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Timing of Tracheostomy Following Brain Tumour Surgery in Cases Requiring Prolonged Mechanical Ventilation

Vikas Chandra Jha[1]*, and Mohammad Shahnawaz Alam[2]

[1]*Associate professor Neurosurgery, MCH, Department of Neurosurgery, All India Institute of Medical Sciences, Patna, India*

[2]*Senior resident, Department of Neurosurgery, All India Institute of Medical Sciences, Patna, India*

Abstract

Background: We planned to compare the outcome of early tracheostomy as compared to delayed in patients with brain tumour (supratentorial and infratentorial) requiring prolonged mechanical ventilation (PMV) postoperatively and also tried to search for risk factors responsible for early tracheostomy in view of scarce literature available on it.

Material &Methods: We included 90 cases who underwent tracheostomy for PMV following brain tumour surgery between September 2018 and September 2020. They were divided in group 1 with early tracheostomy comprising 56 and group 2 with 34 patients.

Result: Group 1, had reduced, weaning time from mechanical ventilation (MV) (p=0.031), ICU stay (p<0.023), hospital stay (p<0.029), VAP (p<0.031), short-term mortality (p<0.028) and better Glasgow outcome score (p<0.001) on follow-up compared with Group 2. Increased mass effect with midline shift and ventilator-associated pneumonia (VAP) (p=0.031) were strong predictors of PMV, on stepwise logistic regression analysis and had a Youden's index of >0.80 and a positive predictive value of 0.88.

Conclusions: Early Patients tracheostomised (<5 days) early for PMV following surgery for brain tumour have better functional recovery and shorter ICU stay. Patients with increased mass effect with increased midline shift and VAP postoperatively have a strong predilection to undergo PMV. However, we should prospectively validate our results in a larger number of cases to substantiate these results.

Keywords: Cranial surgery • Brain tumour • Tracheostomy timing • Early vs. delayed • Risk predictors

Introduction

Early tracheostomy in critically ill patients suffering from non-neurological illness requiring prolonged mechanical ventilation (PMV) has variable results benefits in terms of reducing ventilator-associated pneumonia (VAP), weaning time from mechanical ventilation (MV), intensive care unit (ICU) stay, and short-term mortality. Earlier studies done in neurological patients suffering from traumatic brain injury, stroke, subarachnoid hemorrhage and postoperative patients of infratentorial tumors has shown some benefits in terms of VAP, ICU stay but no benefit in terms of functional recovery and mortality at subsequent follow up [1,2]. Scarce literature is available on timing of tracheostomy in patients undergoing surgery for brain tumor (including both supratentorial and infratentorial) and risk factors responsible for PMV postoperatively [3-6]. Majority of these cases are capable of spontaneous breathing preoperatively and not critically ill. In such patients, preexisting risk factors, including altered consciousness; features of increased intracranial pressure; abnormalities in routine blood investigation, such as hyponatremia and leukocytosis;deranged arterial blood gas (ABG) parameters, such as PaO2 and $PaCO_2$; intraoperative events, such as massive blood transfusion; venous embolism; fluid overload; and postoperative complications, such as meningitis, operative site edema with midline shift, and lower cranial nerve palsies, are more predictive of PMV requirement than illness severity scores, including Acute Physiology And Chronic Health Evaluation (APACHE) II, APACHEIII, and Infection Probability Score, as reported in the literature for critically ill patients suffering from non-neurological illness. Predictors of postoperative PMV should include the aforementioned perioperative factors. Considering the existing knowledge, we planned to evaluate the outcome of early tracheostomy in comparison to delayed in patients requiring PMV following brain tumor surgery (including both supra and infratentorial) and also tried to find out the predisposing risk factors for PMV and suitable timing for tracheostomy [7,8].

***Address for Correspondence:** Vikas Chandra Jha, Associate professor Neurosurgery, MCH, Department of Neurosurgery, All India Institute of Medical Sciences, Patna, India; E-mail: id-drvikaschandrajha@aiimspatna.org*

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Methods

Ethical clearance of the study has been obtained from the institution. We have adhered to the Institutional and Departmental Ethical Guidelines, while working on this study and during its final submission with institutional ethical clearance (no. IEC/2020/355). Detailed written informed consent was obtained at the time of admission from the patients, next of kin, or guardian for the use of their data for teaching and clinical research purposes.

Five hundred and fifty-seven patients had undergone brain surgery for various indications between July 2018 and July 2020 in the neurosurgery department. Among them,340 underwent surgery for brain tumours and 90 patients required tracheostomy for prolonged mechanical ventilation, hence included in this study. The patients were divided into two groups: Group 1 with Early tracheostomy was defined as tracheostomy performed within 8 days of endotracheal tube intubation with PMV, whereas group 2 with late tracheostomy was defined as tracheostomy performed after 8 days of intubation.

Clinical information was obtained from the patients' medical charts. The following data were collected: age, sex, Glasgow Coma Scale (GCS) score at the time of admission, Glasgow outcome score at follow up, and comorbidities, including obstructive lung diseases (i.e., asthma and chronic obstructive pulmonary disease), coronary artery diseases, heart failure, stroke, diabetes, cirrhosis, chronic kidney disease, haemodialysis, and metastases.

