Impact of duration of Prolong Manual Bag ventilated patients in the Emergency Service

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Abstract

Introduction: There are increasing numbers of critically ill patients who need urgent emergency intubation in Emergency Service. Due to limited number of ventilators and even lack of portable ventilators in emergency room, we need to continue prolong manual bag ventilation of those patients after emergency intubation. Therefore, the aim was to analyse the impact of duration of prolong manual bag ventilated patients in the Emergency Service, Tribhuvan University Teaching Hospital in Nepal.

Methods: This was a prospective non-interventional cross-sectional study conducted from August 2012 to July 2013 (one year). This study included those Emergency Intubation cases with written informed consent from patient's party/guardian/legal representative to enroll in this study and excluding otherwise.

Results: 172 (0.4% of 45000 emergency room patients) patients were enrolled and divided in to Group I: Manual Bag Ventilation without Mechanical Ventilation (MBV-MV) *n* = 56 (32.6%) and Group II: MBV with MV **(**MBV+MV) *n* = 116 (67.4%) with accounting the incidence of such critically ill rarely found cases. The age ranges from 11 to 94 years with mean 49+-19. There were 33 Alive and 139 Death (*p* 0.006). M:F= 1.32:1. MBV duration was with median 540 min (*p* 0.02). 22.7% had < 180 minutes MBV with survival rate 28.2% (OR 1.98, *p* 0.162 comparing with > 181 minutes). 58.2% cases were only MBV in ER with 100% mortality. 41.2% had mechanical ventilation after MBV with median 3 days, mean 5.0+- SD 4.9 days in ICUs with 71.5% crude ill-defined mortality (*p* 0.042, ROC 0.704). The probability of survival after emergency intubation varies with duration of MBV as 0.8 in 1 hr (7.6% mortality) and 0.02 after 24 hrs (92.3% mortality) with underlying causes and availability of present treatment.

Conclusion: Irrespective of underlying causes, due to prolong manual bag ventilation without mechanical ventilation; there was increase chance of mortality and even 100% mortality as ill-defined crude mortality.

Key word: Emergency Room, Emergency Intubation, Manual Bag Ventilation, Mechanical Ventilation.

Introduction

Tribhuvan University Teaching Hospital (TUTH) is a tertiary care referral hospital in Nepal. The Emergency Service is one of the busiest emergency in TUTH, receives very critical (Trauma and Non-Trauma) patients those attend from various corner of the country. There are zero to six patients requiring intubation and resuscitation in 24 hours of service with around 45000 patients annually in emergency room (ER). There are limited numbers of

ventilator services available currently in this hospital.

Airway management for adequate ventilation are the most important issues of the acutely critical ill patients in the ER[1]. This life saving procedure in emergency situation is different comparing elective endotracheal intubation (ETI) in operation theatre[2]. It is non-specific amount of tidal volume by manual bag ventilation[3]. An absence of evidence from randomized control trail (RCT) suggests that the decision to use rapid sequence intubation (RSI) during management can neither be supported nor discouraged on the basis of quality evidence[4]. It was also evident that mortality associated with emergent tracheal intubation is highest in patients who are haemodynamically unstable and receiving vasopressor therapy before intubation[5].

There is very limited data of duration of manual bag ventilation (MBV) and its outcome analysis until now. Under various limitations of our ER, especially under staffing to conduct MBV and limited numbers of ventilators in the hospital, we request to patient party to perform MBV after brief training of hand bag ventilation. In fact, Emergency Medicine (EM) is still evolving as a speciality in this part of Asian countries. The aims of this study were to document on the demographic factors, APACHE II score correlation, indications, methods, outcome in terms of death and survival of emergency ETI in the ER in relation to impact of duration of manual bag ventilation.

Methods

This was a prospective non-interventional cross-sectional study between Group I i.e. manual bag ventilation without mechanical ventilation (MBV-MV) and Group 2 i.e. manual bag ventilation then with mechanical ventilation (MBV+MV). This study was done in ER, TUTH from August 2012 to July 2013 (one year) and the study patients transferred to Intensive Care Units of TUTH and other hospitals in Kathmandu Valley for mechanical ventilation.

