

## **THE EFFECT OF EARLY VERSUS LATE TRACHEOSTOMY ON DURATION OF MECHANICAL VENTILATION AND INTENSIVE CARE UNIT STAY IN TRAUMATIC BRAIN INJURY PATIENTS**

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### **Abstract**

Tracheostomy is a surgical procedure that frequently performed for patients in the intensive care units (ICUs). Prolonged mechanical ventilation (MV) is the main indication for tracheostomy in the ICU.

This study aimed to compare the effect of early versus late tracheostomy on duration of mechanical ventilation and ICU length of stay in traumatic brain injury patients and to determine the appropriate timing to perform tracheostomy for those patients.

A Prospective comparative study was performed for head trauma patients with Glasgow coma scale (GCS) less than eight who needed endotracheal intubation with or without mechanical ventilation in the ICU of Al-Sadr Teaching Hospital in Basrah from February 2019 up to December 2019.

In this study, there were 94% males and 6% females, 52% were in the age group between 20-40 years, median duration on endotracheal tube in early tracheostomy (ET) group was 5 days while in late tracheostomy (LT) group was 11 days. Total duration on MV was significantly shorter in ET group (9.63±1.87 versus 17.81±6.66 days in LT group; p<0.05). Post tracheostomy MV duration was shorter in ET (6.23±1.48 versus 10.69±4.34 days p<0.05). The ICU length of stay also was significantly shorter in early group (12.70±1.80 versus 22.37±7.19 days; p<0.05).

In conclusion; early tracheostomy in traumatic brain injury before 7 days from endotracheal intubation significantly shortens the duration of mechanical ventilation and ICU length of stay.

*Key words: early, late, tracheostomy, mechanical ventilation, ICU stay, brain injury.*

### **Introduction**

Tracheostomy is the creation of an opening on the surface of skin that's leads to tracheal lumen<sup>1</sup>. The history of tracheostomy is long and storied. The earliest accounts of a procedure that resembling tracheostomy was found in Egyptian papers that dated back to 3600 BC<sup>2</sup>.

In most instances, endotracheal intubation is used for short-term airway protection and/or ventilation, but tracheostomy is indicated in certain conditions<sup>3</sup>: prolonged mechanical ventilation, pulmonary toilet, upper air way obstruction, and as a part of another procedure (in major head and neck procedures in which it is necessary to remove the whole larynx, a permanent

tracheostomy is an unavoidable consequence).

Traumatic Brain Injuries (TBI) is an alteration in brain function, or other evidence of brain pathology, caused by an external force. The alteration in brain function consists of any period of loss of or a decreased of consciousness level, any anterograde or retrograde amnesia, neurologic deficits or any alteration in mental state at the time of the injury<sup>4</sup>.

Head injuries most often have been classified by one of three main systems<sup>5</sup>: Clinical indices of severity; used most often in clinical research to compare patients among centres. Pathoanatomic type; used most often to describe injuries for acute management. Physical

mechanism; describe the causative forces associated with the injury, used most often in the biomechanics and prevention fields.

**Patients and methods**

A prospective comparative clinical study was designed to compare the difference in duration of mechanical ventilation and intensive care unit length of stay (LOS) among head trauma patients to whom early tracheostomy (ET) was done and those to whom late tracheostomy (LT) was performed. The study was performed for head trauma patients in the ICU at Al-Sadr Teaching Hospital in Basrah, Iraq, during the period from February 2019 up to December 2019. Approval from Arabic Board of Medical Specialty was acquired. Informed consent was taken from patients families.

Inclusion criteria were: Head trauma patients with Glasgow Coma Scale (GCS) five to eight who were on endotracheal tube (ETT) with or without mechanical ventilation, all age groups, and both genders were involved in this study.

Exclusion criteria: GCS four and less, patients with respiratory problems (bronchial asthma and chronic obstructive pulmonary disease), patients with chest trauma, coagulation disorders, and loss of follow-up.