The following laboratory data were collected preoperatively and postoperatively: hemoglobin, platelet count, blood urea nitrogen, creatinine, and albumin. Furthermore, ABG parameters, including pH, partial pressure of oxygen (PAO2), partial pressure of carbon dioxide ($PaCO_2$), and lactate; chest X-ray; and lung function using bedside spirometry tests were analysed.

In addition, data regarding the procedure type (surgical tracheostomy or percutaneous dilation), the length of stay in the ICU, the duration of stay on mechanical ventilation (MV), and mortality were collected. Weaning success was defined as liberation from MV of more than 5 days. VAP was defined as pneumonia occurring 48 hours after MV initiation.

Patients with the following features were considered suitable to wean off from MV: adequate removal of primary pathology (brain tumour), maintaining

PAO2 saturation of 100%, fraction of inspired oxygen of ≤ 40%, positive end-expiratory pressure of ≤ 5, stable hemodynamic status without vasopressors, and adequate spontaneous breathing efforts.

Pressure support ventilation (PSV) was used as the weaning mode in our hospital. When the patient could tolerate a PSV of 10 overnight, a T-piece trial was initiated to evaluate the readiness for extubation. The reintubation criteria included altered consciousness, unstable vital signs, and oxygen saturation of <90% with respiratory distress and use of accessory muscles. The decision for performing tracheostomy was made by the patient's primary surgeon.

All statistical analyses were performed using Statistical Package for the Social Sciences (version 20.0; IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean±standard deviation and compared using independent t-tests. Categorical variables were expressed as number (percentage) and compared using the chi-square test or Fisher's exact test, as appropriate. Multiple logistic regression analysis was performed to identify the factors related to successful weaning from MV and mortality. Factors with a p-value of less than 0.05 in the univariate analysis were entered into the multivariate analysis. A two-tailed p-value of less than 0.05 was considered statistically significant. Youden's index was calculated using response operative curve together with sensitivity, specificity, positive predictive value (PPV), and negative predictive value of statistically significant factors following multivariate regression analysis. Youden's index generalizes from the dichotomous case to the multiclass case as informedness as in this study. The index was graphically represented as the height above the chance line and was also equivalent to the area under the curve (AUC) subtended by a single operating point in the receiver operating characteristic (ROC) curve.

Results

There were 56 patients included in group 1 with early tracheostomy and 34 patients in group 2 with delayed tracheostomy.

Outcome assessment

VAP and effect of tracheostomy timing- ventilator associated pneumonia (VAP) was recorded in 25 (43.85%) patients in group 1 before this procedure was performed and in 29 (85.29%) patients in group 2. The incidence after the tracheostomy in group 1 case was 5.6% and in group 2 it was 52.9% is shown in Table 1. There were significant (p<0.001) difference in reduction in VAP following early tracheostomy as compared to delayed tracheostomy Table 2. Reduction in VAP was responsible for early weaning from mechanical ventilator as analysed for multivariate regression analysis of factor responsible for early weaning.

ICU stay in hospital and tracheostomy timing- we found length of stay (LOS) in ICU was 19.61 ± 2.91 in group 1 and 28.27 ± 2.70 days in group 2 with significance level p<0.001 is shown in Figure 1. Length of stay in hospital was 33.40 ± 3.23 in group 1 and 42.33 ± 3.31 days in group 2 with significant difference in hospital stay in early tracheostomy group (p<0.001) is shown in Figure 2.

Glasgow outcome score on follow up-on one year follow up we found that there was better functional recovery of patient in group 1 (23.21% as compared to group 2.(2.9%) with significant difference in outcome between the two groups (p<0.001) is shown in Table 3.

Short term mortality-At 1 year of follow up-short term mortality was marginally better in early tracheostomy group-(Kaplan mire curve) but it was not statistically significant. (p<0.482) is shown in Figure 3.

Preoperative factors responsible for PMV

Demographic data, clinical and radiological profile, ABG reports, routine blood investigations, and analysis of comorbidities, such as COPD, diabetes mellitus, hypertension, and coronary artery disease, were analyzed. On univariate analysis, factors responsible for PMV were GCS score (p<0.011), lesion size (p<0.04), tumor location (p<0.012), preoperative hydrocephalus (p<0.04), lower cranial nerve palsy (p<0.019), and hyponatremia (p<0.019) were significantly associated with the requirement of PMV is shown in Table 4.

Intraoperative and postoperative factors for PMV

The average GCS score of 10.42 ± 4.95 in Group 1 was significantly higher (p=0.034) than those in Groups 2. Meningitis (p=0.02), deteriorated cranial nerve palsy with decreased cough and swallowing reflexes (p=0.01), operative site oedema with increased midline shift (p=0.02), and hyponatremia (p=0.01)

Table1: Ventilator associated pneumonia before tracheostomy in patients with prolonged mechanical ventilation following brain tumour surgery.

	VAP before tracheostomy		
Tracheostomy	Present	Absent	
Early	25	32	57 (63.3%)
Late	29	4	33 (36.7%)
	54 (60.0%)	36 (40.0%)	90
Chi-squared	16.687		
DF	1		
Significance level	P<0.0001		
Contingency coefficient	0.395		

Table 2: Ventilator associated pneumonia after tracheostomy in patients with prolonged mechanical ventilation following brain tumour surgery.

