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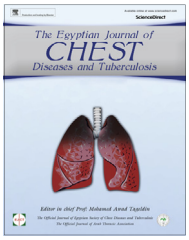

ORIGINAL ARTICLE

Unplanned versus planned extubation in respiratory intensive care unit, predictors of outcome

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KEYWORDS

Unplanned;
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Abstract *Introduction:* The incidence of post-intensive care unit admission complications is high; some of these complications are inevitable and often leads to medical emergencies. Among these complications is the extubation failure whether resulted from planned extubation which is prepared and performed by the medical team or unplanned extubation (UE). Unplanned extubation (UE) is a real event in all ICUS worldwide and is considered as one of the major complications in mechanically ventilated patients. However, its impact on mortality, duration of mechanical ventilation (MV) as well as predictors of UE and need for reintubation had not been adequately defined.

Objective: To define the profile of the patients at risk of unplanned extubation and establish predictive criteria for extubation outcome.

Patients and methods: This study was carried out in the Respiratory Intensive Care Unit of Chest Department, Zagazig University Hospitals during the period from March 2010 to January 2011. Sixty-seven invasively mechanically ventilated patients who were admitted to the RICU were enrolled in the study. They were (47) males and (20) females with mean age (51.56 ± 6.28) years. Patients were admitted to the RICU because of one of the following diagnostic categories; acute exacerbation of chronic obstructive pulmonary disease (AECOPD) (41 patients), Pneumonia (6 patients), Bronchial asthma (2 patients), Pulmonary edema (5 patients), Bronchiectasis (6 patients), Systemic lupus erythematosus (1patient), interstitial lung disease (ILD) (1 patient), Infected cystic lung (1 patient), Overlap syndrome (4 patients). Patients were classified into two groups according to the way of extubation: Group I: Unplanned extubation group (they were 27 patients who underwent UE either self inflicted (13 patients) or accidental extubation (14 patients) and Group II: Planned extubation group (they were 40 patients who fulfilled weaning criteria and tolerated 2-h

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spontaneous breathing trial through T-tube without signs of distress and followed by extubation after 24 h). On admission to ICU the following were carried out and recorded for all patients: Full medical history from the patient (if possible) or his relatives, history of previous intubation and/or ventilatory support and Presence of co morbidities, Full clinical examination, Plain chest and heart X-ray, Arterial blood gases, Routine laboratory investigations, Mechanical ventilation, Assessment of APACHE III score (acute physiology and chronic health evaluation score), Assessment of Glasgow Coma Score (GCS) and Assessment of sequential Organ failure score (SOFA). During ICU stay, assessment of the following parameters was done daily including: GCS, Evidence of agitation, Use of sedatives, Degree of sedation using Ramsay Sedation Scoring System, Presence of any physical restrains (Wrist restraints), Amount of endotracheal secretion, Assessment of the strength of the cough reflex by cough strength scale, Nine equivalents of nursing manpower use score (NEMS) to assess nursing workload and Arterial blood gases. If unplanned extubation occurred during anytime before weaning, the following were reported: Time of UE, Ventilation parameters at the time of UE (ventilatory mode, FIO2tidal volume, rate, amount of pressure support and PEEP), Presence of agitation, use of physical restraints, Use of sedation, Last Ramsay score, Last cough strength scale, Last endotracheal secretion scale, GCS at time of extubation, SOFA score at time of extubation, Last NEMS score, Last ABG. If patient passed to weaning and tolerated SBT for 2 h the following tests were performed before extubation in addition to assessment of the same parameters reported among patients in the UE group including Assessment of swallowing by swallowing score, Minute ventilation recovery time, Dead space addition test (DSA), Cuff leak test. The Outcome of the studied patients as regards extubation was categorized into either extubation success or failure. Also the Outcome of the studied cases as regards mortality was classified into either survival or death.

Results: The results of this study revealed that the frequency of planned extubation represents 59.7% while unplanned extubation represents 40.3% of the studied subjects. There is no significant difference between planned and unplanned extubation as regards the cause of admission to ICU, ($P > 0.05$) with predominance of COPD exacerbation which represents 61.19% of the studied population. On starting MV there is an increased risk of unplanned extubation in a significant way with the presence of agitation (74.07%) and decreased the percentage of use of sedation (37.04%), use of physical restraints (77.78%) and lower Ramsay score value ($1.33 \pm .48$), (P value < 0.05). There is no significant difference as regards history of previous MV, NEMS score and type of respiratory failure between planned and unplanned extubation, (P value > 0.05). Successful extubation is significantly higher in the planned extubation group (75%) in comparison to the unplanned extubation group (18.52%) while extubation failure is significantly higher among the unplanned extubation group (81.48%) in comparison to (25%) in the planned extubation group, (P value < 0.05). Survival represents 92.5% in the planned extubation group and 59.26% in the unplanned extubation group with statistical significance. There is a significant increase in the risk of failed extubation among the unplanned extubation group with moderate and large amounts of E/T secretions (86.36%) and with extubation at the night shift (63.64%), (P value < 0.05). But there is no significant difference among failures or succeeders as regards use of physical restraints, presence of agitation and sedation. There is a significant increase in the risk of failed extubation in the unplanned extubation group with a longer duration of MV (7.32 ± 2.22) days, with increased PaCO2 (54 ± 7.7) mmHg, with $PaO_2/FIO_2 < 200$, with decreased GCS (11.36 ± 1.9) and lower cough strength scale ($1.7 \pm .7$), (P value < 0.05). On the other hand there is no significant difference between successful and failed extubation as regards PH value, Ramsay score, NEMS score and SOFA score, (P value > 0 .05). The frequency of both ways of unplanned extubation in the studied subjects revealed that self inflicted extubation represents 48.15% while accidental extubation represents 51.85%. There is a significant increase in the duration of MV in self inflicted than in accidental extubation (6.07 ± 2.76 VS 3.35 ± 1.13 days), (P value < 0.05). There is an increased risk of self inflicted extubation with the use of physical restraints (92.31%) and presence of agitation (84.62%), (P value < 0.05). But there is no significant difference among them as regards time of extubation, Ramsay score, NEMS, GCS and use of sedation. Successful extubation is significantly higher in the self inflicted group (30.77%) in comparison to the accidental extubation group (7.14%), (P value < 0.05). Survival represents (61.54%) in the self inflicted group and (57.14)% in the accidental extubation group but without any significant difference, (P value > 0.05). Most of successful extubations among the planned extubation group have a mild amount of E/T secretions (86.67%) and without use of sedation (100%) with a significant difference where extubation failure is significantly higher in moderate and large amounts of E/T secretions, (60%), (P value < 0.05). All patients with planned extubation whether successful or failures have been extubated at the morning shift. On the other hand, there is no significant difference between succeeders and failures as regards use of physical restraints and presence of agitation. There is an increased risk of failed extubation among planned extubation with a longer duration of MV (7.6 ± 1.07 days), higher values of $PaCO_2$ (53 ± 1.76) mmHg and lower

