, $P = 0.06$), but not in the "good prognosis" (2 vs. 2%, score 0) and "expected to die in hospital" (80 vs. 75%, score 3) groups. Multivariate analysis found three factors associated with ward mortality: age, tracheostomy tube in place, and Sabadell score. *Conclusion:* Lack of tracheostomy decannulation in the ICU appears to be associated with ward mortality, but only in the group with a Sabadell score of 1.

Keywords Mechanical ventilation · Tracheostomy · Hospital survival · Outcome research · Scoring system

Introduction

The main reasons for tracheostomy in ICU are prolonged mechanical ventilation (MV), failed extubation, sputum retention due to weakness, permanent neurological deficits, or upper airway obstruction [1, 2]. Some clinicians recommend early tracheostomy to reduce secondary lesions of the upper airways induced by the endotracheal tube (ET). Although the results of different studies have supported this approach [3, 4], the most common clinical practice is to restrict tracheostomy to long-term MV patients [5]. In recent decades, the procedural risk of tracheostomy has been reduced, mainly due to the percutaneous approach [6, 7]; however, whether tracheostomy improves the outcome or only transfers the mortality from the ICU to the ward remains controversial [8–14].

On the other hand, a more accurate classification of patients at ICU discharge may offer better approaches to the study of risk factors like tracheostomy. We recently published the Sabadell score that classifies patients at ICU discharge into four distinct populations with different

ward outcomes [15]. We hypothesized that the impact of remaining tracheostomized on ward mortality may differ with patient vulnerability [16]. Thus, we examined the association of ICU discharge with tracheostomy tube in place on ward mortality in the four subgroups with different subjective prognoses as assessed by the Sabadell score.

Materials and methods

We retrospectively studied all MV patients registered in our computerized database between 2003 and 2006 in our 16-bed medical–surgical ICU; accordingly, informed consent was waived. We excluded patients who received <24-h MV in the postoperative period. Variables recorded on admission included age, sex, diagnosis, APACHE II score, and comorbidities. During the ICU stay, we recorded major procedures and adverse events. At ICU (or step-down unit, when applicable) discharge, the attending physician classified the patient according to the Sabadell score, a subjective tool explained in detail elsewhere [15]. Briefly, it has four levels of expected prognosis: score 0 is for patients with good prognosis, score 1 is for patients with poor prognosis in the medium-to-long term, score 2 is for patients with poor prognosis in the short-term, and score 3 is for patients who are expected to die before discharge from the hospital.

Patients who remained tracheostomized at the Critical Care Center discharge were placed in dedicated rooms in ordinary wards (see full description of tracheostomy indication, technique, ICU care, and ICU discharge policy in the ESM). The ward team responsible for their care always included dedicated laryngologists and physiotherapists, but was not informed of the Sabadell score. We retrospectively reviewed the wards' clinical charts to determine the appropriateness of airway care, characteristics of secretions, time to decannulation, technical complications, and cause of death in patients who died.

Statistical analysis

Variables were described using means and standard deviations or percentages and odds ratios, as appropriate. Means of continuous variables were compared using *t* tests with significance set at $P < .05$. Categorical variables were analyzed with Fisher's exact test. The

Table 1 Clinical characteristics of tracheostomized and non-tracheostomized patients at ICU or step-down unit discharge

	No tracheostomy, $n = 806$	Tracheostomy, $n = 130$	*P* value
At ICU admission			
Age (years)	59.0 ± 18.7	60.1 ± 19.9	0.5
APACHE II score (points)	15.7 ± 8.2	17.4 ± 8.8	0.05
APACHE II risk of death (%)	26.6 ± 22.7	33.9 ± 26.2	0.005
Emergency surgery	178 (22.1%)	18 (13.8%)	0.04
Neurological diseases	82 (10.2%)	30 (23.1%)	0.001
Gastrointestinal diseases	144 (17.9%)	7 (5.4%)	0.001
Trauma	138 (17.1%)	36 (27.7%)	0.007
Infectious diseases	94 (11.7%)	24 (18.5%)	0.05
Cardiovascular diseases	116 (14.4%)	9 (6.9%)	0.02
During ICU stay			
Noninvasive ventilation	66 (8.2%)	17 (13.1%)	0.09
Blood transfusion	249 (30.9%)	66 (50.8%)	0.001
Arterial catheter	583 (72.3%)	119 (91.5%)	0.001
Thermodilution catheter	94 (11.7%)	40 (30.8%)	0.001
Vasoactive Drugs	357 (44.3%)	85 (65.4%)	0.001
Parenteral nutrition	97 (12.0%)	21 (16.2%)	0.2
Prone positioning	11 (1.4%)	11 (8.5%)	0.001
Nosocomial infection	100 (12.4%)	76 (58.5%)	0.001
Pneumothorax	5 (0.6%)	4 (3.1%)	0.03
Acute renal failure	90 (11.2%)	23 (17.7%)	0.04
Upper gastrointestinal bleeding	11 (1.4%)	2 (1.5%)	0.7
Self-extubation	41 (5.1%)	8 (6.2%)	0.7
Reintubation	48 (6.0%)	32 (24.6%)	0.001
Step-down unit admission	255 (31.6%)	48 (36.9%)	0.3
At ICU discharge			
Sabadell score 0	603 (74.8%)	56 (43.1%)	0.05
Sabadell score 1	121 (15.0%)	25 (19.2%)	0.4
Sabadell score 2	62 (7.7%)	29 (22.3%)	0.001
Sabadell score 3	20 (2.5%)	20 (15.4%)	0.001