	VAP after tracheostomy		
Tracheostomy	Present	Absent	
Early	3	54	57 (63.3%)
Late	18	15	33 (36.7%)
	21 (23.3%)	69 (76.7%)	90
Chi-squared	28.060		
DF	1		
Significance level	P<0.0001		
Contingency coefficient	0.488		

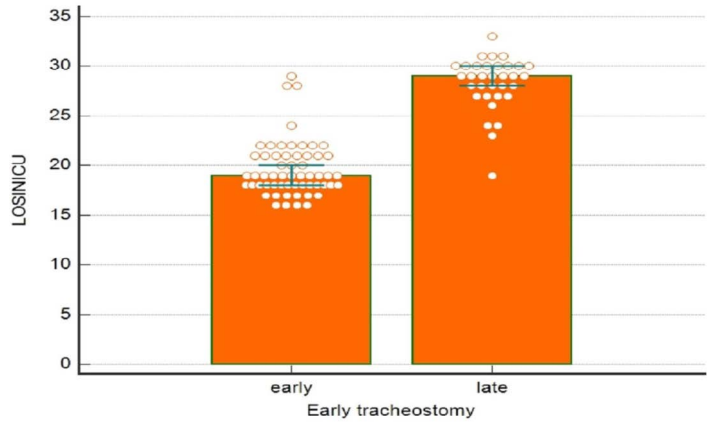

Figure 1. Box and Whisker graph showing comparative length of stay in ICU following tracheostomy (Early vs delayed).

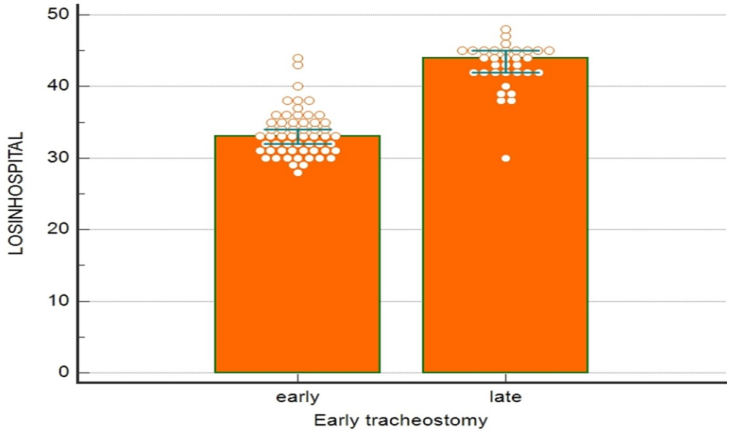

Figure 2. Box and Whisker graph showing comparative length of stay in Hospital following tracheostomy (Early vs delayed).

Table 3: Glasgow outcome score after tracheostomy for prolonged mechanical ventilation 1 year follow up.

	GOS after tracheostomy AT 1 year follow up				
Tracheostomy	Neurovegetative state	Severe disability	Moderate disability	Good recovery	
Early	0	10	34	13	57 (63.3%)
Late	1	22	9	1	33 (36.7%)
	1 (1.1%)	32 (35.6%)	43 (47.8%)	14 (15.6%)	90
Chi-squared	25.752				
DF	3				
Significance level	P<0.0001				
Contingency coefficient	0.472				

were significant factors affecting early extubation. In addition, factors including postoperative cerebrospinal fluid leak, seizures, infarction, reintubation, and intraoperative blood transfusion of more than 1,000 mL were contributory in few patients, but not statistically significant is shown in Table 5.

PPV of risk factors of early tracheostomy

After the analysis of the factors significantly associated with PMV, we found that 640% of the patients who underwent PMV following brain tumor surgery required early tracheostomy due to the persistence of various risk factors and the inability of the patients to withstand extubation trials. On multivariate stepwise logistic regression analysis, we found that VAP and postoperative increased intracranial pressure reflected in increased mass effect were statistically significant in making early extubation difficult. To establish the positive predictive power of the factors responsible for early tracheostomy following univariate and multivariate regression analyses, these factors were subsequently analyzed using ROC curves, and Youden's index was calculated. VAP demonstrated a PPV of 0.084 with Youden's index of 0.056 (p=0.018), increased mideline shift had a PPV of 0.88 withYouden's index of 0.051, preoperative hydrocephalus had a PPV of 0.84 with Youden's index of 0.053, lower cranial nerve palsy demonstrated a PPV of 0.068, infratentorial tumour location showed a PPV of 0.53, and tumour size had a PPV of 0.41 for PMV and early tracheostomy. We used Youden's index in this study as it considers the probability of an informed decision (as opposed to a random guess) and all other predictors of PMV. The cumulative PPVs of all factors were higher than 80% as found using AUC is shown in Table 6 and Figure 4.

Timing of tracheostomy

In this study, the incidence of VAP kept on increasing with 40% of the patients developing VAP within 12 days and 64% of patients who required PMV developing VAP up to 3 weeks, but 7.1% of the patients developed VAP when tracheostomy was performed within 8 days. In majority two trials of extubation were given postoperatively at 48 hrs interval following which tracheostomy was planned with the consent of relatives is shown in Figure 5.