PaO_2/FIO_2 (202 ± 8.23) and cough strength scale (2) in comparison to succeeders, (P value <0.05). There is not any significant difference between succeeders and failures as regards, NEMS, SOFA, GCS and Ramsay scores, ($P > 0.05$). Increased minute ventilation recovery time (12.6 ± 4.7) minutes, and a lower value of swallowing score (13.8 ± 2.62) carry the risk of failed extubation in a significant way, (P value <0.05).

Conclusions: An increase in severity of illness on ICU admission, agitation, less use of sedation with lower Ramsay score during MV intensify the risk of unplanned extubation, which usually occurs during the night shift, even with the use of physical restraints. Unplanned extubation is associated with an increased incidence of failed extubation (especially with accidental extubation) and mortality. Factors affecting airway competence; magnitude of cough on command and abundant amount of E/T secretions are significant predictors of extubation failure in planned and unplanned extubation. Prolonged minute ventilation recovery time, failed DSA test and lower swallowing score are associated with an increased risk of failed planned extubation.

Introduction

Technologic devices used in diagnosis and treatment of pulmonary illness can be annoying and painful as well as life saving. So physicians should care for patients who disrupt or remove these devices such as endotracheal tubes, oxygen masks and intravascular lines [1].

Endotracheal intubation is the main route used to provide effective delivery of mechanical ventilation to intensive care patients. Along with its numerous advantages, intubation is also associated with a number of disadvantages and sometimes very serious complications [2]. Removal of the endotracheal tube and weaning from mechanical ventilation are planned by the medical team. However, some patients deliberately remove the endotracheal tube when they are irritable, or it may be accidentally removed while being transported or during a nursing intervention, radiographic taking, removal of secretions and coughing. This is called "unplanned extubation". The reported incidence rate of unplanned extubation ranges from 3.4% to 22.5% [3].

Unplanned extubation is a potentially serious accident since in 31–78% of cases requires reintubation and/or is complicated by arrhythmias, bronchial aspiration, and difficulty in reintubation or even death [4].

Studies have shown a higher mortality for patients with failed unplanned extubation 28–51% as compared to those who have successfully tolerated the process 0–12% [5].

Although the risk of hypoxic end-organ damage in patients who failed to tolerate unplanned extubation is reduced by prompt reinstitution of ventilatory support, they are still subject to the risks of pneumonia and death [6].

Factors contributing to this event are not well recognized in adult patients and it is unclear for instance whether factors such as the route of intubation, the method of tube fixation or the degree of patient's consciousness could predispose patients to unplanned extubation [7]. Not only factors contributing to unplanned extubation are not well recognized, but also factors predicting reintubation, although the presence of pneumonia may be an indicator for reintubation [8].

Aim of the work

To define the profile of the patients at risk of unplanned extubation and establish predictive criteria for extubation outcome.

Patients and methods

This study was carried out in the Respiratory Intensive Care Unit of Chest Department, Zagazig University Hospitals during the period from March 2010 to January 2011.

Inclusion criteria

Sixty-seven invasively mechanically ventilated patients who were admitted to the RICU were enrolled in the study. They were (47) males and (20) females with age range from (38) to (65) years with mean age (51.56 ± 6.28) years.

Patients were admitted to the RICU because of one of the following diagnostic categories: AECOPD (41 patients), Pneumonia (6 patients), Bronchial asthma (2 patients), Pulmonary edema (5 patients), Bronchiectasis (6 patients), Systemic lupus erythematosus (1patient), ILD (1 patient), Infected cystic lung (1 patient), Overlap syndrome (4 patients).

Patients were classified into two groups according to the way of extubation.

Group I: (Unplanned extubation group)

Unplanned extubation was defined as premature removal of the endotracheal tube by the action of the patient (pulling them out); self-extubation or during nursing care and manipulation of the patient; accidental extubation [3]. They were [27] patients who underwent UE either self inflicted [13] patients or accidental extubation [14] patients.

Group II: (Planned extubation group)

They were (40) patients who fulfilled weaning criteria and tolerated 2-h spontaneous breathing trial through T-tube without signs of distress and followed by extubation after 24 h [9].

- On admission to ICU the following were carried out and recorded for all patients
  (1) Full medical history from the patient (if possible) or his relatives including smoking status, history of previous intubation and/or ventilatory support and Presence of co morbidities.
  (2) Full clinical examination.
  (3) Plain chest and heart X-ray.
  (4) Arterial blood gases.
  (5) Routine laboratory investigations.
  (6) Mechanical ventilation (Patients were mechanically ventilated using Synchronized Intermittent Mandatory Ventilation with pressure support mode (SIMV + PS). When patients fulfilled weaning criteria, a 2 h SBT through T tube was performed [10]. Patients were observed during the 2 h SBT for any signs of distress. Patients who showed no signs of distress with 2h SBT were followed by extubation after 24 h [9]. Patients who revealed signs of distress were reventilated for 24 h and another weaning trial was done by gradual method of weaning [11].
  (7) Assessment of APACHE III score (acute physiology and chronic health evaluation score). It consists of points for (a) physiologic abnormalities (b) Age and (c) chronic health status [12].
  (8) Assessment of Glasgow Coma Score (GCS). The total GCS score is summed to give an overall value of consciousness from 3 to 15 [13].
  (9) Assessment of sequential Organ failure score (SOFA). This assesses the development of progressive physiologic dysfunction in organ systems remote from the site of the primary disease process: a phenomenon originally described as multiple organ failure syndrome [14].
- During ICU stay, assessment of the following parameters was done daily (10 am, 4 pm and 11 pm)
  1. GCS.
  2. Evidence of agitation (defined as excessive non purposeful motor activity) [3].
  3. Use of sedatives [15].
  4. Degree of sedation using the Ramsay Sedation Scoring System [16].
  5. Presence of any physical restrains (Wrist restraints) [3].
  6. Amount of endotracheal secretion which is graded as mild, moderate, and large according to the frequency of suctioning [17].
  7. Assessment of the strength of the cough reflex by cough strength scale [17].
  8. Nine equivalents of nursing manpower use score (NEMS) to assess nursing workload [18].
  9. Arterial blood gases.
- On extubation, the following parameters were reported
- If unplanned extubation occurred during anytime before weaning, the following were reported:
  Time of UE, Ventilation parameters at the time of UE (ventilatory mode, FIO2 tidal volume, rate, amount of pressure support and PEEP), Presence of agitation, Use of physical restraints, Use of sedation, Last Ramsay score, Last cough strength scale, Last endotracheal secretion scale, GCS at time of extubation, SOFA score at time of extubation, Last NEMS score, Last ABG.
- If patient passed to weaning and tolerated SBT for 2 h the following tests were performed before extubation in addition to assessment of the same parameters reported among patients in the UE group:
  1. assessment of swallowing using the bed side scoring evaluation [19]
  2. minute ventilation recovery time (V_ERT) [20].