variables found significant in the univariate analysis were included in a multivariate logistic regression analysis with ward mortality as the dependent (outcome) variable (see ESM).

Results

In the 4-year period, we admitted 3,065 patients, 1,502 of whom needed MV for at least 24 h. Only 936 (62%) of these patients survived the ICU and were transferred to the ward; 130 (13.9%) patients had a tracheostomy cannula in place when transferred to the ward. The overall ward mortality was 87/936 (9.3%) and was higher in patients with a tracheostomy cannula in place at ICU discharge than in those without [34/130 (26%) vs. 53/806 (7%), $P < .001$]. Table 1 depicts the clinical characteristics of these two groups and shows that patients that remained cannulated at discharge were sicker and had more complications.

Table 2 shows the variables associated with ward mortality in the univariate analysis. Blood transfusion, renal replacement therapy, ICU infection, pneumothorax, acute renal failure, upper gastrointestinal bleeding, and reintubation all failed to reach significance. The multivariate analysis found three factors associated with ward mortality: age, tracheostomy, and Sabadell score (see Table 3), with a global accuracy of 93.1% for predicting ward mortality.

Although the overall interaction between tracheostomy and Sabadell score was statistically non-significant ($P = 0.57$), the inclusion of the interaction term suggested that the mortality increase associated with tracheostomy was restricted to patients with intermediate Sabadell scores, whereas minimal or no difference was found between patients with tracheostomy cannulae and those without in the "good prognosis" and "expected to die in hospital" groups (Fig. 1 and ESM).

The ward charts showed wide variability in the length of ward stay in the 34 tracheostomized survivors. Ward stay ranged from 1 to 167 days, resulting in a non-normal distribution with a median of 18 days. Subgroup analysis was not feasible due to the low number of nonsurvivors in Sabadell scores 0 and 1. A wide variety of causes of death were also reported, including nosocomial infection (mainly respiratory tract infection) in 12 patients (35%), relapse of the primary illness (stroke, cancer, heart failure) in ten patients (29%), and progressive global deterioration in nine patients (26%). A direct relationship between tracheal cannula obstruction and death was established in the remaining three patients (9%), two with a Sabadell score of 1 and one with a Sabadell score of 2.

Discussion

The main results of this study reinforce the idea that ICU discharge with tracheostomy tube in place is associated

Table 2 Variables associated with ward mortality in the univariate analysis

Variables	Survivors, $n = 849$	Nonsurvivors, $n = 87$	Odds ratio	95% CI	P value
Tracheostomy	11.3%	39.1%	5.03	3.11–8.13	0.001
Mechanical ventilation > 96 h	38.4%	69.1%	2.62	1.62–4.13	0.001
Noninvasive ventilation	8.2%	14.9%	1.95	1.03–3.70	0.04
Parenteral nutrition	11.8%	20.7%	1.95	1.12–3.42	0.03
Vasoactive drugs	46.1%	56.6%	1.66	1.06–2.59	0.03
Age (years)	58.1 ± 18.9	70.5 ± 11.3	1.05	1.03–1.07	0.001
APACHE II risk of death (%)	26.8 ± 23.1	36.9 ± 24.0	1.02	1.01–1.03	0.001
Sabadell score 0 (reference)	76.0%	16.1%	1	NA	NA
Sabadell score 1	15.2%	19.5%	6.1	2.9–12.6	0.001
Sabadell score 2	7.8%	28.7%	17.4	8.6–35.2	0.001
Sabadell score 3	1.1%	35.6%	158.7	63.8–394.9	0.001

Sabadell score 0 acted as reference value for odds ratio calculation in the other three categories

Table 3 Multivariate logistic regression of factors associated with ward mortality

