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CORRESPONDING AUTHOR:
Roshan Pradhan
Lecturer,
Assistant professor / Anesthesia and critical care, Kathmandu Medical College Public Limited, Nepal.
Email: drroshanpradhan@gmail.com
ORCID:https://orcid.org/0000-0002-0600-4446

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Effect of Timing of Tracheostomy in Clinical Outcome of Neurocritical Patients. Early Versus Late Tracheostomy: A Tertiary Hospital-Based Study

Roshan Pradhan[1], Bidur kc[2], Seema Kumari Mishra [3], Bijay kc [4], Prabin Subedi [5]

[1] Assistant professor, Department of Anaesthesiology and Critical Care, Kathmandu Medial College Public Limied, Sinamangal, Kathmandu, Nepal.
[2] Professor, Department of Neurosurgery, Kathmandu Medial College Public Limied, Sinamangal, Kathmandu, Nepal.
[3] Assistant professor, Department of Obstetrics and Gynaecology, Kathmandu Medial College Public Limied, Sinamangal, Kathmandu, Nepal.
[4] DM Resident, Intensive Care Unit, Kathmandu Medial College Public Limied, Sinamangal, Kathmandu, Nepal.
[5] Resident, Department of Anaesthesiology and Critical Care, Kathmandu Medial College Public Limied, Sinamangal, Kathmandu, Nepal.

ABSTRACT

Introduction: The management of neurocritical patients requires the maintenance of the airway. Most frequently the patients need prolonged intubation or tracheostomy.

Objectives: To assess the effect of early versus late tracheostomy in the clinical outcome of neurocritical patients.

Methodology: A prospective comparative study was carried out at Kathmandu Medical College Public Limited from January 2023 to November 2023 managed in neurocritical Intensive care unit. The patients were allocated into two groups, using sealed envelope containing code numbers, Early tracheostomy group and late tracheostomy group. Early tracheostomy was defined when tracheostomy done within 7 days of endotracheal intubation and late was done after 7 days.

The results were analyzed using the Statistical Package for the Social Sciences (SPSS) software.

Continuous variables were compared using Independent sample t-test. Fisher exact test and chi square test were used for categorical variables. P-value of 0.05 or less was considered statistically significant.

Results: There were 54 patients over study period of which 28 (51.86%) underwent early and late 26 (48.14%) underwent late tracheostomy. There were significant differences between the groups regarding the organism isolated, (p=0.0027) and the outcome in GOSE score (p = 0.013). There were no significant differences between the groups regarding the complication in ICU and duration of hospital stay.

Conclusion: Early tracheostomy is beneficial in neurosurgical patient in terms of decrease in organism isolation, the morbidity and mortality.

INTRODUCTION

The management of neurocritical patients requires the maintenance of the airway. Most frequently patients needed prolonged intubation or tracheostomy. There is an ongoing debate regarding timing of tracheostomy. There is a sparse literature available for optimal timing of tracheostomy in neurocritical patients.[1]

Tracheostomy is indicated in those patients with diminished level of consciousness who cannot be extubated earlier, absence of protective airway reflexes, impairment of respiratory drive and difficulties in managing secretions, thereby improving the work of breathing by reducing airway dead space. However, tracheostomy is not risk-free and

its optimal timing to perform tracheotomy remain still unclear.[2,3,4] Tracheostomy performed during the first week of mechanical ventilation are classified as early, while tracheostomy performed later than seven days are defined as late.[1] Tracheostomy may be considered after 7-14 days if extubation is not feasible. Studies have looked at tracheostomy performed as early but the definition of "early" versus "late" varies widely in the literature.

Mechanically ventilated neurocritical patients are at risk for ventilator-associated pneumonia (VAP) and prolonged ICU stay, with VAP the pathogenesis of which is multifactorial. Factors such as timing and duration of endotracheal ventilation, host factors and virulence of invading bacteria all contribute.[5] We wanted to study about the effect of early versus late because the duration and endotracheal intubation in association virulence and host factors would influence the outcome of the patients. Incidence of VAP, morbidity and mortality may be altered if the patients can be weaned off the mechanical ventilation early post tracheostomy. This makes the early versus late tracheostomy discussion even more relevant in critically ill patients.