  After a 2-h SBT, place patients back on their pre-SBT ventilator settings for up to 25 min and measure minute ventilation (V_E) at three intervals: baseline over preceding 24 h (pre-SBT), post-trial (after SBT) and recovery (return to baseline). Patients were assumed to recover when minute ventilation decreased to 110% of the predetermined baseline.
  3. Dead space addition test (DSA) [21].
  An additional burden of 100 cc dead space was added to the endotracheal tube after 2 h of successfully tolerated SBT between the endotracheal tube and t-piece for 30 min. Clinical signs such as intercostal retraction, accessory muscle use and nasal flaring were monitored in all patients. The use of accessory muscles is defined as the contraction of the sternomastoid muscle. Intercostal retraction was defined as indrawing of the intercostal space during inspiration nasal flaring was defined as active flaring of the nostrils. Patients that successfully tolerated the test – no intercostal retraction or use of accessory muscle of respiration – were extubated.
  4. Cuff leak test to detect the risk of postextubation stridor [22]
  The cuff of the E/T tube was deflated and the sound of air leak was noticed.
- Outcome [15]
  Extubation success: defined as the ability to sustain spontaneous breathing without the need for reintubation for at least 48 h after extubation.
  Extubation failure: defined as the need for reintubation within 48 h from extubation.

Statistical analysis

Data were entered, checked and analyzed using Epi-Info version 6 and SPSS for Windows version 14.0 (SPSS, Chicago, IL, USA). Data were summarized using the arithmetic mean, the standard deviation (SD), Analysis of variance (ANOVA of F test), Chi-Square (χ^2) test and Student's *t*-test. For all the above mentioned statistical tests done, the threshold of significance is fixed at 5% level (*P*-value), *P* value of >0.05 indicates non-significant results, *P* value of <0.05 indicates significant results.

Results

Table 1 demonstrates that the frequency of planned extubation represents 59.7% while unplanned extubation represents 40.3% of the studied subjects.

Table 1 Extubation frequency of the studied population.

	Planned extubation	Unplanned extubation	Total
NO	40	27	67
%	59.7%	40.3%	100%

Table 2 Demographic data of the studied population.

		Planned (n = 40)		Unplanned (n = 27)		P
Age in years		Mean ± SD 52 ± 6.21		Mean ± SD 51.11 ± 6.34		0.571
		NO	%	NO	%	
Sex	Male	30	75	17	62.96	0.433
	Female	10	25	10	37.4	

Table 3 Different causes of admission to respiratory ICU among the studied patients.

	Planned extubation (No. 40)		Unplanned extubation (No. 27)		Total (n = 67)		P
	NO	%	NO	%	NO	%	
AECOPD	28	70	13	48.15	41	61.19	0.07
Severe pneumonia	3	7.5	3	11.11	6	8.96	0.94
Acute severe asthma	1	2.5	1	3.7	2	2.99	0.65
ILD exacerbation	1	2.5	0	0	1	1.49	0.84
Infected Bronchiectasis	3	7.5	3	11.11	6	8.96	0.94
Pulmonary edema	2	5	3	11.11	5	7.46	0.64
Overlap syndrome	1	2.5	3	11.11	4	5.97	0.35
SLE	1	2.5	0	0	1	1.49	0.84
Infected cystic lung	0	0	1	3.7	1	1.49	0.84
Total	40	100	27	100	67	100	0.29

Table 4 Patient characteristics on starting MV.

		Planned extubation (n = 40)		Unplanned extubation (n = 27)		p
		NO	%	NO	%	
Previous MV		8	20	2	7.41	0.28
Presence of agitation		15	37.5	20	74.07	0.007
Use of sedation		28	70	10	37.04	0.015
Use of physical restraints		20	50	21	77.78	0.042
Type of respiratory failure	Type I	5	12.5	5	18.52	0.742
	Type II	35	87.5	22	81.48	
		Mean ± SD		Mean ± SD		
Ramsay sedation score		2.89 ± 1.02		1.33 ± 0.48		0.001
NEMS score		31.6 ± 2.65		31.85 ± 3.86		0.581

Table 2 demonstrates the mean age of planned extubated patients (52 ± 6.21 years) and that of unplanned extubated patients (51.11 ± 6.34 years) with no significant difference ($p > 0.05$) and there was also no significant difference in respect to the sex of both groups ($P > 0.05$).

Table 3 demonstrates that there is no significant difference between planned and unplanned extubation as regards the causes of admission to ICU ($P > 0.05$) with predominance of COPD exacerbation which represents 61.19% of the studied population Table 4.

On starting MV there is an increased risk of unplanned extubation in a significant way with the presence of agitation (74.07%) and decreased the percentage of use of sedation (37.04%), use of physical restraints (77.78%), and lower Ramsay score value (1.33 ± .48), P value < 0.05. There is no significant difference as regards history of previous MV, NEMS score and type of respiratory failure between planned and unplanned extubation (P value > 0.05).

Outcome of this work was evaluated first in relation to extubation success (Table 5) and second in relation to mortality (Table 6). Successful extubation is significantly higher in the planned extubation group (75%) in comparison to the unplanned extubation group (18.52%) while extubation failure is significantly higher among the unplanned extubation group

Table 5 Outcome of the studied patients in relation to extubation.

	Planned extubation (No. 40)		Unplanned extubation (No. 27)		Total		p
	NO	%	NO	%	NO	%	
Extubation success	30	75	5	18.52	35	52.4	0.001
Extubation failure	10	25	22	81.48	32	47.76	

Table 6 Outcome of the studied patients in relation to mortality.