The main inclusion criterion for this study was the patients brought to this ER with acutely critically ill those need emergency intubation with written informed consent given by patient's party or guardian to enrol in this study. The exclusion criteria are referral patient intubated in other hospital and when consent was refused by patient's party or guardian. The intubated patients were followed until the final outcome either in TUTH or any other hospital where the patient had been transferred by 'case holding during the study period' and by direct visit and telephone follow up until 1 month of their registry in this study. Ethical approval had been taken prior to this study from Institute of Medicine, Tribhuvan University.

Data analysis was done by using Microsoft Excel, SPSS and Epi Info. Statistical significance is taken as $p<0.05$ with 95% Confidence Interval wherever feasible. Kaplan - Meier analysis was used to analyse the death and alive outcome with duration of manual bag ventilation. The Area Under Curve (ROC curve) analysis was used to analyse the final outcome of survival or mortality with duration of manual bag ventilation or mechanical ventilation. APACHE II scoring system was used to analyse approximate mortality interpretation of the patients at time of ER presentation with MedCalc 3000, Build 244186 v11.2.2[7].

Results

172 (0.4% of 45000 ER patients) cases were enrolled in this study as fulfilling inclusion criteria. Group I: MBV without MV (MBV-MV) $n = 56$ (32.6%) and Group II: MBV with MV (MBV+MV) $n = 116$ (67.4%). The age ranges from 11 to 94 years with mean 49+-19. There were 33 Alive with mean age 41.09 +- 18.89 SD and 139 Death with mean age 51.3 +- 18.75 SD (p 0.006). M:F= 1.32:1. 36.6% patients needed emergency intubation (EI) arrived during the night shift, which was a 12 hour shift (p 0.577). The data showed 44.8% used ambulance and same proportion used taxi. There were more EI patients of Group II than Group I in stroke related (22.4% vs. 14.3%), severe head injury as traumatic brain injury related (12.1% vs. 5.4%) and organophosphate and other poison related (9.5% vs. 3.6%), chronic obstructive pulmonary disease related (14.7% vs. 7.1%) and seizure related (6% vs. 3.6%) patients groups. However, there were more EI patients of Group I than Group II in severe sepsis and septic shock (25% vs. 16.4%), hepatic encephalopathy and gastrointestinal related (14.3% vs. 5.2%), asystole and cardiac arrest on ER arrival (12.5% vs. 1.7%) chronic kidney diseases related (5.4% vs. 5.2%) and others (8.9% vs. 6.9%) patients groups. Intubation was most commonly to secure airway due to low GCS and/or airway obstruction 106 (52.8%) and for hypoxia 66 (37.2%) [Group I vs. Group II with OR 2.27 p 0.033]. Result also

showed significant correlation between Death / Alive with intubation to secure airway outcome mortality 84.9% and that of hypoxia 74.2% (*p* 0.043), in overall mortality 80.8% (*p* 0.043). In total *n*=172, median ER arrival and time of intubation (A-I) duration was 52.50 minutes (*p* 0.012) in comparison with Alive/Death at the end. In same Alive/Death comparison, Group I shows 100% mortality but Group II showed median time duration was 35 minutes (*p* 0.83).

Results of APACHE II score with mean 25.53+- 6.865 (*p* 0.001) in total cases. Those of Group I with mean 27.95+-7.32 with 100% mortality and Group II with mean 24.36+-6.34 (*p*0.017). The APACHE II mortality interpretation rate was with mean 51.13+-50.56% (*p* 0.008) in total cases. Similarly, APACHE II mortality interpretation rate of Group I with mean 58.02+- 21.92% with 100% mortality whereas Group II mean was 47.8+-19.1% (*p* 0.059). There were 5.4% Grade III laryngoscope during EI in Group I compare to 0.9% in Group II. Midazolam was used more in Group II (79.3%) than Group I (66.1%) [*p* 0.09]. There were 28 (16.3%) of total cases did not used any sedation, similarly in 21.4% in Group I and 13.8% in Group II. Suxamethonium was mostly used neuromuscular blocking agent (NMBA) as 93 (54.1%) of 172 cases whereas 59.5% in Group II than 42.9% in Group I (*p* 0.05). There were also 56 (32.6%) of 172 EI were done without using NMBA as crash intubation, i.e. more high in Group I (44.6%) than Group II (26.7%) [*p* 0.03].

