A Review of the Impact of Early Tracheostomy Among Head Injury Patients

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ABSTRACT
Individual suffers from a head injury required a specific plan of treatment and nursing care to achieve the best outcome they could have. The initiation of tracheostomy is one of the interventions that may be executed on head injury patients especially for those with prolonged respiratory issue. Early tracheostomy (ET) is believed to offer a significant positive impact compared to late tracheostomy (LT). The objectives of this literature search are to determine past studies regarding the evaluation of the tracheostomy approach among head injury patients and identifying the gaps of knowledge on the initiation of tracheostomy and head injury patients. The information and past research on the topic of tracheostomy and head injury were identified according to the systematic review PRISMA approach from multiple online databases which are PubMed, Science Direct, Springer Link, and ProQuest. Recent articles from the last decade of 2010-2020 had been identified to explore the practice and outcome of tracheostomy among head injury patients. There are 17 studies were included which discussed the impact of the tracheostomy approach and 15 of the studies in which a total of 6, 705 patients were really focused on the comparison between ET (n=3189) and LT (n=3516) among head injury patients. The definition of ET was varied between the studies, but it is within the range of fewer than 7 days for ET. ET had reported significant findings in reducing the duration of mechanical ventilation, reduce the duration of ICU stay, better functional outcome, and faster decannulation rate. On the other hand, most of the past studies had shown that ET was not significant in reducing the mortality rate of the patients. The initiation of ET does contribute a good outcome for the head injury patients in terms of the duration of mechanical ventilation and ICU stay. However, the association between ET with overall hospitalization duration, the incident of pneumonia, and the mortality rate are still inconclusive. The review also shows that ET contributes to a better functional outcome.

Keywords: *Early Tracheostomy, Head Injury Patients*

1. INTRODUCTION

Head injury is a medical condition described when the individual had suffered an injury or trauma to the scalp, skull, or brain. The injury could be blunt or penetrating trauma to the head which is accompanied by an episode of alteration in that person's level of consciousness [1]. Patients who experienced head injury are one of the cases that usually needed the support of mechanical ventilation (MV) to prevent the condition of hypoxemia or hypercapnia that may lead to secondary insult or further damage to the brain. In case of severe head injury, the establishment of an airway and oxygen therapy via MV is deemed to be the most important intervention to maintain adequate oxygenation for the patient [2]. However, for those head injury patients who are likely to have difficulty in weaning off MV support or requires re-intubation, the issue arises whether these patients should be preserved with MV support via oral intubation of endotracheal tube (ETT) or to proceed with early cannulation of tracheostomy instead.

The term tracheostomy is subjected to the technique of anterior opening into the trachea via the incision at the neck area to create an artificial surgical airway. This procedure creates an air passage to help the individual breathing effort in case the upper airway is obstructed or impaired [3, 4]. The main reason for a tracheostomy to be initiated is due to prolong episodes of mechanical ventilation, when the weaning off the ventilator is difficult to be done which is quite common in case of head injury especially in the patient with severe traumatic brain injury (TBI) or a massive haemorrhagic stroke [5-7].

The idea of early cannulation of tracheostomy is believed to offer benefits and positive outcomes for the patient with a head injury. Nevertheless, the indication of whether to perform ET or on the later stage is still uncertain. Thus, this systematic review was conducted to determine past studies regarding the evaluation of the tracheostomy approach among head injury patients and identifying the gaps of knowledge on the initiation of tracheostomy and head injury patients.

2. METHODOLOGY

2.1. Literature Search

The information and past literature review about the topic of tracheostomy and head injury were identified according to the systematic review approach by using Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [8]. The following online database which is PubMed, Science Direct, Springer Link, and ProQuest was used to identify recent articles or past research that provide evidence related to the topic.

The main objective of this systematic review is to explore the practice and outcome of tracheostomy among head injury patients. The assessment of eligibility for the past studies was conducted in three stages which are screening for the title, abstract, and full text as shown in Figure 1.1 of the PRISMA chart with specific assessment tools were analysed. All studies reported on tracheostomy intervention on head injury patients including TBI, non- TBI, and postcranial surgery patients that had been published during the last decade between 2010 to 2020 in English language publication; had been included. The studies which do not focus on head injury patients as the subjects of the study and do not indicate the outcome of tracheostomy performed on the patients with head injury had been excluded.