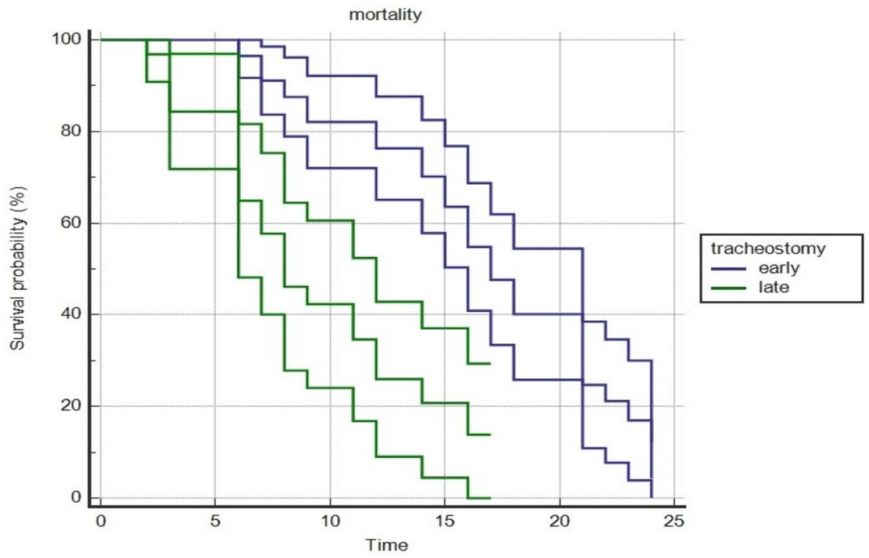

Figure 3. Kaplan-Miere survival curve showing comparative result of short term mortality following tracheostomy (Early vs delayed).

Table 4: Demography and clinical profile of patients with risk factors responsible for prolong mechanical ventilation (PMV) requirement postoperatively.

	PMV with Tracheostomy		
Parameters	**Group-1,Early tracheostomy(<8days) N=56**	**Group-2,Delayed tracheostomy(>8days) N=34**	**P value**
Age	44.63 ± 18.46yr	41.63 ± 8.95yr	0.073
Sex-male	55.35%(31/56)	73.52%(25/34)	
female	33.92%(19/56)	26.47%(9/34)	
Tracheostomy timing	4.31 ± 2.23	11.23 ± 7.89	
Re explorative craniotomy	12.5%(7/56)	44.11%(15/34)	0.112
Open tracheostomy	21.42%(11/56)	32.35%(11/34)	
Percutaneous tracheostomy	80.35%(45/56)	67.64%(23/34)	
GCS Score	10.42 ± 4.95	11.38 ± 6.89	0.011
Size of the Lesion(in cm)	5.5 ± 4.89	4.8 ± 3.87	
Size of the lesion<3cm	21.42%(12/56)	7.1%(4/56)	
>3-6cm	39.28%(22/56)	8.9%(5/56)	
>6cm	48.21%(27/56)	35.71%(20/56)	0.04
Location-supratentorial	10.71%(6/56)	47%(16/34)	
infratentorial	89.28%(50/56)	50%(17/34)	0.011
Lower cranial nerve palsy	45	28	0.001
Pre operative mideline shift (mm)	11.24 ± 8.7(SD)	8.24±6.89	
Supratentorial lesion with hydrocephalus	17.85%(10/56)	11.76%(4/34)	0.04
Compression over brain stem with obstructive hydrocephalus	33.92%(19/56)	14.70%(5/34)	
Hemoglobin <8 gm/dl	39.28%(22/56)	35.29%(12/34)	
Leucocyte count in 1000/dl	17.23 ± 11.89	14.89 ± 8.34	0.024
Blood platelets in 1000/µL	1.35 ± 0.76	1.62 ± 0.89	
Blood urea nitrogen mg/dl	43 ± 21.42	39.78 ± 43	
Serum sodium mg/dl	121 ± 19.56	129 ± 17.28	0.019
Serum potassiummg/dl	2.9 ± 4.3	2.9 ± 4.23	
Serum lactate mg/dl	22.32 ± 19.56	20.21 ± 16.43	
PaO2mm Hg	76 ± 34.29	79.65 ± 34	
PaCo2 mm Hg	44.34 ± 28.69	40.45 ± 28.12	0.067
Creatinine mg/dl	1.9 ± 1.89	1.98 ± 2.01	
Albumin g/dl	3.46 ± 4.29	4.12 ± 3.89	
COPD	10.71%(6/56)	20.5%(7/34)	
DM	28.57%(16/56)	35.29%(12/34)	
HTN	32.1%(18/56)	41.17%(14/34)	
CAD	1.7%(1/56)	2.94%(1/34)	

Table 5: Factors associated with Prolonged mechanical ventilation (risk factors found significant on univariate analysis were subjected to multivariate stepwise logistic regression analysis PMV.