	Planned extubation (No. 40)		Unplanned extubation (No. 27)		Total		*p*
	NO	%	NO	%	NO	%	
Survival	37	92.5	16	59.26	52	77.61	0.0029
Death	3	7.5	11	40.74	14	20.9	

Table 7 Analysis of different variables among patients with UE at the time of extubation in relation to outcome.

		Successful extubation ($n = 5$)		Failed extubation ($n = 22$)		*p*
		NO	%	NO	%	
Use of physical restraints	Yes	5	100	16	72.73	0.47
	No	0	0	6	27.27	
Endotracheal secretions	Mild	4	80	3	13.64	0.008
	Moderate	1	20	9	40.91	
	Large	0	0	10	45.45	
Time of extubation	Morning shift	3	60	0	0	0.001
	Mid shift	2	40	8	36.36	
	Night shift	0	0	14	63.64	
Use of sedation	Yes	4	80	6	27.27	0.09
	No	1	20	16	72.73	
Presence of agitation	Yes	5	100	15	68.18	0.37
	No	0	0	7	31.82	
		Mean ± SD		Mean ± SD		
Duration of MV in days		3.6 ± 2.3		7.32 ± 2.22		0.04
Gas exchange parameters	PH	7.40 ± .46		7.37 ± .02		0.405
	$PacO_2$	45 ± 8.30		54 ± 7.7		0.042
	$Pao2/FIO_2$	204.67 ± 2.18		171.13 ± 28.4		0.03
Ramsay score		1.97 ± 1.5		1.3 ± .48		0.174
GCS		15 ± 0		11.36 ± 1.9		0.000
SOFA		2.8 ± .77		3.2 ± .96		0.239
Cough strength scale		3.9 ± 0.35		1.7 ± .7		0.001
NEMS		31.65 ± 3.92		31.38 ± 4.35		0.723

(81.48%) in comparison to (25%) in the planned extubation group, (P value < 0.05). As regards the mortality rates reported in this work, survival represents 92.5% in the planned extubation group and 59.26% in the unplanned extubation group with statistical significance.

Table 7 shows a significant increase in the risk of failed extubation among the unplanned extubation group with moderate and large amounts of E/T secretions (19 out of 22 patients) (86.36%) and with extubation at the night shift (63.64%), (P value < 0.05). But there is no significant difference among failures or succeeders as regards use of physical restraints, presence of agitation and sedation. There is a significant increase in the risk of failed extubation in the unplanned extubation group with a longer duration of MV (7.32 ± 2.22) days, with increased $PaCO_2$ (54 ± 7.7) mmHg, with PaO_2/FIO_2 < 200, with decreased GCS (11.36 ± 1.9) and lower cough strength scale (1.7 ± .7), (P value < 0.05). On the other hand there is no significant difference between successful and failed extubations as regards PH value, Ramsay score, NEMS score and SOFA score, P value > 0.05.

Table 8 demonstrates the cut off and its sensitivity, specificity, +ve and –ve PP for the independent predictors for unplanned extubation failure. It reveals cough strength scale $\leqslant 2$ with a sensitivity, specificity, +ve and –ve PP of 91%, 93%, 94% and 92%, respectively, pressure support > 10 cm H_2O which was lastly delivered by the MV with a sensitivity, specificity, +ve and –ve PP of 95%, 100%, 100% and 83%, respectively, moderate and large amounts of endotracheal

Table 8 Validity of predictors of unplanned extubation failure.

Variable	Sensitivity%	Specificity%	+ve PP	–ve PP
Cough strength scale $\leqslant 2$	91	93	94	92
PS Cm H_2O > 10	95.45	100	100	83.3
Moderate and large amounts of E/T secretions	86	80	95	60
Mid and night shift	100	60	91.7	60
GCS $\leqslant 11$	100	80	95.7	100
SOFA > 3	31.82	100	100	25

Table 9 Frequency of different ways of unplanned extubation.

	Self inflicted	Accidental	Total
NO	13	14	27
%	48.15	51.85	100

secretions which have a sensitivity, specificity, +ve and –ve PP of 86%, 80%, 95% and 60%, respectively and mid and night shifts have a sensitivity, specificity, +ve and –ve PP of 100%, 60%, 91.7% and 60%, respectively, GCS ⩽11 has a sensitivity, specificity, +ve and –ve PP of 100%, 80%, 95.7% and 100%, respectively, where SOFA score >3 has a specificity and +ve PP of 100%. All the previous cutoff values are significant predictors of failure in unplanned extubation patients.

Table 9 demonstrates the frequency of both ways of unplanned extubation in the studied population. Self inflicted extubation represents 48.15% while accidental extubation represents 51.85%.

Table 10 shows a significant increase in duration of MV in self inflicted than in accidental extubation (6.07 ± 2.76 VS 3.35 ± 1.13 days), (*P* value <0.05). There is an increased risk of self inflicted extubation with the use of physical restraints (92.31%) and presence of agitation (84.62%) (*P* value <0.05). But there is no significant difference among them as regards time of extubation, Ramsay score, NEMS, GCS and use of sedation.

Outcome of UE whether self inflicted or accidental extubation was evaluated first in relation to extubation success and second in relation to mortality (Table 11). Successful extubation is significantly higher in the self inflicted group (30.77%) in comparison to the accidental extubation group (7.14%) while extubation failure is significantly higher among the accidental extubation group (92.86%) in comparison to (69.23%) in the self inflicted group, (*P* value <0.05). As regards the mortality rates that was reported among the UE group, survival represents (61.54%) in the self inflicted group and (57.14)% in the accidental extubation group while death represents (38.46%) in the self inflicted group and 42.86% in the accidental extubation group but without any significant difference, (*P* value > 0.05).

Table 12 shows that most of the successful extubation among the planned extubation group have a mild amount of E/T secretions (86.67%) and without use of sedation (100%) with a significant difference where extubation failure is significantly higher in moderate and large amounts of E/T secretions (6 out of 10), (60%), (*P* value <0.05). All patients with planned extubation whether successful or failure have been extubated at the morning shift. On the other hand, there is no significant difference between succeeders and failures as regards use of physical restraints and presence of agitation. There is an increased risk of failed extubation among planned extubation with longer duration of MV (7.6 ± 1.07 days), higher values of $PaCO_2$ (53 ± 1.76) mmHg and lower PaO_2/FIO_2 (202 ± 8.23) and cough strength scale (2) in comparison to succeeders, (*P* value <0.05). There is not any significant difference between succeeders and failures as regards, NEMS, SOFA, GCS and Ramsay scores (*P* value >0.05).