Tracheostomy in neurocritical patients has the main objective of increasing comfort and shortening the duration of sedation, mechanical ventilation and intensive care stay.[6,7] It was believed that this would translate into improved short term and long term morbidity and mortality. Evidence on the advantages of early over late tracheostomy is conflicting.[8] Studies showed a linear relationship between tracheostomy timing and ICU length stay. Delayed tracheostomy may place neurocritical patient at undue risk of ventilator associated pneumonia, prolonged ICU stay from prolonged mechanical ventilation.[5] Study done by Griffith et al. showed that the outcomes in terms of sedation, morbidity, mortality and incidence of VAP were similar in the two groups. Hence there are contradictory evidences favoring both early versus late tracheostomy.[9] A recent meta-analysis done by McCredie et al. concluded that early tracheostomy conferred no benefit in terms of mortality and morbidity.[10] On the contrary Premraj et al. in their meta-analysis stated that early strategy did offer a benefit over late tracheostomy in terms of Mechanical ventilation days, Length of stay and long term mortality.[11] This could also be relevant in terms of out of pocket expenditure for patients in neurosurgical services.[12] Hence we want to assess the effect of early versus late tracheostomy in clinical outcome of neurocritical patients at our center.

METHODOLOGY

This is a prospective, comparative study of all cases of neurocritical patients from January 2023 to November 2023 managed in the Neurocritical intensive care unit (ICU) of Kathmandu Medical College Public Limited after ethical clearance from the institutional review committee. The sample size was calculated assuming an effect size of 0.3 between the groups, alpha error 0.05 and power of 80%. The calculated sample size was 54 using G power software version 3.1.9.4.

Inclusion criteria

1. Patients without any provision for removal from mechanical ventilation (eg. Patients with severe brainstem injury)
2. Prolong mechanical ventilation
3. Difficulty of weaning
4. Weaning failure

Exclusion criteria

1. Patient with preexisting tracheostomy tube

There is no definite consensus in literature for a fixed cutoff of timing determining early and late tracheostomy. Our neurosurgical ICU protocol defines early tracheostomy was done within 7 days and late were done after 7 days of endotracheal intubation.

When the decision to tracheostomize the patient was taken, patients were enrolled in the study. Depending upon the day at which the tracheostomy was performed, we divided them into the two groups of early and late tracheostomy. Now both the groups were prospectively followed up until their discharge from our neurocritical care unit. The decision for tracheostomy was lead by team of neurosurgeon and open tracheostomy was done under general anesthesia by ENT surgeons.

Sputum was usually sent at intubation, during tracheostomy and every seven days till the culture was negative. Tracheostomy care was done as per the guidelines. The data that were collected were patient's Age, sex, risk factors, comorbidities, primary pathology, organism isolation, and clinical outcome in terms of development of VAP, Glasgow Outcome Scale Extended (GOSE) and duration of hospital stay.

Data were taken using standardized pre-formed proforma by Anaesthesiologist on duty.

These data were tabulated and evaluated statistically using IBM SPSS 20.0. Continuous variables were compared using Independent sample t-test. Fisher exact test and chi square test were used for categorical variables. P-value of 0.05 or less was considered statistically significant.

RESULTS

There were 54 patients over the study period. Most of them were male (61.1%) with male to female ratio of 1.57:1. Mean age of the patients was 52.68±16.92. Early tracheostomy was observed in 28 (51.85%) patients while late tracheostomy was seen in 26 (48.14%) patients. Fig. 1 shows the CONSORT flow chart for patient recruitment.