	Coefficient (β)	SE	Wald χ^2	Odds ratio	95% CI	P value
Intercept	−5.579	0.732	58.123	0.004		0.001
Age (years)	0.028	0.011	6.896	1.03	1.01–1.05	0.009
Tracheostomy	0.796	0.317	6.310	2.2	1.2–4.1	0.01
Sabadell score 1	1.538	0.381	16.295	4.6	2.2–9.8	0.001
Sabadell score 2	2.388	0.379	39.678	10.9	5.2–22.9	0.001
Sabadell score 3	4.488	0.485	85.718	88.9	34.4–230.1	0.001

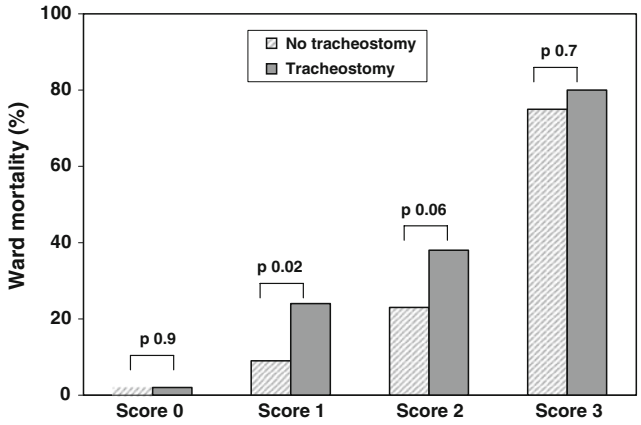

Fig. 1 Ward mortality in each group related to the presence of a tracheostomy cannula at ICU discharge. *P*-values from the interaction term between tracheostomy and Sabadell score were included in the multivariate logistic regression model

with increased ward mortality, but only in patients with intermediate prognoses (Sabadell scores 1 or 2).

Our discussion will focus on three factors: the role of tracheostomy in ICU patients, the Sabadell score as a prognostic tool, and the quality of tracheostomy care in the ward and possible improvements.

Tracheostomy is often performed in ventilated ICU patients; however, the frequency of its application varies widely, with reported incidences ranging from 5 to 40% of all intubated patients [17]. While different medical approaches account for some of these differences, case mix is the strongest predictor for tracheostomy. Other database reviews have found different effects on survival, ranging from beneficial to deleterious [17, 18]. Some investigators suggest that although tracheostomy speeds ICU discharge and thus increases ICU survival, more of these patients die on the ward, resulting in a null effect on overall hospital mortality [18].

The prognosis of patients discharged from the ICU has received little attention. We recently devised a subjective scoring system, the Sabadell score, which easily classified patients into four groups with very different survival outcomes at hospital discharge [15]. The multicentric validation of this score is now under investigation. Although the present study selected only patients that underwent MV > 24 h, no difference was found in global ward mortality for each group in comparison with the general ICU population studied in the original paper describing the score. However, discharge from the ICU with a tracheostomy cannula in place had a statistically significant effect on ward mortality in the multivariate analysis of this study but not in the original paper; we attribute this difference to the higher proportion of patients with a tracheostomy cannula at ICU discharge because only MV patients were selected.

In terms of patients' safety, tracheostomy care has been given intermediate importance, most likely because of the low rate of patients with tracheostomies in the general hospital population and the assumption that there are no alternatives to tracheostomy. In our hospital setting, which includes a step-down unit as well as dedicated laryngologists and physiotherapists in the ward, the incidence of cannula-related deaths was very low. The vast majority of deaths were attributable to underlying conditions or infections acquired during long hospital stays. Therefore, the higher mortality rate in patients discharged from the ICU before decannulation might reflect the greater severity of these patients rather than an increased risk inherent in tracheostomy cannulae in the ward.

Limitations of the study

Internal validity: The 3-year study period reasonably excludes seasonal variations and was recent enough to reflect current performance. Though the overall interaction between tracheostomy and Sabadell score was statistically non-significant, the distinct behavior of scores 1 and 2 compared to scores 0 and 3 appeared clinically relevant. Some of the issues related to the retrospective nature of the study were reduced by the prospective recording of the main data. Nevertheless, records of the cause of death have been repeatedly recognized as less accurate in the clinical scenario [19].

External validity: Before extrapolating the results of our single center study to other ICUs, differences in early versus late tracheostomy, early versus late decannulation, availability of step-down units, and training and nurse staffing in the wards should be taken into account.

The clinical impact of our study will result from a better definition of the population most likely to benefit from outreach team surveillance in the ward or from a prolonged stay in the step-down unit until decannulation, when feasible.

We conclude that lack of tracheostomy decannulation in the ICU appears to be associated with ward mortality, but only in the group with a Sabadell score of 1. Whether discharge without decannulation is a direct risk factor or a marker of sicker patients remains to be elucidated.

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