On evaluation of certain tests to predict planned extubation outcome, this table reveals that increased minute ventilation recovery time (12.6 ± 4.7) minutes, and lower value of swallowing score (13.8 ± 2.62) carries the risk of failed extubation in a significant way, (*P* value <0.05) (Table 13). Successful DSA test have the ability to predict successful extubation in 22 patients (73.33%) where failed DSA test had increased among extubation failure in 7 patients (70%) in a significant way, (*P* value <0.05). On the other hand, cuff leak volume had no significant difference between succeeders and failures, (*P* value >0.05).

Table 14 shows a higher percent of certain parameters at the time of extubation among UE in comparison to planned extubation which are presence of agitation (74.07%) VS (45%), use of physical restraints (77.78%) VS (50%) with significant difference (*p* value <0.05). Also lower values were reported for Ramsay score (1.63 ± 0.66) in UE extubation patients VS (2.75 ± 1.8) in planned extubation patients with significant difference, (*p* value <0.05) and shorter duration of MV in UE extubation patients (3.07 ± 1.27) in comparison to (5.5 ± 1.48) in the planned group with a significant difference (*P* value <0.05) indicating that these factors increase the risk of UE.

Table 10 Comparison of self and accidental extubations regarding different variables at the time of extubation.

		Self inflicted	(*n* = 13)	Accidental	(*n* = 14)	*P*
		NO	%	NO	%	
Use of physical restraints	Yes	12	92.31	9	64.29	0.04
	No	1	7.69	5	35.71	
Time of extubation	Morning shift	2	15.38	1	7.14	0.53
	Mid shift	4	30.77	6	42.86	
	Night shift	7	53.85	7	50	
Use of sedation	Yes	5	38.46	5	35.71	0.64
	No	8	61.54	9	64.29	
Presence of agitation	Yes	11	84.62	9	64.29	0.039
	No	2	15.38	5	35.71	
		Mean ± SD		Mean ± SD		
Ramsay score		1.38 ± .56		1.38 ± .75		0.64
GCS		12.85 ± 2.08		13 ± .38		0.62
NEMS		31.32 ± 4.02		31.57 ± 3.96		0.73
Duration of MV		6.07 ± 2.76		3.35 ± 1.13		0.024

Table 11 Outcome of both ways of unplanned extubation in relation to extubation success or failure and in relation to mortality.

	Self inflicted (n = 13)		Accidental (n = 14)		Total (n = 27)		P
	NO	%	NO	%	NO	%	
Success	4	30.77	1	7.14	5	18.52	0.035
Failure	9	69.23	13	92.86	22	81.48	
Survival	8	61.54	8	57.14	16	59.26	
Death	5	38.46	6	42.86	11	40.74	

Table 12 Comparison of different variables at the time of extubation among studied planned extubation group in relation to outcome.

		Succeeders (n = 30)		Failures (n = 10)		p
		NO	%	NO	%	
Use of physical restraints	Yes	16	53.33	4	40	0.73
	No	14	46.67	6	60	
Endotracheal secretions	Mild	26	86.67	4	40	0.004
	Moderate	4	13.33	4	40	
	Large	0	0	2	20	
Time of extubation	Morning shift	30	100	10	100	0.002
	Mid shift	0	0	0	0	
	Night shift	0	0	0	0	
Use of sedation	Yes	0	0	6	60	0.001
	No	30	100	4	40	
Presence of agitation	Yes	14	46.67	4	40	0.74
	No	16	53.33	6	60	
		Mean ± SD		Mean ± SD		
Duration of MV		4.8 ± .76		7.6 ± 1.07		0.001
Gas exchange parameters	pH	7.41 ± .46		7.39 ± .01		0.272
	$PaCO_2$	43.33 ± 11.01		53 ± 1.76		0.009
	PaO_2/FIO_2	216.67 ± 6.61		202 ± 8.23		0.001
GCS		14.7 ± .71		14.6 ± .69		0.798
SOFA		2.69 ± .76		2.79 ± .79		0.412
Cough strength scale		4 ± .53		2 ± 0		0.001
NEMS		30.7 ± 1.62		30.9 ± 1.32		0.321
Last Ramsay score		2.76 ± 1.7		2.74 ± 1.9		0.743

Table 13 Comparison of different tests used to predict extubation outcome among planned extubation group.

		Successful planned (n = 30)		Failed planned (n = 10)		p
		Mean ± SD		Mean ± SD		
(V_ERT)	Baseline L/m	6.93 ± .87		7.2 ± 1.03		0.427
	Post trial L/m	9.9 ± .97		10.3 ± 1.02		0.053
	Recovery time (min)	4.53 ± 1.09		12.6 ± 4.7		0.001
Swallowing score		16.03 ± .76		13.8 ± 2.62		0.030
Cuff leak volume		117.83 ± 4.6		117.5 ± 5.45		0.852
		No	%	No	%	p
DSA	Success	22	73.33	3	30	0.038
	Failed	8	26.67	7	70	

Discussion

The decision to extubate a patient is one of the most challenging decisions facing intensivists. In many critical care units, this decision is based more on intuition and personal experience than on clinical evidence or scientific rationale. This leads to a wide variation in practice patterns and large differences in the duration of MV. However, the absence of evidence-based practice is certainly not caused by a lack of importance regarding this decision. Leaving a patient intubated for too long can have grave consequences, predisposing the patient to ventilator-associated pneumonia and increasing his or her ICU length of stay. Alternatively, extubating a patient too soon will frequently lead to reintubation, an act associated with greater morbidity and mortality [15].

Table 14 Risk factors for unplanned compared to planned extubation at time of extubation.

		Planned (n = 40)		Unplanned (n = 27)		*P*
		Mean ± SD		Mean ± SD		
NEMS		30.8 ± 2.33		30.3 ± 3.21		0.67
GCS		14.65 ± .3		13.18 ± .35		0.56
SOFA		2.74 ± .8		3 ± .8		0.73
Ramsay score		2.75 ± 1.8		1.63 ± .66		0.02
Duration of MV in days		6.02 ± .4		5.46 ± 2.26		0.001
		NO	%	NO	%	
Agitation		18	45	20	74.07	0.032
Use of physical restraints		20	50	21	77.78	0.028
Time of extubation	Morning	40	100	3	11.11	0.001
	Mid	0	0	10	37	
	Night	0	0	14	51.85	

Unplanned extubation is a real event in all ICUS worldwide and is considered as one of the major complications in mechanically ventilated patients. However, its impact on mortality, duration of MV as well as predictors of UE and need for reintubation had not been adequately defined [23–25].