There were 51 (29.7%) cardiopulmonary resuscitation (CPR) cases in total, more in Group I (53.6%) than Group II (18.1%) [OR 5.22, *p* 0.0000043] in mortality outcome. There were 33 (19.2%) survive in total and 28.4% survival rate in Group II. However, there was 100% mortality in Group I (*p* 0.000023). MBV duration with median was 540 minutes (*p* 0.02), (ROC Area 0.343, SE 0.048, *p* 0.005). 22.7% had < 180 minutes MBV with survival rate 28.2% (OR 1.98, *p* 0.162 comparing with > 181 minutes). 58.2% cases are only MBV in ER with 100% mortality. 41.2% had mechanical ventilation after MBV with median 3 days, mean 5.0+- SD 4.9 days in ICUs with 71.5% crude ill-defined mortality (*p* 0.042, ROC 0.704). One month survival rate with Cerebral Performance Categories Scale1-2 is 15.7% & 3-4 is 2.9% in total cases. The probability of survival after EI varies with duration of MBV as 0.8 in 1 hr (7.6% M = mortality), 0.8 in 2 hrs (9.5% M), 0.64 in 3 hrs (13.5% M), 0.34 in 6 hrs (40.6% M), 0.09 in 12 hrs (62.5% M) and 0.02 after 24 hrs (92.3% M) with underlying causes and availability of present treatment.

51 (29.7%) CPR cases of 172 EI cases were analysed with duration of manual bag ventilation. The outcome of CPR and OPR (Only Pulmonary Resuscitation) groups of MBV duration were range 20-4140 minutes with median 360, mean 559, SD 729.1 minutes (ROC Area 0.719). 41.2% had < 180 minutes MBV with survival rate 14.3% (*p* 0.000312 comparing with > 181 minutes in percentile). 58.2% cases were only MBV in ED with 100% mortality. 41.2% had MV after MBV with mean 5.1+- SD 5.4 days in Intensive Care Units with 85.7% crude ill-defined mortality (*p* 0.023, ROC 0.149). One month survival rate with Cerebral Performance Categories Scale1-2 was 5.9%. The probability of survival after CPR varies with duration of MBV was 0.8 in 1 hr, 0.6 in 2 hrs, 0.4 in 3 hrs, 0.3 in 6 hrs, 0.1 in 12 hrs and 0.0 after 24 hrs with underlying causes and availability of present treatment.

Of 172 patients, 56 (32.6%) were emergency crash intubation (ECI) and 116 (67.4%) were rapid sequence intubation (RSI) patients. Duration of manual bag ventilation in ER of ECI showed range 20 to 4140 minutes with mean 584.38+-655.03 (*p* 0.08 of median 390 minutes). That of RSI was range 45 to 4320 minutes with mean 803.53+-836.96 (*p* 0.004 of median 540 minutes). Those patients of both group who received MBV but no MV showed 25 (44.64%) of ECI whose duration ranges 20 to 1500 minutes with mean 489.4+-482.14 and median 300 minutes with 100% morality. Similarly that of RSI accounted 31 (26.72%) patients and the duration of MBV was range 45 to 4320 minutes with 1161.29+-1224.38 and median 750 minutes with 100% mortality. 31 (55.4%) ECI patients were MBV with MV with 81% mortality (*p* 0.02). 85 (73.3%) RSI patients were MBV with MV with 68.2% mortality (*p* 0.0004).

Table 1. *N* = 172 with duration of MBV

Duration of MBV Hr	Minute	ER	ICU	Alive	Death	Cumu-lative	Risk	Probability of Survival	Mortality rate
1 hr	<60 min	14	3	1	13	158	172	0.9	7.6%
2 hrs	61-180	25	19	10	15	133	158	0.8	9.5%
3 hrs	181-360	27	19	9	18	106	133	0.64	13.5%
6 hrs	361-720	50	41	7	43	56	106	0.34	40.6%
12 hrs	721-1440	41	27	6	35	15	56	0.09	62.5%
> 24 hrs	> 1440	15	7	0	12	3	15	0.02	92.3%
Total		172	116	33	136				