	Univariate regression analysis, odds ratio 95% CI	P value	Multivariate regression analysis, odds ratio 95% CI	P value
GCS<8	1.34(0.462-1.561)	0.018	0.841(0.462-1.212)	0.061
Operative site edema with mideline shift	1.442(0.887-1.679)	0.024	1.242(0.682-1.779)	**0.003**
VAP	1.184(0.648-1.832)	0.011	1.384(0.748-1.832)	**0.001**
Lower cranial nerve palsy	1.283(0.487-0.735)	0.038	0.853(0.482-1.065)	0.059
Size of the tumour>6cm	1.446(1.034-1.568)	0.016	0.726(0.434-0.968)	0.121
Infratentorial location of the tumour	1.034(0.262-1.061)	0.018	0.841(0.462-1.212)	0231
Meningitis	1.184(0.648-1.832)	0.011	0.784(0.748-1.832)	0.067
Serum sodium	0.983(0.487-0.735)	0.038	0.653(0.482-0.865)	0.069
seizures	.346(.034-1.568)	0.066	-	-
Intraoperative blood transfusion>1000ml	0.987(0.575-1.135)	0.514	-	-
Duration of surgery>6hrs	0.826(0.334-0.968)	0.121	-	-

Risk factors not significant on univariate and multivariate stepwise logistic regression analysis.

Table 6: Predictive property of factors responsible for postoperative PMV calculated from receiver operating characteristics curve (ROC curve) analysis after stepwise logistic regression analysis.

Predictive factors	sensitivity	specificity	PPV	NPV	Youden's index	Odds ratio	P values
GCS	0.76	0.78	0.84	0.56	0.56	0.741(0.462-1.162)	0.018
VAP	0.82	0.81	0.88	0.51	0.51	1.242(0.887-1.479)	0.031
Increased postoperative mideline shift	0.67	0.61	0.84	0.45	0.53	0.943(0.842-1.031)	0.011
Lower cranial nerve palsy	0.56	0.51	0.68	0.66	0.43	0.753(0.482-0.965)	0.012
Infratentorial location of the tumour	0.67	0.59	0.53	0.56	0.41	0.261(0.254-0.358)	0.008
Size of the tumour	0.52	0.41	0.41	0.71	0.39	0.941(0.532-1.341)	0.009

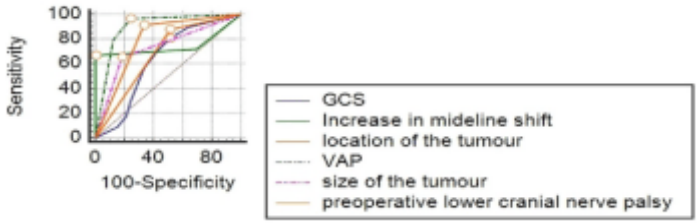

Figure 4. Comparative receiver operative curve analysis (ROC) of predictors of prolonged mechanical ventilation.

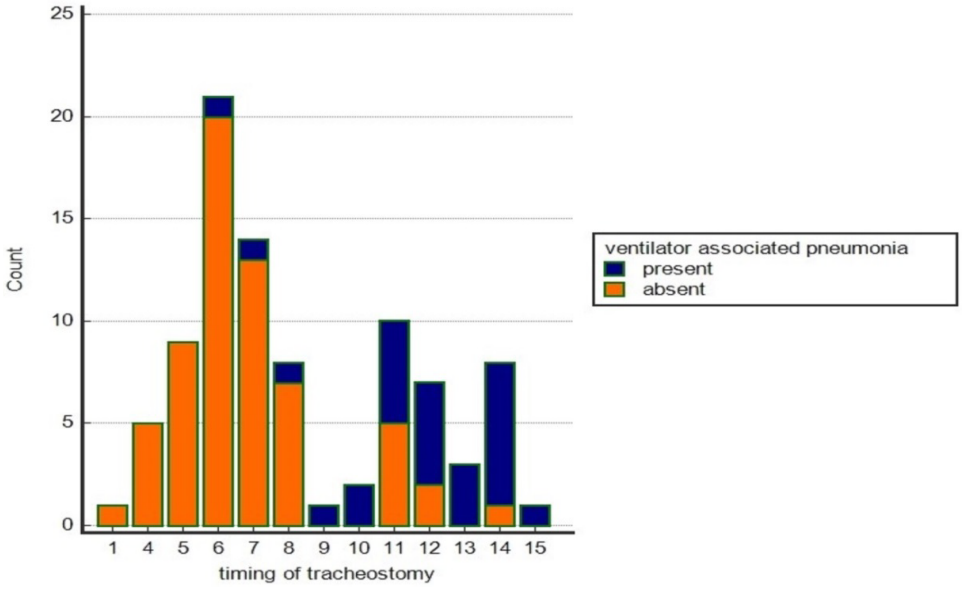

Figure 5. Relation of ventilator associated pneumonia and number of days on ventilators.