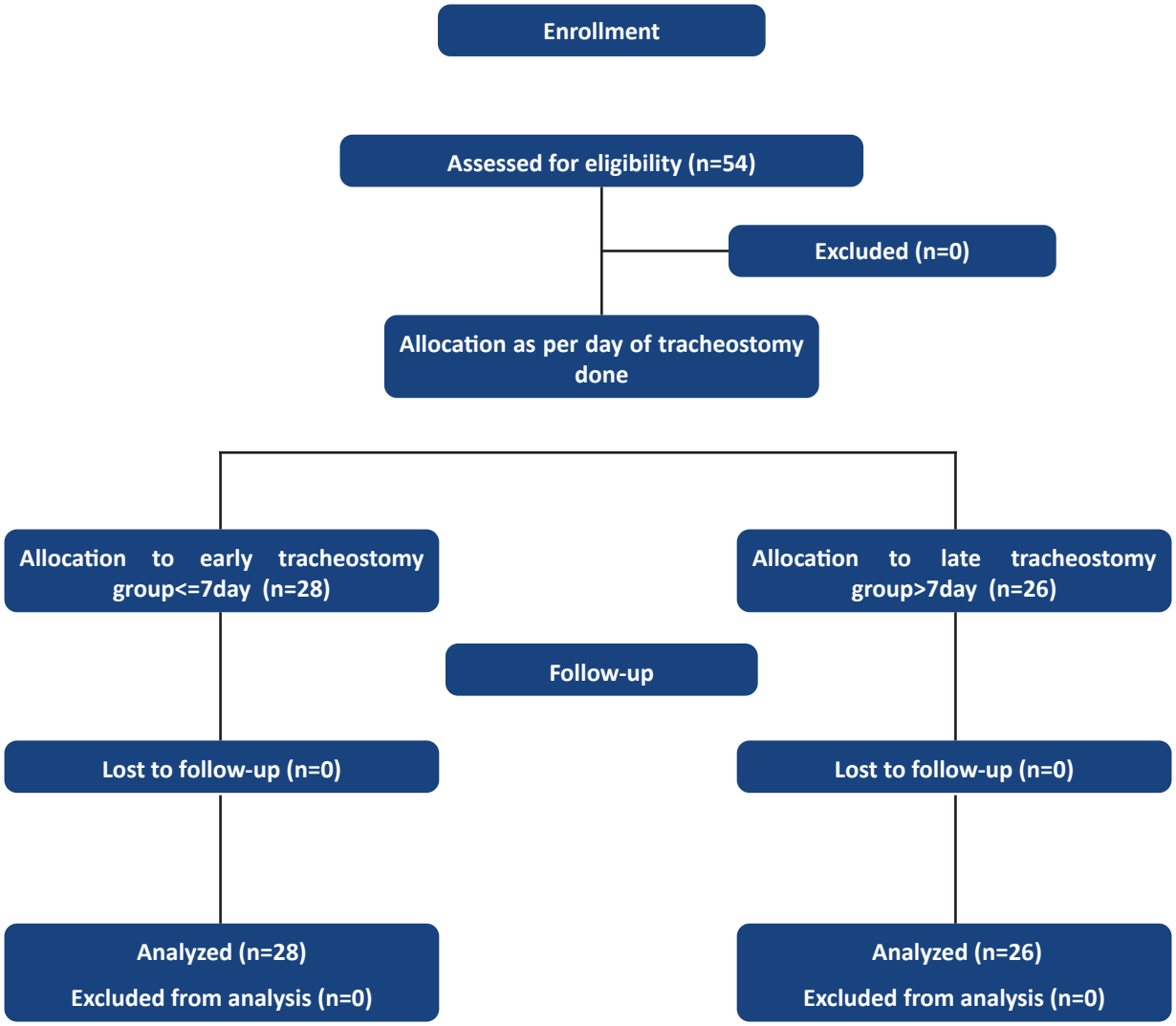

Fig 1: CONSORT Flow chart of the study

Table 1: Demographic data

CHARACTERISTICS		Total Patients (n=54)	Comparing Among Two Groups		P-Value
			Early Tracheostomy (<=7 Days) (n=28)	Late Tracheostomy (> 7 Days) (n= 26)	
Age (in years)	(Mean±SD)	52.68±16.92	52.464±17.99	51.308±19.56	0.815
Sex	Male	33 (61.1%)	16 (57.1%)	17 (65.4%)	0.539
	Female	21 (38.9%)	12 (42.9%)	9 (34.6%)	

Table 2: Clinical parameters between two groups; comparison done using independent T test for continuous variable and Fisher exact and chi square for categorical variable.