Duration of MBV Minutes	n	%	Alive		Death		Survival Mortality Rate	Survival Rate	
< 180	39	22.7	11	OR1.98	28	p 0.163	11/39 A	28.2%	71.8%
> 181	133	77.3	22	P 0.163	111	OR 1.98	22/133 D	16.5%	83.5%
			33		139		33/172 T	19.2%	80.8%

One month survival rate with Cerebral Performance Categories (CPC) Scale					In hospital Mechanical Ventilation ICU stay		
CPC	Total	%	Alive	%		Minutes	Days
CPC 1-2	27/172	15.70%	27/33	81.80%	Median	4320	3 days
CPC 3-4	5/172	2.90%	5/33	15.20%	Mean	7312.983	5 days
1 Expire	1/172	0.60%	1/33	3%	SD	7044.097	4.9 days

Table 2:

Variables	Total Cases	*MBV – MV* Group I	*MBV+MV* Group II	*p* value of mean of Group I & II
Number of cases	*N* = 172 (100%)	*n* = 56 (32.6%)	*n* = 116 (67.4%)	
Gender				0.89
Male	98 (57)	32 (57.1)	66 (56.9)	OR 1.01
Female	74 (43)	24 (42.9)	50 (43.1)	
Time of arrival at ED				
1. 9 am – 3 pm	60 (34.9)	22 (39.3)	38 (32.8)	0.50
2. 3 pm – 9 pm	49 (28.5)	15 (26.8)	34 (29.3)	0.87
3. 9 pm – 9 am	63 (36.6)	19 (33.9)	44 (37.9)	0.73

Means of transportation				
1. Ambulance	77 (44.8)	25 (44.6)	52 (44.8)	0.89
2. Taxi	77 (44.8)	24 (42.9)	53 (45.7)	0.85
3. Others	18 (10.4)	7 (12.5)	11 (9.5)	0.73
Diagnosis				
1. Stroke related	34 (19.8)	8 (14.3)	26 (22.4)	0.29
2. Sepsis and shock	33 (19.2)	14 (25.0)	19 (16.4)	0.25
3. COPD related	21 (12.2)	4 (7.1)	17 (14.7)	0.25
4. Head injury TBI related	17 (9.9)	3 (5.4)	14 (12.1)	0.27
5. HE and GI related	14 (8.1)	8 (14.3)	6 (5.2)	0.04
6. Others	13 (7.6)	5 (8.9)	8 (6.9)	0.42
7. OPP & other poisons	13 (7.6)	2 (3.6)	11 (9.5)	0.23
8. Asystole and CA related	9 (5.2)	7 (12.5)	2 (1.7)	0.006
9. CKD related	9 (5.2)	3 (5.4)	6 (5.2)	1.00
10. Seizure related	9 (5.2)	2 (3.6)	7 (6.0)	0.72
Intubation for				0.033
Secure airway	108 (52.8)	42 (75)	66 (56.9)	OR 2.27
Hypoxia	64 (37.2)	14 (25.0)	50 (43.1)	
Laryngoscopy				
Grade I	147 (85.5)	44 (78.6)	103 (88.8)	0.19
Grade II	21 (12.2)	9 (16.1)	12 (10.3)	0.40
Grade III	4 (2.3)	3 (5.4)	1 (0.9)	0.10
Grade IV	0	0	0	
Sedation uses				
Midazolam	129 (75)	37 (66.1)	92 (79.3)	0.09
Ketamine	13 (7.6)	7 (12.5)	6 (5.2)	0.08
Non	28 (16.3)	12 (21.4)	16 (13.8)	0.29
Others	2 (1.1)	0	2 (1.7)	1.00

Muscle relaxants				
Suxamethonium	93 (54.1)	24 (42.9)	69 (59.5)	0.05
Vecuronium	14 (8.1)	5 (8.9)	9 (7.8)	0.77
Non	56 (32.6)	25 (44.6)	31 (26.7)	0.03
Others	9 (5.2)	2 (3.6)	7 (6.0)	0.72
CPR				0.0000043
No	121 (70.3)	26 (46.4)	95 (81.9)	
Yes	51 (29.7)	30 (53.6)	21 (18.1)	OR 5.22
Outcome				0.000023
Death	139 (80.8)	56 (100)	83 (71.6)	
Alive	33 (19.2)	0	33 (28.4)	

Table 3: Continuous variable analysis results.