2.2 Study Selection

A total of 12, 424 articles were identified and 10, 128 articles were eventually removed as the research articles were not related to the current study interest and were published before the year 2010 during the screening process. From the remaining 2296 articles, 1164 of them were eliminated due to duplication. The remaining 1132 articles had been engaged in abstract review. From the review, 985 articles were found not met with the inclusion criteria of the topic. Most of the studies had discussed the issue of tracheostomy concerning other health or medical issues such as respiratory failure, otorhinolaryngological issues, trauma, and sepsis. The excluded articles also only discuss the epidemiology of tracheostomy and its indication, tracheostomy care, complications, and others. Subsequently, 147 articles left had been retrieved for full- text review. 130 articles were then further eliminated as the studies were not engaged in the discussion on the outcome or implication of tracheostomy, were not focus on the head injury patients, and review papers. Eventually, 17 articles had been included in the study. The data from the articles that had been extracted consist of originated country, setting, study design, methodologies, sample size, assessment tool, research objectives, and outcome.

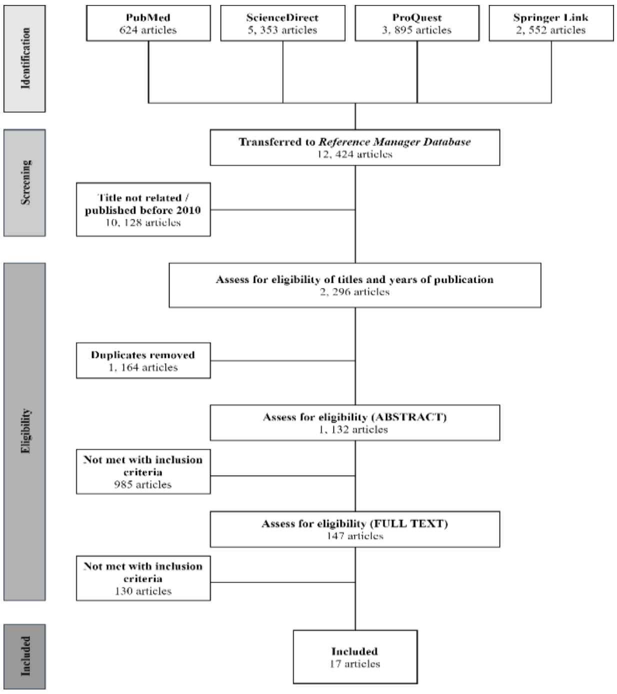

Figure 1.1: PRISMA Flow diagram on search strategy

3. RESULTS

3.1. Definition of Early Tracheostomy (ET)

Among 17 studies included in the review, 15 studies were focused on the comparison between ET and LT approaches towards the outcome. The definition of ET and LT were varies. Five studies contemplate that the initiation of tracheostomy is considered early when it is performed within 7 days after oral intubation [9-13]. On the other hand, two studies [14, 15] describe ET is within 8 days post-intubation and the other four studies [16-20] had considered it to be within 10 days.

From the last decade, only one study [24] which is included in this review uses the timeframe before 6 days as an ET whereby if the procedure performs on the seventh day onward, it is already considered late. There is one case-control study among 91 TBI patients at a tertiary medical centre in Tokyo who had specified the group of ET is among the patients who underwent the tracheostomy procedure within 3 days of post-intubation [21]. Lastly, there was a study conducted to evaluate the outcome of ET and LT but the study was not properly disclosing the criteria of ET [22].

Based on this review, most of the studies conducted in the Asian country had chosen the timeframe of <10 days to > 10 days to categorized between ET and LT while the Western and European countries tend to set it between <7 days to > 7 days. A report by the Brain Trauma Foundation also had concluded a different definition of the timing of tracheostomy from their analysis but it is within the range of fewer than 7 days [23]. On the other hand, a propensity-matched cohort study report by the American College of Surgeons had portrayed that $\leq$ 8 days is considered ET and >8 days is late.