Hence the purpose of this study was to define the profile of patients at risk of unplanned extubation and to guard against its occurrence thus decreasing the risk of reintubation complications and complications of prolonged MV, LOS in ICU and hospital. Also to define certain parameters to be taken into consideration before extubation is planned as predictors helping to identify patients that are likely to have extubation failure.

This study was carried out on 67 mechanically ventilated patients. Regarding the method of extubation, they were classified into two groups, group I (unplanned extubation), and group II (planned extubation) to assess the incidence of unplanned extubation and risk factors for its development in comparison to planned extubation. The two groups were matched as regards, age, sex, cause of admission, type of respiratory failure and previous mechanical ventilation (Tables 2–4).

On admission to the RICU, different scoring systems were used to evaluate patients; APACHE III score, GCS, SOFA score, NEMS and Ramsay score.

APACHE III score represents the health status of the patient and the severity of illness. Bad general health and associated co morbidities may contribute to the event of unplanned extubation [3].

GCs which evaluate the neurological state of the studied patients are used to assess patients at risk of UE as the more alert the patient the higher the incidence of such event; also good mentation is not only a risk of UE, but also essential for airway protection, thus can predict patients who can be successfully extubated [26].

Choosing the SOFA score to predict the outcome of extubation regarding success or failure came from the study of Adel [27] who found that this score has the most predictive value in the detection of the respiratory complications inside the RICU. So, predicting such complications may predict the incomplete readiness of our studied patients for extubation.

Many risk factors were observed in previous studies which contribute to UE; agitation, lack of sedation, use of physical restraints and nursing workload [5,8].

So, in this work, these parameters were evaluated for the patients of the two studied groups.

NEMS is one of the scoring systems used to assess the nursing workload, and the relation between busy loaded nurse with duties and UE [28]. NEMS was developed based on Simplified Therapeutic Scoring System-28 (TISS-28) and validated as a suitable and simple therapeutic index to measure nursing workload in ICU [29].

The effectiveness of sedations is more important than just the current use of sedation, so that the Ramsay score which was the first scoring system for evaluating sedation in mechanically ventilated patients was used to evaluate how deeply sedated patients in the studied two groups, because the less sedated alert patient carries a greater risk of UE [28].

This study reported percentage of UE incidence of 40.3% among the 67 patients included in this study, (Table 1). This is nearly in agreement with Jiang et al. [30] and Yeh et al. [31] who reported an incidence of UE of 22% and 42%, respectively. On the other hand, Nevins and Epstein [32], Pandey et al. [33] and Chang et al. [3] in their studies reported an incidence of UE of 10%, 3.4% and 8.7%, respectively.

The reason for an increased incidence of UE in this study than in other studies may be due to different patient characteristics as regards severity of illness, associated co morbidities, different MV durations before extubation and different ICU qualified nurses educated about such events and their sequale, also due to the different ways of E/T tube fixation which may lead to an increase in the percentage of accidental extubation in this study (51.85%), (Table 9), with an overall increase in the percentage of UE, while in other studies the percentage of accidental extubation did not exceed 29%.

This study reported percentage of self inflicted extubation incidence of (48.15%) among the 27 UE patients, while percentage of accidental extubation is (51.85%), (Table 9). This is not in agreement with Chevron et al. [28] and Nevins and Epstein [32] studies which reported an incidence of self inflicted extubation of 87%, 71%, respectively while accidental extubation represents 13%, 29%, respectively.

The reason for an increased incidence of accidental extubation in this study than in other studies may be due to the less educated nurses about how to give an intubated patient a care (dressing and radiographing) with attention to the E/T tube and the poor loose traditional way of E/T tube fixation may play a great role.

Outcome of this work was evaluated first in relation to extubation success and second in relation to mortality. Successful extubation is significantly higher in the planned extubation group (75%) in comparison to the unplanned extubation group (18.52%) while extubation failure is significantly higher among the unplanned extubation group (81.48%) in comparison to (25%) in the planned extubation group, P value <0.05 (Table 5).

The higher incidence of extubation failure in the unplanned extubation group was consistent with Eryuksel et al. [34] who found that 88% of unplanned extubated patients before the weaning process is established need reintubation.

In accordance with the current study which found that 30.77% of self extubated patients did not require reintubation, (Table 11), Bhattacharya et al. [35] in their study found that 69% of self extubated patients did not require reintubation. While in accidental extubation, (92.85%) of them require reintubation and only one patient passed successfully (Table 11). This is close to Bhattacharya et al. [35] that found a reintubation rate in such population was 100%.

As regards the mortality rates that were reported in this work, there is a significant increase in the mortality rate in UE than in the planned extubation group (40.74%) versus (7.5%), respectively, (Table 6), P value <0.05.

Scott et al. [36] found no significant difference between planned and unplanned extubation groups as regards mortality. This difference may be due to the different number of the studied populations in both studies, different severity of initial illness, associated co morbidities and different diagnostic categories. Also, accidental nature of more than 50% of the patients in the unplanned extubation group in this study and the more developed serious complications such as AF and cardiac arrest may increase the mortality rate compared with other studies.

On evaluating risk factors contributing to the development of unplanned extubation, the current study reported many significant risk factors for UE development when compared to planned extubation, including; a higher APACHE III score on admission (25.96 ± 5.36) VS (20.65 ± 6.86), on starting MV, presence of agitation (74.07% VS 37.5%), decreased use of sedation (37.04% VS 70%), lower Ramsay score (1.33 ± .0.48 VS 2.89 ± 1.02), use of physical restraints (77.78% VS 50%) where unplanned extubation occurred significantly in the night shift (51.85%), P value <0.05, (Tables 4 and 14).

Chang et al. [37] in their study found that an APACHE III score >17 carries a greater risk of UE. These data reflect that the initial severity of illness which has a strong influence on developing UE, as patient with higher APACHE tends to have worsened clinical status, more associated co-morbidities and more acid–base disturbance predicting an increase in the incidence of UE.

But Chevron et al. [28] found no significant difference between the planned and unplanned extubation groups regarding the APACHE score on admission. This may be due to the difference in characteristics of patients included in the two studies and may be due to the measurement of APACHE on the first day of hospitalization, therefore some scores may not accurately reflect patient conditions at the time of extubation.