Continuous Variables		Minimum	Maximum	Mean	SD	*p* value	Chi-Square	95% CI
Age in years								
Total Cases	*N* = 172 (100%)	11	94	49.34	19.154	0.049	80.326	0.047-0.056
Group I	*n* = 56 (32.6%)	16	87	50.82	20.138	0.999	14.000	1.000-1.000
Group II	*n* = 116 (67.4%)	11	94	48.63	18.708	0.139	63.103	0.128-0.146
ED arrival and intubation time period (A-I Time in minutes)								
Total Cases	*N* = 172 (100%)	5	3480	258.05	479.737	0.000	505.965	0.000-0.000
Group I	*n* = 56 (32.6%)	5	3480	339.46	565.064	0.098	48.500	0.093-0.104
Group II	*n* = 116 (67.4%)	5	2700	218.75	429.798	0.000	297.793	0.000-0.000
APACHE II score								
Total Cases	*N* = 172 (100%)	11	44	25.53	6.865	0.001	60.140	0.000-0.002
Group I	*n* = 56 (32.6%)	14	44	27.95	7.32	0.954	13.643	0.963-0.971
Group II	*n* = 116 (67.4%)	11	42	24.36	6.343	0.026	41.810	0.023-0.031
APACHE II mortality interpretation rate								
Total Cases	*N* = 172 (100%)	15	88	51.13	20.558	0.000	138.081	0.000-0.000
Group I	*n* = 56 (32.6%)	15	88	58.02	21.921	0.000	29.714	0.000-0.000

Group II	*n* = 116 (67.4%)	15	88	47.80	19.088	0.000	91.724	0.000-0.000
Duration of Manual bag ventilation then without mechanical ventilation (minutes)								
Total Cases	*N* = 172 (100%)	15	4320	732.15	787.242	0.000	148.233	0.000-0.000
Group I	*n* = 56 (32.6%)	15	4320	861.25	1016.303	0.934	21.714	0.949-0.957
Group II	*n* = 116 (67.4%)	60	4320	669.83	644.613	0.000	88.138	0.000-0.000
Duration of mechanical ventilation (minutes)								
Total Cases	*N* = 172 (100%)	0	43200	4932.01	6721.708	0.000	602.070	0.000-0.000
Group I	*n* = 56 (32.6%)	N/A						
Group II	*n* = 116 (67.4%)	60	43200	7312.98	7044.097	0.000	209.500	0.000-0.000

Discussion

There were no such comparable studies found in literature review to compare this study results till the time of this study. We did emergency intubations without failure even in those with grade II and grade III laryngoscopic views. Our ER is mainly adult emergency service but we provide paediatric emergency service for trauma and very critically ill patients irrespective of age group on ER arrival. Therefore, our patients' age ranges from very young to old. There were wide ranges of time period (ER arrival and intubation time period) as patients were brought earlier but later due course of ER boarding needed emergency intubations also took accounts in this study. This duration of wide period gap in our study was due to deterioration of critically ill patients boarding in ER due severity of the illness with overcrowding and access block[6] and limitation of elective intubation due to overbooked ventilators in ICU in our hospital and various limitations in other referring hospitals.

With due consideration, we could not stop using MBV even if its ill-defined crude mortality was high in our study. Our results outcome of 'death and alive' were showing higher rate of mortality and none were discharge from ER after emergency intubation due to high severity of the patient's condition (initial APACHE II mortality interpretation scoring and rate correlation) comparing with a study conducted by Leon D. Sanchez et al[2].

The two groups, Group I: MBV without MV (MBV-MV) *n* = 56 (32.6%) and Group II: MBV with MV (MBV+MV) *n* = 116(67.4%) were on the base of cases incidence without matching due to rarity of critically ill patients during the study period. In addition, there was no possibility of randomized controlled trail study in such issues. However, it was evidence based documentation of impact of duration of MBV with outcome of emergency intubated patients in ER. Moreover, there were no such studies found in literatures until this study was conducted from Asian countries also where MBV is common due to lack of sufficient ventilators. Similarly, there were no such studies found on literatures review in those countries where ventilator facilities are instantly available in their part of the World.