3.2. Tracheostomy Rate and Study Population

The tracheostomy rate was significantly higher in the late group compared to the early group in most of the studies included in the review. Except for one study [11], other studies recorded a lower rate of ET in their study with the rate between 24.2% to 48.2% in their respective study. All study was conducted among adult patients with head injury (TBI and non-TBI), SAH, Stroke and neurosurgical cases except a recent study [18] which includes the children less than 15 years old with TBI. The study recorded 167 (46.2%) children who had been proceeding with ET compared to 127 (35.2%) of them in the LT group.

There are multiple reasons that lead to the significant result of LT reported in the studies. Most of the studies reported that the decision for tracheostomy will be done by the attending physician or consultant. But the decision to proceed with tracheostomy might be delayed due to the patient unstable condition, old age, poor expected outcome, and financial constraints [10, 11, 14, 17, 24, 25]. All these factors need to be meticulously evaluated before the procedure is decided to be initiated. The tracheostomy approach will be delayed a day after another if all these factors are remained contraindicated for it to be carried on.

According to Table 3.1, the majority of the sample included in all studies were significantly higher in males (n=4874) compared to females (n=1831) except the studies three studies [9, 10, 19] which the sample between males (n=171) and females (n=192) was comparable in total. According to the statistic, males have a higher incidence rate of TBI compared to women, especially during early adulthood [26]. This condition resulted since males were the common road user that have a higher risk to get involved in a head injury due to road traffic collisions. Head injury was substantially higher among the male population also contributed by the work- related head injury. However, in view of sports-related injury, female population have higher incident compared to male. From all the studies reviewed, the sample that had been included were patients subjected to head injury due to falls, road traffic accidents, work-related injury, and stroke.

All studies included in this review were conducted among the TBI population except three studies, which contain the data from patients with stroke, non-TBI, and SAH [9]; among the patients with poor SAH [10]; and among neurosurgical patients following head injury [17]. There are three studies from different continents that discovered the outcome of ET and LT among head injury patients in general. There are 6, 705 patients with various specific diagnoses related to head injury recorded in all 15 studies combined.

3.3. In-Hospital Outcome

Most of the studies included in the review were focussing on the outcome for the hospital's in-patient such as the duration of mechanical ventilation, length of stay in ICU and hospitalization, mortality rate, the incident of pneumonia, and neurological outcome. All 17 studies had reported on a few outcomes to the patient during their hospitalization (Table 3.2). While the report on the duration of mechanical ventilation (MV) dependency and ICU length of stay were among the top report included, there are few studies report on specific outcomes related to in-patient matter such as the incident of nosocomial infection [11, 20], duration on antibiotic usage [12, 20],

Table 3.1: Summary of studies included on tracheostomy approach, population and rate

Author	Year published	Origin	Type of study	Definition of ET and LT (days)	Study population	Population Sample (Male/Female)	Tracheostomy Rate ET/LT, n(%)	Research aim
Pinheiro et al.	2010	Brazil	Retrospective	< 8 vs ≥ 8	Head injury	28 (16/12)	11 (39.3%) 17 (60.7%)	In-hospital outcome
Rizk et al.	2011	USA	Retrospective / Prospective	< 7 vs ≥ 7	Head injury	3104 (2351/753)	1577 (50.8%) 1527 (49.2%)	In-hospital & post discharge outcome.
Wang et al.	2011	Taiwan	Retrospective	< 10 vs ≥ 10	Head injury	66 (47/19)	16 (24.2%) 50 (75.8%)	In-hospital outcome
Alali et al.	2013	Canada	Retrospective	≤ 8 vs >8	TBI	1811 (1345/466)	873 (48.2%) 938 (51.8%)	In-hospital outcome
Huang et al.	2013	Taiwan	Retrospective	< 10 vs ≥10	TBI	38 (24/14)	11 (28.9%) 27 (71.0%)	In-hospital outcome
Jeon et al.	2014	South Korea	Retrospective	< 10 vs ≥10	Neurosurgical, Head injury	125 (69/56)	39 (31.2%) 86 (68.8%)	In-hospital outcome
Gessler et al.	2015	Germany	Retrospective	≤ 7 vs >7	Poor SAH	148 (54/94)	54 (36.5%) 94 (63.5%)	In-hospital outcome
Siddique et al.	2016	Pakistan	Retrospective	< 7 vs ≥ 7	TBI	100 (55/45)	49 (49%) 51 (51%)	In-hospital outcome
Khalili et al.	2017	Iran	Retrospective / Prospective	< 6 vs ≥ 6	TBI	152 (136/16)	53 (34.8%) 99 (65.1%)	In-hospital & post discharge outcome.
Shibahashi et al.	2017	Japan	Retrospective	< 3 vs ≥ 3	TBI	91 (66/25)	40 (43.9%) 51 (56.1%)	In-hospital outcome
Qureshi et la.	2018	Pakistan	Retrospective	< 10 vs ≥ 10	TBI	48 (21/27)	15 (31.2%) 33 68.8%)	In-hospital outcome
Rosyidi et al.	2018	Indonesia	Retrospective	Not mention	TBI	60 (54/6)	Not mention	In-hospital outcome
Alsherbini et al.	2018	USA	Retrospective	≤ 7 vs >7	Stroke, non-TBI, SAH	140 (69/71)	44 (31.4%) 96 (68.55%)	In-hospital outcome
McLaughlin et al.	2019	USA	Retrospective	< 10 vs ≥ 10	TBI	361 (132/127)	167 (46.2%) 127 (35.8%)	In-hospital outcome
Robba et al.	2020	Europe	Retrospective / Prospective	< 7 vs ≥ 7	TBI	433 (333/100)	180 (41.5%)253 (58.4%)	In-hospital & post discharge outcome.