CHARACTERSTICS			Total Patients (n=54)	Comparing Among Two Groups		P-Value
				Early Tracheostomy (<=7 Days) (n=28)	Late Tracheostomy (> 7 Days) (n= 26)	
Risk Factors	Alcohol	No	28 (51.9%)	15 (53.6%)	13 (50.0%)	0.795
		Yes	26 (48.1%)	13 46.4%)	13 (50.0%)	
	Smoking	No	36 (66.7%)	19 (67.9%)	17 (65.4%)	0.849
		Yes	18 (33.3%)	9 (32.1%)	9 (34.6%)	
Co-morbidities	None		15 (27.8%)	8 (28.6%)	7 (26.9%)	0.776
	Diabetes Mellitus		8 (14.8%)	5 (17.9%)	3 (11.5%)	
	Hypertension		28 (51.9%)	13 (46.4%)	15 (57.7%)	
	Thyroid Disorder		3 (5.6%)	2 (7.1%)	1 (3.8%)	
Primary Pathology	Thalamic Bleed		5 (9.3%)	2 (7.1%)	3 (11.5%)	0.555
	Brain Stem Bleed		5 (9.3%)	3 (10.7%)	2 (7.7%)	
	Severe Head Injury		21 (38.9%)	10 (35.7%)	11 (42.3%)	
	Aneurysmal Bleed		6 (11.1%)	3 (10.7%)	3 (11.5%)	
	Basal Ganglia Bleed		6 (11.1%)	3 (10.7%)	3 (11.5%)	
	Lobar Bleed		5 (9.3%)	4 (14.3%)	1 (3.8%)	
	Malignant Ischemic Stroke		2 (3.7%)	1 (3.6%)	1 (3.8%)	
	Refractory Seizure		2 (3.7%)	1 (3.6%)	1 (3.8%)	
	Intraventricular Bleed		1 (1.9%)	1 (3.6%)	0	
	Posterior Fossa Bleed		1 (1.9%)	0	1 (3.8%)	
	Cardiac Complications		1 (1.9%)	1 (3.6%)	0	
	Brain Herniation Syndrome		2 (3.7%)	1 (3.6%)	1 (3.8%)	

Table 3: Organism isolated in sputum culture between the groups; comparison done using Fisher exact test

CHARACTERSTICS		Total Patients (n=54)	Comparing Among Two Groups		P-Value
			Early Tracheostomy (<=7 Days) (n=28)	Late Tracheostomy (> 7 Days) (n= 26)	
Organism Isolated	No Growth	25 (46.3%)	20 (71.4%)	5 (19.2%)	0.000274*
	Acienetobacterbaumannii	9 (16.7%)	3 (10.7%)	6 (23.1%)	
	KlebsiellaPneumoniae	8 (14.8%)	2 (7.1%)	6 (23.1%)	
	AcienetobacterSpp	1 (1.9%)	0	1 (3.8%)	
	Esherichia Coli	5 (9.3%)	2 (7.1%)	3 (11.5%)	
	KlebsiellaOxytoca	2 (3.7%)	0	2 (7.7%)	
	Pseudomonas Aeruginosa	4 (7.4%)	1 (3.6%)	3 (11.5%)	

*Statistically significant

Table 4: Complication in ICU between the groups

CHARACTERSTICS		Total Patients (n=54)	Comparing Among Two Groups		P-Value
			Early Tracheostomy (<=7 Days) (n=28)	Late Tracheostomy (> 7 Days) (n= 26)	
Complications in ICU	None	18 (33.3%)	12 (42.9%)	6 (23.1%)	0.490
	VAP	20 (37.0%)	8 (28.6%)	12 (46.2%)	
	Sepsis	7 (13.0%)	1 (3.6%)	6 (23.1%)	
	ARDS	6 (11.1%)	5 (17.9%)	1 (3.8%)	
	Cardiac Complications	1 (1.9%)	1 (3.6%)	0	
	Brain Herniation Syndrome	2 (3.7%)	1 (3.6%)	1 (3.8%)	

Table 5: Outcome of GOSE between the groups

CHARACTERISTICS		Total Patients (N=54)	Comparing Among Two Groups		P-Value
			Early Tracheostomy (<=7 Days) (N=28)	Late Tracheostomy (> 7 Days) (N= 26)	
Outcome of GOSE	Dead	22 (40.7%)	8 (28.6%)	14 (53.8%)	0.013*
	Vegetative State	2 (3.7%)	2 (7.1%)	0	
	Lower Severe Disability	4 (7.4%)	1 (3.6%)	3 (11.5%)	
	Upper Severe Disability	9 (16.7%)	4 (14.3%)	5 (19.2%)	
	Lower Moderate Disability	8 (14.8%)	5 (17.9%)	3 (11.5%)	
	Upper Moderate Disability	4 (7.4%)	3 (10.7%)	1 (3.8%)	
	Lower Good Recovery	4 (7.4%)	4 (14.3%)	0	
	Upper Good Recovery	1 (1.9%)	1 (3.6%)	0	