Discussion

Neurosurgical patients requiring prolonged mechanical ventilation following brain tumor surgery are a different subset of patients than those suffering from other critical illnesses. The majority of the patients with brain tumours can meet their breathing requirements without supplemental oxygen preoperatively. Those patients who require prolonged postoperative intubation for ventilator support have inherently increased risk of pulmonary adverse events as VAP, lung atelectasis, pulmonary effusion, pneumothorax, and neurological adverse events as seizures, meningitis, operative site bleed and raised intracranial pressure, etc. Maintenance of airway for cases requiring PMV by creating artificial airway by tracheostomy is mandatory for reducing dead air space, better tracheal toilet, physiotherapy, and ambulation. Studies in literature are not unanimous with the timing of tracheostomy as few have reported as early as 48 hrs to as late as 10 days for early tracheostomy in such cases without putting emphasis on the functional outcome of patients [9,10].

On analysis of outcome in our study, we found that early tracheostomy has a better outcome in terms of reduction in ventilator-associated pneumonia (VAP). The reported incidence of VAP in the study by Sachdeva was 70%, and Ewigs have reported 50% incidence in their studies. The incidence of VAP in our study is in between the two studies (60%). VAP leads to respiratory distress, inability to maintain normal arterial and alveolar oxygen saturation, and delays extubation and weaning from mechanical ventilation (MV) [11,12]. In the studies of Sachdeva, Jeon and Chen incidence of VAP was higher in the late tracheostomy group similar to the present study and there was a remarkable reduction in VAP following early tracheostomy although the patient population in their studies were heterogeneous (cases with mixed neurosurgical illness as a brain tumour, brain hemorrhage, etc. suggesting reduction in VAP following early tracheostomy [13,14].

Length of stay in ICU as well overall duration of stay in hospital was reduced in early tracheostomy as compared to delayed tracheostomy in our study. Early tracheostomy due to Earlier weaning from ventilator lead to decreased ICU stay and a similar outcome was noticed in other studies having patients with brain tumours exclusively and critically ill neurosurgical patients but none of these studies suggested advantage in either short term or long term mortality. In our study although follow up was not long at 1-year patients with an early tracheostomy has reduced short term mortality.

Our study suggests a good functional recovery in the patients who were tracheostomised early. There are few studies available mentioning the functional outcome in brain tumour cases and the majority of them have an infratentorial tumour as the predominant location. These studies did not show significant differences in functional recovery between the two groups in patients with a brain tumor. In the present study number of patients with supratentorial locations were more as compared to other studies. One reason for better functional recovery in our study may be due to the fact that Increased midline shift due to increased edema around the operative area was a major risk factor for PMV which receded slowly in complex skull base tumour with less deleterious effect as compared to infratentorial tumours located in the vicinity of the brain stem where surgery can cause permanent damage leading to worse functional recovery. The second reason for better functional recovery in our study may be the willingness of the patient's relatives to give consent for tracheostomy earlier and acceptance of an advanced life support system with more active involvement in subsequent physiotherapy after discharge from the hospital which had also been suggested in systemic review by Nakarada-Kordic. These suggestions are also reflected in better short-term mortality in patients who underwent early tracheostomy [15].

On analyzing the risk factors responsible for prolonged mechanical ventilation(PMV) in the present study, we found few perioperative factors, as low GCS score, infratentorial location, large tumour size, hydrocephalus, postoperative meningitis, brain infarction, VAP, seizures, brain edema with increased midline shift on radiology, hyponatremia had shown a positive correlation with PMV, which conforms to the findings of other studies that have reported these factors responsible for PMV in patients undergoing surgery for a brain tumour [16,17].

These perioperative factors predominant of which were increased operative site edema with increased midline shift and VAP, postoperatively were mainly responsible for causing lower GCS in patients causing an inability to maintain the airway in the present study.

Different studies have reported variable GCS scores as the cutoff value for PMV: Goettler have reported that 80% of patients with GCS scores of <9 underwent surgery and needed tracheostomy for PMV, whereas Mokhleshi have reported that patients with GCS scores of <10 were not suitable for extubation. The major reason for requiring PMV is the inability to maintain a patent airway in patients with lower GCS scores (<8) in the present study [18,19].

In this study, patients with tumours larger than 6 cm were significantly associated with postoperative PMV, whereas in the studies by Shubert, and Cai tumours larger than 3 cm were associated with delayed extubation. The reason for the differences in tumour size in this study was tumour location, as in the previous studies, tumours were predominantly located in the brainstem where chances of respiratory centre dysfunction were higher, whereas in this study, supratentorial lesions were more common with increased postoperative edema responsible for lower GCS and PMV [20].

Meningitis is a common complication leading to the altered sensorium, poor postoperative GCS scores, and the need for PMV, which were also reported in the studies by Raimondi and Rouje. In this study, meningitis was more common in patients with preoperative hydrocephalus, intraventricular bleeding, operative site hematoma, brain edema; Bharti and Benett have reported similar findings [21,22]. These findings suggest the cisternal component of postoperative residual blood as a major component acting as an irritant to the meninges [23].

Lower cranial nerve palsy was found in 33% of the patients who required PMV. Lower cranial nerve palsy leads to poor and weak swallowing reflex, leading to pooling of saliva in the oral cavity and airways, leading to respiratory tract obstruction and increased respiratory distress with increased chances of VAP. A similar proposition was suggested in the studies by Dubey and Jallo [24,25].