ET=early tracheostomy, LT=late tracheostomy, pts=patients, MV=mechanical ventilation, ICU=Intensive Care Unit, DVT=deep vein thrombosis, TBI=traumatic brain injury, SAH=subarachnoid hemorrhage, VAP=ventilator associated pneumonia

the incidence of DVT and ulcer [14, 18], decannulation rate [10, 19, 27]. In addition, one study had reported morbidity rates among the sample [20] and another study [10] had included the outcome of sedation usage among the sample population in their study.

Table 3.2: Summary of reported outcome Measured (ET vs LT)

Author (year)	Outcome Measured									
	In-patient								Outpatient	
	Duration on MV	*ICU LOS*	*Hospital LOS*	*Mortality rate*	*Incident of pneumonia*	*Nosocomial infection*	*Duration on antibiotic*	*Neurological outcome*	*Decannulation rate*	*Functional outcome*
Pinheiro et al., (2010)	N/A	Mean ± SD. 4.73 ± 2.28 vs 16.94 ± 7.68 (p<0.0001)	N/A	46% vs 65% (p=0.044)	54% vs 70% (p=0.44)	N/A	N/A	N/A	N/A	N/A
Rizk et al., (2011)	N/A	OR (95% CI. 0.23 (0.20-0.28) (p<0.0001	N/A	N/A	N/A	OR (95% CI) 1.52 (1.26-1.83) (p<0.0001)	N/A	3% vs 6% (p<0.0001)	N/A	43% vs 29% (p<0.0001)
Wang et al., (2012)	Mean ± SD. 5.1 ± 6.8 vs 5.9 ± 10.6. (p:0.58)	Mean ± SD. 14.9 ± 8.9 vs 22.1 ± 7.6 (p<0.0001)	Mean ± SD. 38.0 ± 21.4 vs 46.8 ± 22.0 (p=0.62)	N/A	44% vs 76% (p=0.04)	25% vs 24% (p=1.00)	Mean ± SD. 2.2 ± 3.4 vs 11.6 ± 8.7 (p<0.0001)	N/A	N/A	N/A
Alali et al. (2013)	OR (95% CI). 0.70 (0.66-0.75) (p<0.001)	OR (95% CI). 0.70 (0.66-0.75) (p<0.001)	OR (95% CI). 0.80 (0.74-0.86) (p<0.001)	8.4% vs 6.8% (p=0.32)	41.7% vs 52.7% (p<0.001)	N/A	N/A	N/A	N/A	N/A
Huang et al., (2013)	N/A	SD (days) 16(8) vs 29(13) (p=0.004)	SD (days) 50(30) vs 67(33) (p=0.15)	9% vs 15% (p=1.00)	N/A	N/A	N/A	Mean (SD) 2 (1) vs 2 (0) (p=1.00)	N/A	N/A
Jeon et al., (2014)	Mean ± SD. 4.6 ± 5.5 vs 8.0 ± 14.1 (p:0.05)	Mean ± SD. 19.9 ± 10.6 vs 31.1 ± 18.2 (p:0.000)	Mean ± SD. 70.6 ± 48.8 vs 71.6 ± 54.6 (p:0.743)	2.6% vs 4,6% (p=1.00)	7.7% vs 25.6% (p=0.433)	N/A	N/A	N/A	N/A	N/A