There were 33 (19.2%) survive in total cases who got MV after MBV (28.4% survival rate of Group II) but 100% mortality who did not get MV and only MBV in ER (Group I). This was the main reason, irrespective of underlying causes, due to prolong MBV without MV, there was increase chance of mortality and we saw even 100% mortality as ill-defined crude mortality. It was 'crude ill-defined mortality' because we could not confirm the death was due to lack MV or severity of underlying disease condition or prolong MBV. Therefore the null hypothesis could not prove that "A prolonged duration of manual ventilation is NOT different

from early mechanical ventilation in terms of outcome for emergency intubated patients" rather a prolonged duration of MBV was harmful than there was still more chance of survival when early MV after short duration of MBV in ER.

The above data results showed the clear image of prolong duration on MBV, the poorer the outcome after EI irrespective of underlying causes. The survival rate was decreasing with increasing time of duration of MBV. Therefore, the duration of MBV was directly proportionate to increasing mortality rate and inversely proportionate to survival rate after EI cases irrespective of underlying diseases. The results of MBV duration with median 540 minutes (nine hours, *p* 0.02) which was quite prolong duration in ER. There were no document data of such prolonged MBV in ED of others parts of the World. The study clearly document that there were higher chance of survival if we transfer EI patients with MBV within 180 minutes (three hours, survival rate 28.2%). Once the duration of MBV increase beyond more than three hours, the mortality rate increases by 83.3%. This study also showed 58.2% cases were only MBV in ED with 100% mortality. 41.2% had mechanical ventilation after MBV with median 3 days, mean 5.0+- SD 4.9 days in ICUs with 71.5% crude ill-defined mortality (*p* 0.042, ROC 0.704). One month survival rate with Cerebral Performance Categories Scale 1-2 is 15.7% & 3-4 is 2.9% in total cases. Therefore, the probability of survival after EI is indirectly proportionate with increased duration of MBV with underlying causes and availability of present treatment.

We had more access block than overcrowding in our ER (Access Block Index 70.6% vs. Over Crowding Index 1.7%) due to limited number of beds and increasing number of patient flow as multi-speciality tertiary care center[6]. The decision of intubation was depending up on patients condition after presenting in the ER with standard practice by on duty emergency physician. The time taken to intubate after ER arrival varies because of boarding time and progressive of the severity of disease or sudden deterioration of the condition. Therefore, the median A-I time was prolong (52.50 minutes).

APACHE II score and mortality appreciation rate is one of the wisely used validated tools for assessing severely ill patient in ER. Therefore, we used this tool to analyse the severity of the cases in addition to duration of manual bag ventilation after emergency intubation. The results of APACHE II score in total cases (*p* 0.001) and those of Group I and Group II (*p* 0.017) correlate with outcome severity comparing with APACHE II mortality appreciation rate (*p* 0.008 in total cases and Group I vs. Group II *p* 0.05).

Conclusion

Irrespective of underlying causes, due to prolong MBV without MV; there was increase chance of mortality and even 100% mortality as ill-defined crude mortality. It was 'crude ill defined mortality' because we could not confirm the death was due to lack MV or severity of underlying disease condition or prolong MBV. A prolonged duration of MBV is harmful and there was still more chance of survival when early MV after short duration of MBV in ER. Therefore, the duration of MBV is directly proportionate to mortality rate and inversely proportionate to survival rate after EI cases irrespective of underlying diseases

Therefore, with limited resources, with limited number of emergency medicine trained human-power, limited number of ventilators and limited hospital facilities and space, these emergency intubated patients need continue manual bag ventilation until the death or alive outcome situation in this part of the World. We can increase probability of survival as team approach beginning from Pre-Hospital Emergency Care to In-Hospital Emergency Care with upgrading Emergency Medicine training along timely availability of mechanical ventilator supports and then care by definite treatment stakeholders of critical care teams.

Limitations

This was based on one centre study, not done such kind of study before. The groups were unmatched in number of cases between comparing groups, due to rarity of the cases and severity of critically ill patients during the study period. Methodology limitation, not feasible to conduct randomization and intervention study due to severity of illness, otherwise can see better results.

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