Hyponatremia was a predisposing factor for postoperative altered sensorium and prolonged ICU stay in this study. However, on stepwise logistic regression analysis, it was not significantly associated with PMV. A similar observation was reported by Padhi and Leung [26,27].

Extubation is usually performed within 24 h after brain tumour surgery; however, a subgroup of patients who required PMV. In this study, the meantime for early tracheostomy was 4.31 ± 2.23 days, which is similar to the timing reported in the studies by, Guriachev Qureshi Teoh and Arabi These studies have clearly demonstrated the advantages of early tracheostomy in cases requiring PMV [28,29]. In addition, a systematic review of randomized trials has suggested that early tracheostomy has beneficial effects in terms of reduction in the incidence of VAP, short-term mortality, and ICU stay in critically ill patients. We planned to perform earlier tracheostomy (<8 days) in this study as it improved patient care in terms of frequent tracheostomy toileting, fewer chances of mucous plug impaction, and ease in mobilization with a decreased incidence of VAP with early weaning [30]. These findings were similar to the reported advantage of early tracheostomy in studies reporting outcomes after early tracheostomy in such patients but we observed better functional recovery as well improved short-term mortality on follow up in our study.

Although we did not calculate treatment cost reduction as a beneficial effect of early tracheostomy in this study, decreases in ICU and hospital stay along with improvements in GCS and GOS scores are surrogate indicators of treatment cost reduction.

Limitation of the Study- This study has few limitations as this was a retrospective observational study with relatively small sample size and short follow-up period. Therefore, the power to suggest significant differences may be inadequate. The analysis of long-term outcomes, long-term disability, and chronic cases was lacking. To validate the predictive value, further prospective studies with a large number of patients with brain tumours are required.

Strength of the study it is one of the few studies highlighting the significance of early tracheostomy in patients undergoing brain tumour surgery. In this study, we found positive predictors of early tracheostomy based on clinical parameters such as GCS, lower cranial nerve palsy, tumour location, increased mass effect suggested by increased postoperative midline shift on NCCT head, and VAP. This is probably one of the few studies that have considered tumour characteristics, intraoperative events, and postoperative complications for predicting the requirement of PMV in patients with a brain tumour. This is one of the few studies suggesting good functional outcomes and improved short-term mortality following early tracheostomy in patients undergoing surgery for brain tumours requiring PMV.

Conclusion

Patients with Early tracheostomised (<5 days) undergoing PMV following surgery for brain tumour have better functional recovery and shorter ICU stay. Patients with increased mass effect with increased midline shift and VAP postoperatively have a strong predilection to undergo PMV. However, we should prospectively validate our results in a larger number of cases to substantiate these results.