Gessler et al., (2015)	OR (95% CI) 0.59 (0.38-0.94) (p=0.02)	N/A	N/A	7.7% vs 7% (p=0.93)	48.7% vs 68.8% (p=0.03)	N/A	N/A	OR (95% CI) 21 (53.8) vs 98 (62.4) (p=0.35)	HR (95%CI) 0.5 (0.31-0.79) (p=0.003)	N/A
Siddique et al., (2016)	days 10 vs 13 (p=0.031)	days 11 vs 13 (p=0.030)	days 29 vs 25 (p=0.279)	N/A	N/A	N/A	N/A	40.8% vs 27.4% (p=N/A)	N/A	N/A
Baron et al., (2016)	N/A	median (IQR) 7 (13-14) vs 29 (19-41) (p<0.001)	median (IQR) 9 (3-17) vs 30 (22-42) (p<0.001)	40% vs 38% (p=0.86)	N/A	N/A	N/A	N/A	N/A	N/A
Khalili et al., (2017)	N/A	Mean ± SD. 26.79 ± 13.16 vs 34.92 ± 20.07 (p:0.09)	Mean ± SD. 38.58 ± 20.18 vs 46.40 ± 24.56 (p:0.049)	18.9% vs 18.2% (p>0.99)	52.8% vs 59.6% (p=0.492)	N/A	N/A	N/A	N/A	n (%) 20 (52.6) vs 43 (43.4) (p=N/A)
Shibahashi et al., (2017)	n (days) 5 (4-6) vs 8 (6-10) (p<0.001)	n (days) 10 (7-13) vs 11 (10-15) (p=0.021)	n (days) 53 (40-65) vs 57 (45-67) (p=0.021)	3% vs 8% (p=0.380)	33% vs 41% (p=0.51)	N/A	N/A	40% vs 39% (p=0.99)	N/A	N/A
Schneider et al., (2017)	n (%) 14 (26.4) vs 2 (10.5) (p=0.043)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	HR (95%CI) 1.09 (1.01-1.17) (p=0.021)	mRS–median (IQR) 5 (5-6) vs 5 (4-5) (p<0.001)
Qureshi et al., (2018)	days (%) 2 (4.2) vs 19 (39.6) (p=0.004))	N/A	days (%) 0 (0) vs 17 (35.4) (p=0.001)	20.8% vs 64.6% (p=0.013)	6.3% vs 43.8% (p=0.005)	N/A	N/A	N/A	N/A	N/A
Rosyidi et al., (2018)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Alsherbini et al., (2018)	Mean (SD) 13.4 (9.4) vs 18.2 (8.3) (p=0.005)	Mean (SD) 15 (10-20) vs 20.5 (15.8-27) (p=0.002)	N/A	N/A	N/A	N/A	N/A	Poor outcome mRS (%) 36 (82%) vs 73 (76%)	N/A	N/A
McLaughlin et al., (2019)	RR (95% CI) 0.55 (0.46–0.65) (p=N/A)	RR (95% CI) 0.77 (0.63–0.93) (p=N/A)	RR (95% CI) 0.62 (0.53–0.72) (p=N/A)	4.1% vs 3.3% (p=N/A)	23.9% vs 41.4% (p=N/A)	N/A	N/A	N/A	N/A	N/A
Robba et al., (2020)	N/A	Coeff. (SE) 6.89 (1.58) (p<0.001)	Coeff. (SE) 11.45 (3.35) (p<0.001)	N/A	27.2% vs 39.7% (p=0.010)	N/A	n (%) 90.3% vs 98% (p0=.001)	OR (95% CI. 1.96 (1.16-3.28) (p=0.006)	N/A	OR (95% CI. 1.69 (1.07-2.67) (p=0.018)