The decision about the need for tracheostomy was related to opinion of attending neurosurgeon, ICU anaesthesiologist, and otolaryngologist. The patients were divided into two groups

according to the timing of tracheostomy; early tracheostomy group: Those patients to whom tracheostomy was done at less than seven days from endotracheal intubation. Late tracheostomy group: Those patients to whom tracheostomy was done at or after seven days from endotracheal intubation.

Tracheostomy procedure was done to all patients by open surgical technique; in operating room under general anaesthesia (all patients already had endotracheal tube).

Statistical analysis was done by SPSS-23 (statistical package for social science, version 23). Parametric data continuous variables were presented using descriptive statistics which expressed as mean±standard deviation (SD) or as frequencies and percentages and by using student t-test. Chi square test was used to compare between the two groups. P-values less than 0.05 were considered significant.

**Results**

The study involved 51 patients of whom three unfortunately died during ICU stay (1 from early group and 2 from late group) and were lost from the study. Forty eight patients were included in the study, 24 patients were subjected to early tracheostomy (ET) and 24 patients were subjected to late tracheostomy (LT). Each group was subdivided into two groups according to whether the patient is on mechanical ventilation or not.

Table I: Gender distribution of both groups

	ET group		LT group		Total	
	No.	%	No.	%	No.	%
Males	24	100%	21	87.5%	45	94%
Females	0	0.0%	3	12.5%	3	6 %
Total	24	100%	24	100%	48	100%

(P value 0.117)

Table II: Age distribution in both groups

	ET group		LT group		Total	
	No.	%	No.	%	No.	%
Younger than 20 years	8	33%	5	21%	13	27%
20-40 years	12	50 %	13	54%	25	52%
40-60 years	2	8.5%	5	21%	7	15%
Older than 60 years	2	8.5%	1	4%	3	6%
Total	24	100%	24	100%	48	100%

(P value 0.6)

Table III: Mechanism of injury of patients in both groups

	ET group		LT group		Total	
	No.	%	No.	%	No.	%
RTA	19	79 %	23	96 %	42	88%
*Others	5	21 %	1	4 %	6	12%
Total	24	100%	24	100%	48	100%

(P value 0.112)

Table IV: Neurological diagnosis of both groups

Neurological diagnosis	ET group		LT group		Total	
	No.	%	No.	%	No.	%
Diffuse axonal injury	10	42%	12	50%	22	46%
subdural hematoma	2	8%	4	17%	6	13%
ICH+Subdural haematoma Or IV hemorrhage	3	12.5%	1	4 %	4	8%
Multiple brain contusions	5	20.8%	0	0.0%	5	10%
ICH	4	16.7%	7	29 %	11	23%
Total	24	100%	24	100%	48	100%

(P value 0.156)

Table V: Duration on endotracheal tube (ETT)

	ET ( days )	LT ( days )	P value
Median	5	11	0.0001

Table VI: Mechanical ventilation days of both groups

		ET group (N=13)	LT group (N=13)	P value
Days on MV before tracheostomy	mean±SD	4.53± 1.66	11.15 ± 3.13	0.0001
	Median	5.0	10.0	
Days on MV after tracheostomy	mean±SD	6.23 ± 1.48	10.69 ± 4.34	0.0001
	Median	6.0	11.0	
Total duration of MV ( days)	mean±SD	9.63 ± 1.87	17.81 ± 6.66	0.0001
	Median	11.0	19.0	

Table VII: ICU length of stay of both groups

		ET group	LT	P value
Days of ICU LOS for all patients	mean±SD	12.70 ± 1.80	22.37 ± 7.19	0.0001
	Median	13.0	20.0	
Days of ICU LOS for patients without MV	mean±SD	11.27 ± 1.42	17.54 ± 2.50	0.0001
	Median	11.0	18.0	
Days of ICU LOS for patients with MV	mean±SD	13.92 ± 1.04	26.46 ± 7.38	0.0001
	Median	14.0	23.0	