* Statistically significant

Table 6: Duration of Hospital stay between the groups

Duration of Hospital Stay (in days)	Tracheostomy Group	Mean/Standard Deviation	P-Value
	Early Tracheostomy n= 28	21.57±13.321	0.412
	Late Tracheostomy n=26	25±17.06	

The two groups showed no significant differences in term of age (p=0.815), sex (p=0.53), risk factors (p=0.79), comorbidities (p=0.849), primary pathology (p=0.55), suggesting a uniform distribution of the cases in these two groups. (Table 1 & 2)

The commonest organism seen in our study were 9(16.7%) Acienetobacterbaumannaii, 8(14.8%) klebsiella pneumonia, 5(9.3%) Esherichia Coli, 4(7.4%) Pseudomonas Aeruginosa and other bacterial colonies was 3(5.6%) were seen. In our study, organisms isolated in early tracheostomy showed fewer organisms with respect to the late tracheostomy group which was statistically significant. (P = 0.00027) (Table 3)

Among those groups in neurocritical care, ICU complication with 20(37%) Ventilator associated pneumonia, 7(13%) sepsis, 6(11.1%) Acute respiratory distress syndrome 1(1.9%), cardiac complication and 2(3.7%) brain herniation syndrome. (Table 4)

The endpoints of these patients were studied in terms of Glasgow Outcome Score Extended (GOSE) score where mortality was seen in 22(40.7%) cases, 2(3.7%) were vegetative state, 4(7.4%) were lower severe disability, 9(16.7%) were upper severe disability, 8(14.8) were lower moderate disability, 4(7.4%) were upper moderate disability, 4(7.4%) lower good recovery and 1(1.9%) was upper good recovery. In our study outcome in GOSE score between the tracheostomy groups showed that the early tracheostomy group had fewer mortality and morbidity which was statistically significant. (P = 0.013) (Table 5)Duration of hospital stay, our study showed mean hospital stay for early tracheostomy was 21.57±13.321 whereas late tracheostomy was 25±17.06.(Table 6)

DISCUSSION

Tracheostomy is the most commonly performed procedures in

neurosurgical critical patients.[1]It is indicated in those patients with diminished level of consciousness who cannot be extubated earlier, absence of protective airway reflexes, impairment of respiratory drive and difficulties in managing secretions, thereby improving the work of breathing by reducing airway dead space.[2,3,4]

The appropriate timing for tracheostomy insertion has been a subject of debate recently, despite the fact that its function in critical care has been established as an alternative to prolonged ET intubation. However, the statement is controversial and depends upon the opinion of the treating specialist. An issue that remains after all these debates is whether early tracheostomy improves patient outcomes more than late tracheostomy. The time of tracheostomy has been linked to varying outcome disparities, according to a number of small observational and cohort studies.[13]

Because of improvements in critical care technology, critically ill patients are surviving and there has been an increasing need for mechanical ventilator for prolonged duration. Due to the laryngeal protective mechanisms being bypassed and disabled, prolonged endotracheal (ET) intubation increases the risk of oropharyngeal contamination of the pulmonary system and increases the risk of laryngeal and tracheal system injury. Long-term ET intubation has been successfully replaced by tracheostomy because it makes patient handling and pulmonary toileting easier, increases patient comfort, requires less sedation, allows for the possibility of oral feeding, improves respiratory mechanics, causes less oral trauma, and reduces the risk of VAP.[14,15]

In a study done by Rai S et al. the commonest organism were Acinetobacter 19(28.4%), Pseudomonas 16(23.9%) and multiple bacterial colonization were seen in 31(46.3) cases.[13] Our study also showed Acinetobacter baumannaii in 9(16.7%), 8(14.8%) had Klebsiella pneumonia, Esherichia coli 5(9.3%), Pseudomonas aeruginosa 4(7.4%) and other bacterial colonies was cultured in 3(5.6%) patients. In contrast to above, Saravanam PK et al. showed pseudomonas aeruginosa in majority of the cases (28%), followed by Coagulase-negative staphylococcus aureus (27%), esherichia coli(14%).[16]