MV=mechanical ventilation, ICU=Intensive Care Unit, LOS=length of stay, mRS=modified Rankin Scale, SD=standard deviation, N/A=not applicable, OR=odd ratio, Coeff.=coefficient, SE=standard error, HR=hazard ratio

3.3.1. Duration of Mechanical Ventilation (MV) support

Ten studies had reported on the outcome of the duration of MV uses among head injury patients and nine of them had reported significant findings between ET and shorter duration of MV support [9, 10, 13, 14, 17-19, 21, 27]. However, a study among 66 patients with a severe head injury in Taiwan [20] has suggested otherwise which shows an insignificant relationship between ET and LT with a *p*-value of 0.58. The other seven studies did not include the duration of MV as one of their measured outcomes.

3.3.2. ICU and Hospital Length of Stay (LOS)

There are thirteen, and eleven studies respectively reported on the significance of the ET approach on LOS in ICU and hospital. All reported study shows the significant result of fewer days of ICU stay if ET had been carried out; with almost all studies shows the significant value of $p<0.0001$. Three studies had stated the difference between LOS in ICU between ET and LT group could reach the gaps of 12 days average [9, 15, 17]. A study among pediatric patients [18] and among adults with moderate and severe TBI report [30] the advantage of ET could decrease the LOS in ICU up to 20 days gap. All studies indicate that patients with a head injury could stay in ICU for around 11 to 39 days with ET could narrow it down to 5 to 26 days.

Given hospital LOS, there are seven studies reported a significant finding of ET toward the shorter LOS and four studies had proven otherwise [13, 16, 17, 20]. One study had found that ET had shortened patient's LOS by20% over the 4th quartile of the hospital [14]. This condition gives the patients a lower odd of developing other hospital-acquired complications such as pneumonia or nosocomial infection. This outcome was also similar inthe pediatric patient with TBI [18]. From that study, the children were found to have low chances of complications and side effects that will eventually jeopardize their prognosis. Patients who have a lesser LOS due to the ET approach also have a higher functional outcome during their six-month regular follow-up with higher GOSE outcomes compared to those with the LT [24]. In addition, another study had concluded that LT will increase the LOS stay by the mean of 11.45 days [12].

However, there was a study reported that the length of hospitalization was recorded higher in patients with ET [13]. In that study, patients with prolong ETT intubation have fewer days in hospital by the margin of 4 days with the analysis shows an insignificant *p*-value of 0.279. On the other hand, a study originated from South Korea mentioned that ET was only associated with reduced length of ICU stay (p=0.000) but not for overall hospital stay (p=0.743) [17].

3.3.3 Mortality Rate

The mortality rate is one of the long-term outcomes reported in most of the studies included. Ten studies had included the mortality rate data in their data collection. However, only three studies reported a significant association between the ET and mortality rate [15, 19]. In the study among 28 head injury patients in one of the teaching hospitals in Brazil, the mortality of patients receiving ET (46%) and LT (65%) tracheostomy were differs by 19% with *a p*-value of 0.044 [15]. On the other hand, another study among 48 TBI patients indicates a difference of 43.8% between both groups (p=0.013) [19]. The rest of the studies in this review shows no significant relationship between ET and LT toward mortality rate. In addition, five studies indicate that ET contributes a higher mortality rate even though the margin difference was not too high which is around 0.7%-2%.

3.3.4. Incidence of Pneumonia

The relationship between ET and the incidence of pneumonia is also popular and has become one of the outcomes measured. Ten studies reported regarding this association and seven of them show a significant relationship. Pneumonia could be varies based on its specific categories such as community-acquired pneumonia (CAP), healthcare-associated pneumonia (HCAP), hospital-acquired pneumonia (HAP), and VAP [28]. Nevertheless, recent guidelines have recommended the exclusion of the term HCAP from medical vocabulary [29].

However, a few studies were not determining the specific type of pneumonia included in their research [14,18, 20]. All these three studies reported a significant association between ET and the incident of pneumonia with *a p*-value of <0.001 [14] and 0.04 [20]. However, one of them only compared the rate of pneumonia incidents between ET (27.2%) and LT (41.4%) without statistical analysis [18]. On the other hand, most of the studies were include the incident of VAP due to its close relationship with mechanical ventilation use.