References

1. Andriolo, Brenda NG, Regis B. Andriolo, Humberto Saconato, and Álvaro N. Atallah, et al. "Early versus late tracheostomy for critically ill patients." *Cochrane Database Syst Rev* 1 (2015).
2. Siempos, Ilias I., Theodora K. Ntaidou, Filippos T. Filippidis, and Augustine MK Choi. "Effect of early versus late or no tracheostomy on mortality and pneumonia of critically ill patients receiving mechanical ventilation: a systematic review and meta-analysis." *Lancet Respir Med* 3 (2015): 150-158.
3. Shibahashi, Keita, Kazuhiro Sugiyama, Hidenori Houda, and Yuichi Takasu, et al. "The effect of tracheostomy performed within 72 h after traumatic brain injury." *Br J Neurosurg* 31 (2017): 564-568.
4. Bösel, Julian, Petra Schiller, Yvonne Hook, and Michaela Andes, et al. "Stroke-related early tracheostomy versus prolonged orotracheal intubation in neurocritical care trial (SETPOINT) a randomized pilot trial." *Stroke* 44 (2013): 21-28.
5. Gessler, Florian, Haitham Mutlak, Stefan Lamb, and Michael Hartwich, et al. "The impact of tracheostomy timing on clinical outcome and adverse events in poor-grade subarachnoid hemorrhage." *Crit Care Med* 43 (2015): 2429-2438.
6. Huang, Hua-Wei, Guo-Bin Zhang, Ming Xu, and Guang-Qiang Chen, et al. "The impact of tracheostomy timing on clinical outcomes and adverse events in intubated patients with infratentorial lesions: early versus late tracheostomy." *Neurosurg Rev* 44 (2021): 1513-1522.
7. Clark, Paul A., Ryan C. Inocencio, and Christopher J. Lettieri. "I-TRACH: validating a tool for predicting prolonged mechanical ventilation." *J Intensive Care Med* 33 (2018): 567-573.
8. Clark, Paul A., and Christopher J. Lettieri. "Clinical model for predicting prolonged mechanical ventilation." *J Crit Care* 28 (2013): 880-e1.
9. Goriachev, A.S., I.A. Savin, K.M. Gorshkov, and M.N. Konkov, et al. "Early tracheostomy in patients with tumors in the posterior cranial fossa during postoperative period." *Anesteziol Reanimatol* 2 (2004): 58-60.
10. Qureshi, Adnan I., Jose I. Suarez, Parag D. Parekh, and Anish Bhardwaj. "Prediction and timing of tracheostomy in patients with infratentorial lesions requiring mechanical ventilatory support." *Crit Care Med* 28 (2000): 1383-1387.
11. Sachdeva, Deepashu, Daljit Singh, Poonam Loomba, and Amandeep Kaur, et al. "Assessment of surgical risk factors in the development of ventilator-associated pneumonia in neurosurgical intensive care unit patients: Alarming observations." *Neurol India* 65 (2017): 779.
12. Ewig, Santiago, Antoni Torres, Mustafa El-Ebiary, and Neus Fàbregas, et al. "Bacterial colonization patterns in mechanically ventilated patients with traumatic and medical head injury: incidence, risk factors, and association with ventilator-associated pneumonia." *Am J Respir Crit* 159 (1999): 188-198.
13. Jeon, Young-Tae, Jung-Won Hwang, Young-Jin Lim, and Sue-Young Lee, et al. "Effect of tracheostomy timing on clinical outcome in neurosurgical patients: early versus late tracheostomy." *J Neurosurg Anesthesiol* 26 (2014): 22-26.
14. Chen, Wei, Fujun Liu, Jing Chen, and Lu Ma, et al. "Timing and outcomes of tracheostomy in patients with hemorrhagic stroke." *World Neurosurg* 131 (2019): e606-e613.
15. Nakarada-Kordic, Ivana, Niamh Patterson, Jill Wrapson, and Stephen D. Reay. "A systematic review of patient and caregiver experiences with a tracheostomy." *Patient* 11 (2018): 175-191.
16. Cai, Ye-Hua, Heng-Yu Zeng, Zhong-Hua Shi, and Jing Shen, et al. "Factors influencing delayed extubation after infratentorial craniotomy for tumour resection: a prospective cohort study of 800 patients in a Chinese neurosurgical centre." *J Int Med* 41 (2013): 208-217.
17. Bharati, Sachidanand J., Mihir Prakash Pandia, Girija Prasad Rath, and Parmod Kumar Bithal, et al." Perioperative problems in patients with brainstem tumors and their influence on patient outcome."*J Anaesthesiol Clin Pharmacol* 32 (2016): 172.
18. Goettler, Claudia E., Jonathan R. Fugo, Michael R. Bard, and Mark A. Newell, et al. "Predicting the need for early tracheostomy: a multifactorial analysis of 992 intubated trauma patients." *J Trauma Acute Care Surg* 60 (2006): 991-996.
19. Mokhlesi, Babak, Aiman Tulaimat, Ty J. Gluckman, and Yue Wang, et al. "Predicting extubation failure after successful completion of a spontaneous breathing trial." *Respir Care* 52 (2007): 1710-1717.
20. Schubert, Armin, Edward J. Mascha, Eric L. Bloomfield, and Glenn E. DeBoer, et al. "Effect of cranial surgery and brain tumor size on emergence from anesthesia." *Anesthesiology* 85 (1996): 513-521.
21. Raimondi, Anthony J., and Tadanori Tomita. "Hydrocephalus and infratentorial tumors: incidence, clinical picture, and treatment." *J Neurosurg* 55 (1981): 174-182.
22. Roujeau, Thomas, Federico Di Rocco, Christelle Dufour, and Franck Bourdeaut, et al. "Shall we treat hydrocephalus associated to brain stem glioma in children?." *Childs Nerv Syst* 27 (2011): 1735.
23. Bennett, Marc, and David S. Haynes. "Surgical approaches and complications in the removal of vestibular schwannomas." *Otolaryngol Clin North Am* 40 (2007): 589-609.
24. Jallo, George I., Tania Shiminski-Maher, Linda Velazquez, and Rick Abbott, et al. "Recovery of lower cranial nerve function after surgery for medullary brainstem tumors." *Neurosurgery* 56 (2005): 74-78.
25. Dubey, Arvind, Wen-Shan Sung, Mark Shaya, and Ravish Patwardhan, et al. "Complications of posterior cranial fossa surgery—an institutional experience of 500 patients." *Surg Neurol* 72 (2009): 369-375.
26. Padhi, Rajesh, Baikuntha Nath Panda, Snehalata Jagati, and Subhas Chandra Patra. "Hyponatremia in critically ill patients." *Indian J Crit Care Med* 18 (2014): 83.
27. Leung, Alexander A., Finlay A. McAlister, Selwyn O. Rogers, and Valeria Pazo, et al. "Preoperative hyponatremia and perioperative complications." *Arch Intern Med* 172 (2012): 1474-1481.
28. Teoh, W.H.L., K.Y.C. Goh, and C. Chan. "The role of early tracheostomy in critically ill neurosurgical patients." *Ann Acad Med* 30 (2001): 234-238.
29. Arabi, Yaseen, Samir Haddad, Nehad Shirawi, and Abdullah Al Shimemeri. "Early tracheostomy in intensive care trauma patients improves resource utilization: a cohort study and literature review." *Crit Care Med* 8 (2004): 1-6.

30. Terragni, Pier Paolo, Massimo Antonelli, Roberto Fumagalli, and Chiara Faggiano, et al. "Early vs late tracheotomy for prevention of pneumonia in mechanically ventilated adult ICU patients: a randomized controlled trial." *Jama* 303 (2010): 1483-1489.

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