Our study suggested a significant benefit of early tracheostomy in terms of fewer organisms isolated and better outcome with respect to the late tracheostomy group which was statistically significant (P = 0.00027). Growth of fastidious organisms like Acinetobacter species, common ICU MDR isolates like Klebsiella, Pseudomonas, E. coli etc present in higher incidences in late tracheostomy indicates that early tracheostomy may cause less organism colonization, infection and thus isolation. Proper bronchial toileting with better oral care and lesser sedation requirements result in less number of hospital stay could be the contributing causes as seen in our study. This could justify the better GOSE at discharge as seen in our study. The direct association between a neurological outcome such as GOSE and timing of tracheostomy is yet to be studied but it could be postulated that timing can have some direct and indirect influence on the outcome in neurocritical care patients. Fagon et al. suggested that the incidence of VAP increases by 1% per day of invasive mechanical ventilation.[17] Risk factors associated with bacterial colonization include residing in a medical care home and the presence of a cuff. Presence of cuffed tube in chronic patients could be the possible cause for increase in colonization of bacteria in late tracheostomy which was a similar finding in our study.[18]

In our study we demonstrate that the outcome in terms of GOSE in early versus late tracheostomy revealed improved functional outcome in the early tracheostomy group which was statistically significant (p= 0.013) which corroborates to the findings in the systemic review done by Ludin SM et al. which showed that late tracheostomy had poorer functional outcome compared to early tracheostomy group (p=0.018).[19,20] Similarly, Bosel J et al. had shown less mortality in early tracheostomy group.[21] In contrast to above Shekhar et al. showed there were no significant changes in terms of morbidity and mortality. Sepsis/ VAP were the most common causes of mortality in late tracheostomy group which was similar to our study.[22]

A study done by Chopra P et al. showed no differences was observed in hospital stay, p= 0.461 which was similar finding p= 0.412 in our study.[23] Morakami FK et al. showed early tracheostomy in critical patient had shorter hospital stay 42±32 vs52±50 days, p<0.001 which was in contrast 21.57±13.321 vs 25±17.06, p =0.412 to our finding.[24]

Evidence on the advantages of early over late tracheostomy is conflicting and the recommendations are still based on the experiences of neurosurgeon rather than on scientific evidence.[4] Our study was done in an attempt to look into which timing of tracheostomy was better in terms of morbidity, mortality and overall functional outcome of the patient in a neurosurgical unit consisting of heterogeneous group of patients. Although there have been numerous studies from Nepal, Neupane BR et al. and Shrestha P et al. comparing early versus late tracheostomy, none of these have compared the functional outcome of the patients.[1,2]

In any medical specialty, especially in neurocritical care, functional outcome is an important factor that cannot be missed. This is where our study comes to become more pertinent. As per our study, GOSE was significantly more in favor of early tracheostomy. Further studies are needed to look into tracheostomy timing and outcome with this perspective. While a strong recommendation advocating early tracheostomy cannot still be made in complex neurocritical patients, further studies are needed to assess the role of timing of tracheostomy aiming an improved functional outcome.

CONCLUSION

Tracheostomy within 7 days is a feasible and safe procedure for neurocritical patients. Early tracheostomy was associated with fewer organisms isolated with significant improvement in morbidity, mortality or neurological outcomes with shorter duration of hospital stay and fewer respiratory adverse events.

RECOMMENDATIONS

Early tracheostomy is beneficial in neurocritical patients in terms of lesser organism isolation with improved GOSE outcome. In the future, randomized study with multiple centers to include a large sample size may be a better option to answer and validate most of the findings of this study. We recommend future studies to consider these groups of patients.

LIMITATION OF THIS STUDY

In our study we evaluated GOSE at the time of discharge. We could not evaluate GOSE at 3 months and 6 months due to loss of follow up.

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CONFLICT OF INTEREST

We declare no conflict of interest

FINANCIAL DISCLOSURE

None

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