The other seven studies which specifically discuss VAP with four studies [10, 12, 13, 17] describe a significant outcome and three studies reported otherwise [15, 21, 24]. Despite these inconsistent finding, it can be concluded that ET might be beneficial in minimizing the chances of VAP as the incident rate of it were low in all studies with the average of 33.93% compared to the LT group (51.86%).

3.3.5. Nosocomial Infection and Antibiotic Period

Only four studies discussed the outcome of nosocomial infection incidents and duration for antibiotic treatment. One study had reported the incident of nosocomial infection and the duration of antibiotics administered to the 66 head injury patients in a tertiary trauma centre in Taiwan [20]. The study had enlisted the isolated pathogens on the patient with ET and LT which shows a higher trend of gram-negative pathogens growth which are *pseudomona aeruginosa*, *Acinetobacter baumanii*, and *Haemophilis somnus* in the LT group (76%) compared to 25% occurrence in the ET group even though the association between ET and incident of leucocytosis was found insignificant (p=1.00). However, the duration of antibiotic treatment between these two groups was found significant (p<0.001). One of the study only report the outcome of infection occurrence which shows that the LT group was about a half times more expected to have an infectious rate with p<0.0001 [11]. On the other hand, another study had reported a significant value of p=0.001 of antibiotics used between the ET and LT groups [12].

3.4 Post Discharge Outcome

Studies pertaining to post-discharge outcome or outpatient is fashionable among the head injury population to assess their recovery rate and quality of life. However, the study regarding functional outcome and timing of tracheostomy is quite remote. Based on the studies included in this review, only four studies include the measurement of functional outcome [11, 12, 24, 27] while two studies evaluate decannulation rate [10, 27] and its association with the ET approach.

3.4.1 Decannulation Rate

Decannulation of tracheostomy was significantly earlier among the sample of the ET group with a median time of 42 days compared to 54 days in the LT group [10]. The multivariate analysis documented in this study recognized that ET is associated with early decannulation with *a p-* value of 0.03. The study was performed on head injury patients with poor SAH. The other study had documented a thorough investigation on the rate of decannulation among stroke patients with a significant finding of p=0.021 [27]. The decannulation rate is briefly described in this study based on several characteristics such as type of tracheostomy approach – percutaneous or surgical approach, complications of tracheostomy during hospitalization, and other clinical conditions.

3.4.2 Functional Outcome (FO)

Four studies reported on patient's FO after they had been discharged from the hospital. All studies had found that ET is associated with better FO for patients with a head injury. ET significantly improved the patient's six-month prognosis however it was unfavorable among the elderly [24]. This condition is believed contributed by the fewer days in ICU and hospitalization. Patients with LT will have poor FO based on GOSE score compared to the ET group with the *p-* value of 0.018 and increase the number of the day waiting for tracheostomy will increase the risk of mortality by 6% (p<0.001) [12]. One study had evaluated patient functional status based on the medication of Functional Independence Measure (FIM) with finding that ET group patients are likely to be functionally independent during discharge (p<0.001) [11]. On the other hand, another study had assessed the respondent's FO at 3 and 12 months with the modified Rankin Scale (mRS) and Barthel Index Score [27]. For 12 months assessment, the patient who had been decannulated showed functional improvement with a median (IQR) Barthel index of 35 (10-80).

4. CONCLUSION

This review concludes that the initiation of ET does significantly contribute to a good outcome in view of shorter duration of MV dependency and fewer days of ICU stay. However, the association between ET, mortality rate, overall hospital LOS and incident of pneumonia are still inconclusive. The studies included in this review shows that ET contributes to a good result for decannulation rate and FO, but the study was limited during the last decade especially in South-east Asian population. The evaluation on ET and head injury survivor's quality of life, post-discharge neurological outcome is also limited.

AUTHORS' CONTRIBUTIONS

S.M.L for conceived the original idea to compile the data from the past studies. Eventually, the literature search was done by M.F.M and both authors discussed and agreed with the main focus and idea of this review paper. Both authors had read and approved the final written review.

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