Table VIII: Days of ICU stay after tracheostomy in both groups

		ET group (N=24)	LT group (N=24)	P value
Days of ICU stay after tracheostomy for all patients	mean±SD	4.83±1.76	10.7±6.2	0.0001
	Median	4	8.5	
Days of ICU stay after tracheostomy for patients without MV	mean±SD	4.64±1.42	5.7±1.42	0.040
	Median	4	6	
Days of ICU stay after tracheostomy for patients with MV	mean±SD	8.67±1.11	15±5.4	0.0001
	Median	9	14	

Table IX: Glasgow Coma Scale analysis of both group

Tracheostomy groups	GCS1 at admission Mean±SD	GCS2 before tracheostomy Mean±SD	GCS3 day one after tracheostomy Mean±SD	GCS4 day three after tracheostomy Mean±SD	P value
ET (N=24)	6.38±1.05	6.58±0.93	7.13±1.03	8.04±0.95	0.0001
LT (N=24)	6.63±0.87	6.79±0.97	7.13±1.11	8.08±1.14	0.0001
P value	0.728	0.529	1.000	0.863	

Table X: Frequency of complications of tracheostomy in both group

	ET group		LT group		Total	
	No.	%	No.	%	No.	%
No complication	16	67%	15	63%	31	65 %
Wound infection	7	29%	8	33%	15	31 %
Tube displacement	1	4%	1	4 %	2	4 %
Total	24	100%	24	100%	48	100%

(P value 0.6)

### Discussion

Tracheostomy is one of the most commonly performed surgical procedure in the ICU for patients with endotracheal intubation and mechanical ventilation<sup>6</sup>. Although the timing to perform tracheostomy is between 7-10 days<sup>7</sup>, but the optimal timing is still controversial<sup>8</sup>. The incidence of ventilator associated pneumonia is directly related to the duration of mechanical ventilation, this complication is associated with significant morbidity and mortality<sup>9-11</sup>.

Tracheostomy was proven to be an assistant in the care of head trauma patients<sup>12,13</sup>. Many studies found that early tracheostomy is beneficial for head trauma patients, most of them found that it decrease the duration of mechanical ventilation<sup>6,14-16</sup> and ICU length of stay<sup>17-19</sup>. In the present study, early tracheostomy was performed before 7 days (median 5 days) of endotracheal

intubation while late tracheostomy at or after 7 days (median 11 days). Roushdy et al<sup>20</sup>, Kang et al<sup>8</sup>, and Nasim Ahmed and Yen H Kuo<sup>21</sup> performed early tracheostomy before 7 days and late tracheostomy at or after 7 days. kapil et al<sup>6</sup>, performed early tracheostomy at or before 5 days while late tracheostomy after 5 days of endotracheal intubation. Sugerman et al<sup>22</sup> randomize patients into ET group at 3-5 days while LT group at 10-14 days.

There are many factors affect the timing of tracheostomy including: Hemodynamic condition of the patients, the parent's hesitation from the operation as they worried about invasiveness of the procedure and its complications, and suspicion of cervical spine injury that cause limitation of neck mobility and may cause delay in performing the procedure. The mean duration of mechanical

ventilation among patients with early tracheostomy in our study was  $9.63 \pm 1.87$  days, while it was  $17.81 \pm 6.66$  days in late group, the difference was statistically significant. The result is comparable to Roushdy et al<sup>20</sup>, ET ( $10.97 \pm 6.82$ ) days versus LT ( $16.28 \pm 8.65$ ) days. kapil et al<sup>6</sup> ET ( $8.1 \pm 5.4$ ) versus LT ( $11.7 \pm 7.2$ ) days. Kang et al<sup>8</sup>, ET (median 14 days) versus LT (median 35 days). Our result not match with Nasim Ahmed and Yen H Kuo<sup>21</sup>, ET ( $15.7 \pm 6.0$ ) days versus LT ( $20.0 \pm 16.0$ ) days (no statistical significant difference between two groups).