In respect of GCS, there was no significant difference between planned and unplanned extubation groups regarding this score on admission (12 ± 1.92), (11.85 ± 1.97) and at extubation (14.65 ± .3), (13.18 ± .35), respectively, p value >0.05, (Table 14).

Chevron et al. [28] and Chang et al. [3] found that UE occurred in more alert patients especially if GCS $\geqslant 9$. It was noticed that in the unplanned extubation group in this work, the GCS was >9 and this is in accordance with the previous two studies.

Regarding agitation, the unplanned extubation group was more agitated than the planned extubation group on starting MV (74.07%). This demonstrates the importance of agitation as a risk of UE which is in agreement with Phoa et al. [5], Birkett et al. [8] and Elmetwally et al. [24] that found agitation in (75%,60% and 72.5%) of their studied UE patients, respectively. This difference continues at the time of extubation and still 74.07% of the unplanned extubation group were agitated, while only 45% of the planned extubation group were agitated, P value <0.05, (Table 14).

The main cause of agitation in critically ill patients include inability to communicate, continuous stimulation with noise (e-g equipments alarms), lack of mobility, sleep deprivation and some treatable causes such as electrolyte disturbance and ICU psychosis [5].

Regarding the use of sedation and its effectiveness which was assessed by Ramsay score, on starting MV, 70% of planned extubated patients were sedated in comparison with the unplanned extubated group in which only 37.04% of them were sedated, P value <0.05, (Table 4).

This finding is in agreement with Chang et al. [3] that found only 37% of UE patients were sedated while in planned extubated patients the ratio reached 76%.

Regarding the last Ramsay score before extubation, this score was significantly lower in the unplanned extubation group than in the planned extubation group (1.63 ± .66, 2.75 ± 1.8), respectively, p value <0.05, (Table 14).

This is also in accordance with Chevron et al. [28] who found a lower Ramsay score in the unplanned compared with the planned group (1.56 ± .35, 2.98 ± 1.4), respectively. Moreover, the Ramsay score in unplanned self inflected and accidental extubation also was in lower levels (1.38 ± .56, 1.38 ± .75), respectively, (Table 10).

Thus, the more alert, agitated and less sedated patient is at a great risk of UE development.

Shedding light on the use of physical restraints in the studied patients, the unplanned extubation group was more restrained than the planned extubation group on starting MV and at the time of extubation (77.78%), P value <0.05 (Tables 4 and 14).

This is consistent with Chang et al. [3] who found that 82% of UE patients were restrained while only 37% of planned extubation were restrained.

Also 12 out of 13 patients (92.31%) of self extubated patients of this work were physically restrained which is in agreement with Chang et al. [37] who found that 80% of self extubated patients were restrained at the time of extubation. Moreover, 9 out of 14 patients (64.29%) of accidentally extubated patients were physically restrained (Table 10).

Evaluating NEMS as a risk factor of UE, revealed an insignificant difference between the two groups regarding this score on admission (31.6 ± 2.65, 31.85 ± 3.86) and at the time of extubation (30.8 ± 2.33, 30.3 ± 3.21), respectively (Tables 4 and 14).

This is in agreement with Chevron et al. [28] that found no relation between nursing workload and the development of UE.

This may be due to the fact that NEMS score usually used to indicate nursing workload during a 24 h time period rather than at the time of extubation. Although Listello and Fessler [38] stated that the frequency of UE increases when nurse staffing was reduced, in the current study we did not measure the overall staffing in our ICU at the time of UE.

Taking the time of extubation into considerations, a strong relation between the time of extubation – namely mid and night shift – and the occurrence of unplanned extubation was observed in this work, where 24 out of 27 patients (88.88%) were extubated in mid and night shifts, (Table 7). This is nearly consistent with Chang et al. [37] who found that 76% of the unplanned extubation group was extubated in the mid and night shifts.

Moreover, among the self inflicted and accidental extubation, 11 out of 13 patients (84.6%) of the self extubation group and 13 out of 14 patients (92.86%) of the accidental extubation group were extubated in the mid and night shifts, (Table 10).

The reason for increased unplanned extubation in mid and night shifts may be explained by the deficient nurses in such periods besides the excess duties facing nurses in comparison to other shifts, but Chevron et al. [28] in their study found the time between 7 am and 7 pm is the rush hour of developing UE and they explained this observation by the fact that this is the period that the ICU is the busiest and the nurses may be distracted from their frequent monitoring of the intubated patients by other duties.

In the current study it was observed that the distraction of nurses may be more in mid and night shifts because nurses had more additional jobs like answering questions to the relatives about the current state of their patients and the expected prognosis and it may the same question about the same patient by different relatives in addition to the deficient number of nursing in these shifts, also mid and night shifts may increase the anxiety of already agitated patients by sleep deprivation and equipment alarms.

On the other hand, 100% of the planned extubation group were extubated in the morning shift whether successful or failed patients (Table 12) according to the rules of extubation which selected the morning shift as a suitable time for such event for availability of staff and sufficient nursing [25].

Successful extubation is the ultimate goal of weaning from invasive MV [15]. The overall extubation failure rate in the studied patients of this work was (47.67%), (Table 5), which was consistent with Chang et al. [3] that found an incidence of (57%,) extubation failure in their study. This study reported extubation failure in 22 patients out of 27 of the UE group (81.48%).

The current study reported many significant risk factors for extubation failure and need for reintubation in the UE group, which are long duration of MV (7.32 ± 2.22) days, presence of moderate and large amounts of E/T secretions (86.36%) with +ve PP 94%, lower GCS (⩽11) with +ve PP 95.7%, lower cough strength scale (⩽2) with +ve PP 94%, Pao2/FIO2 <200, PS > 10CmH2O with +ve PP 100% and hypokalemia, *P* value <0.05, (Tables 7 and 8).

Elmetwally et al. [24] isolated predictors of reintubation among the UE group which are higher APACHE II score (25.3 ± 4.6 VS 14.9 ± 1.8), older age (65.8 ± 5.7 VS 53.5 ± 5.5 years), hypoalbuminemia (3 ± .99 gm/dl) associated VAP, MODS and co morbidity.

Failed unplanned extubation had a longer duration of MV compared with successful unplanned extubation. This is in agreement with Scott et al. [36] that found an increase in the duration of MV in the failed UE patients (9.15 ± 2.23, 6.43 ± 1.98) days, respectively. This can be explained by a delay in the weaning process, more chance to hazards of MV and nosocomial complications which may lead to extubation failure.