Duration of mechanical ventilation after tracheostomy: In ET group was ( $6.23 \pm 1.48$  days while in late group was  $10.69 \pm 4.34$  days, also this difference was statistically significant. This result is comparable to study of Kang et al<sup>8</sup> who found that ventilator duration after tracheostomy is significantly shorter in ET (median 13 days) versus LT (median 17 days). This result was disagreed with Yassen Arabi et al<sup>23</sup> who found that ventilator duration after tracheostomy in ET group was  $4.9 \pm 1.2$  days similar to that of LT ( $4.9 \pm 1.1$ ) days.

Intensive care unit length of stay in our study to all patients of ET group was  $12.70 \pm 1.80$  days while in LT was  $22.37 \pm 7.19$  days. This significant statistical difference goes with kapil et al<sup>6</sup>, ET ( $18.0 \pm 13.3$ ) LT ( $21.2 \pm 11.3$ ), and Kang et al<sup>8</sup> ET (median 21 days) LT (median 42 days), and Nasim Ahmed and Yen H Kuo<sup>21</sup> ET ( $19.0 \pm 7.7$ ) LT ( $25.8 \pm 11.8$ ). This result did not match with Sugerman et al<sup>22</sup> who found no statistical significant difference in duration of ICU stay between ET and LT groups, ET ( $16 \pm 5.9$ ) days versus LT ( $19 \pm 11.3$ ) days.

Duration of ICU stay after tracheostomy in all patients of ET group was (median 4 days) while (median 8.5 days) in LT group, this difference was statistically significant. This result was comparable with Young T Jeon et al<sup>17</sup> who found that duration in ICU after tracheostomy was

$11.2 \pm 10.1$  days in ET group versus  $16.1 \pm 16.5$  days in LT; but was in disagree with Yassen Arabi et al who found that duration of ICU after tracheostomy was  $6.3 \pm 1.3$  days in ET similar to that of LT group ( $6.9 \pm 1.1$ ) days.

The above results of mechanical ventilation duration and ICU length of stay may be explained by the facts that the tracheostomy results in reduction of physiological dead space and airway resistance with increase of tidal volume<sup>24</sup>, and the tracheostomy tube improve airway suctioning and oral hygiene that results in reduction of occurrence of ventilator associated pneumonia<sup>25</sup>. These factors may also help in the improvement of cerebral oxygenation, so early tracheostomy results in earlier weaning from MV in addition to earlier discharge from ICU than LT.

Patients without mechanical ventilation showed earlier discharge from ICU in ET group than LT group which may be explained by that those patients with LT had prolonged endotracheal intubation which made them more vulnerable to retained secretions and respiratory complications that might continue even after performing tracheostomy and subsequently prolonged their ICU stay.

In this study, there was significant improvement of GCS over the days after performing tracheostomy ( $p < 0.05$ ) in both groups. Chintmani et al<sup>26</sup> also compared GCS between tracheostomy and non-tracheostomy group found significant improvement of GCS after performing tracheostomy over serial measures during ICU stay. The improvement of GCS over days after performing tracheostomy may be related to the fact that tracheostomy improves cerebral oxygenation. In addition it is less irritant to the patient and decreases the need for sedation<sup>27</sup>.

In our study, wound infection was the most common reported complication in both groups, as it was present in 31.2% of all patients (ET and LT) with no

statistical significant difference between the two groups. Kang et al<sup>8</sup>, Roushdy et al<sup>20</sup> also reported that tracheostomy wound infection was the most common complication.

Conclusion: Early tracheostomy in

traumatic brain injury when performed within 7 days of endotracheal intubation will facilitate weaning from mechanical ventilation that leads to significant reduction in total duration on MV ventilation and reduces ICU stay.

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