Regarding the amount of E/T secretions and cough strength scale, Khamiees et al. [17] found that 88% of failed patients were with moderate to large amounts of E/T secretions compared to (86.36%) in the current study and the more the E/T secretions and frequency of suctioning the more the extubation failure.

This identifies that the factors of airway competence namely cough strength and amount of E/T secretions are important predictors of extubation outcome.

The fact that factors of airway competence should play such a decisive role in predicting extubation outcome is not surprising. Sustenance of good gas exchange following extubation demands that patients maintain a patent native airway and continue to breathe without the aid of the ventilator. Excessive secretions especially in the absence of good cough reflex lead to bronchial plugging, atelectasis and, all of which can cause respiratory re-failure [17].

Chevron et al. [28] reported a higher incidence of failed extubation with GCS ⩽11 which was in agreement with the finding observed in the current study, (Table 7). This is because that good mentation is not only a risk of UE, but also essential for airway protection, thus can predict patients who can be successfully extubated [26].

Incidence of extubation failure among the planned extubation group reported in this work was (10 out of 40 patients), 25% (Table 5) which was in accordance with Cohen et al. [39] and Robriquet et al. [15] that reported 28%, 20% extubation failure in their studied population, respectively.

Demling et al. [40] and Conti et al. [41] reported 3.3%, 1.7% extubation failure in their studied population, respectively.

This study reported significant risk factors for extubation failure in the planned extubation group which are moderate and large amounts of E/T secretions (60%), with cough strength scale ⩽2, with increased use of sedation (60%), Pao2/FIO2 (202 ± 8.23), higher Paco2 (53 ± 1.76), longer duration of MV (7.6 ± 1.07), longer V_ERT (12.6 ± 4.7) minutes, failed DSA test (70%) and lower swallowing score (13.8 ± 2.62), *P* value <0.05 (Tables 12 and 13).

In the current study, the observed cough strength scale ⩽2 and the presence of moderate and large amounts of E/T secretions in 60% among failed planned extubation patients confirm the importance of what is called airway competence in predicting how success is such an amazing event.

Failed planned extubation had a longer duration of MV compared with successfully planned extubation (7.6 ± 1.07, 4.8 ± .76) days, respectively. Again, this may lead to more hazards of MV and a chance for nosocomial complications, so the importance of developing such predictive criteria for extubation failure is a must.

In the planned extubation group, no significant difference in GCS between successful and failed patients (Table 12), *P* va-

lue >0.05, this is because the fact that previously prepared patients to such event and we did not extubate a patient without a good mentation, and the failure in this group is influenced by other parameters such as cough strength scale and amount of Endotracheal secretions.

Table 13 compares the ability of the different new tests in predicting extubation outcome whether success or failure.

Regarding the minute ventilation recovery time, there was no significant difference between successful and failed patients regarding the baseline minute ventilation which is the last minute ventilation recorded from the ventilator while patient is ready for T-tube trial, (6.93 ± .87, 7.02 ± 1.03) L/m, respectively, *P* value >0.05.

But, Raoof, [42] stated that 10 L/m is a threshold parameter for weaning above which failure occurs. This confirms, that most of accepted weaning parameters, cannot predict the outcome of extubation.

Comparing the post-trial minute ventilation which is the minute ventilation recorded after completed the 2 h SBT and returning the patient on the MV with the last parameters set before T-tube trial, also no significance between successful and failed patients (9.9 ± 0.97, 10.3 ± 1.02) L/m, respectively, *P* value >0.05.

The reason for increasing the post trial minute ventilation more than the base line may be due to the stress on the patients who start to depend on him/herself without the aid of the ventilator in sustaining a spontaneous breath sufficient to pass to the amazing extubation, so patients become slightly tachypneic may be within an unnoticed range that may be passed unobserved by the physician whether the tachypnea is due to stress and fear or due to starting or impending refailure or distress [20].

Minute ventilation recovery time was significantly shorter in successful than failed patients (4.53 ± 1.09), (12.6 ± 4.7) minutes, respectively, *P* value <0.05 (Table 13), delivering a new parameter that can predict the extubation outcome.

This is in agreement with Martinez et al. [20] who found a mean minute ventilation recovery time in successfully studied patients 3.6 ± 2.7 min while in failed patients was (9.6 ± 5.8 min).

The reason for the significant increase in the recovery time in failed extubated patients is unknown. It may be conjectured that prolonged recovery time seen in patients who failed extubation may reflect an unresolved disease process that may impact on sustained spontaneous breathing after extubation, an independent variable of severity of illness that cannot be identified by severity of illness scores or disease-specific limitations of established weaning criteria [20].

Regarding the swallowing score, the mean swallowing score was lower in failed than in successfully planned extubation (13.8 ± 2.62), (16.03 ± .076), respectively, *P* value <0.05 (Table 13). This was confirmed by results of Colonel et al. [19] that found a lower swallowing score in the failed than in successfully extubated patients (<11).

The impairment of swallowing causes airway obstruction and impairs patient ability to cough and expectorate especially if intubation is longer than 6 days [43].

Shedding light on the dead space addition test, 73.33% of successful extubation in the planned extubation group can tolerate the test and no signs of distress as intercostal retraction or working ala nasi can be noticed, and finally, no desaturation observed, while in failed extubated patients 70% of them cannot tolerate the test and signs of distress and desaturation can be observed *p* value <0.05, (Table 13).

This shows the ability of the DSA test to predict extubation outcome in agreement with Solsona et al. [21] who found that 75% failure rate in patients who cannot tolerate the test.

Taking the cuff leak test into consideration, Kriner et al. [22] demonstrated the ability of this test to detect the patients at risk of post extubation stridor and thus need reintubation, and the cuff leak volume was at least 100 ml or at least 10% of the delivered tidal volume. In the current study, there was no significant difference between successful and failed extubations as regards cough leak volume (117.83 ± 4.6), (117.5 ± 5.45), respectively (Table 13).

This can be explained by approximately in most of the studied patients, the usage of steroids common in management, thus no post-extubation Laryngeal edema developed and influenced the extubation in the studied patients [44].

Conclusions

An increase in severity of illness on ICU admission, agitation, less use of sedation with a lower Ramsay score during MV intensify the risk of unplanned extubation, which usually occurs during the night shift, even with the use of physical restraints. Unplanned extubation is associated with an increased incidence of failed extubation (especially with accidental extubation) and mortality. Factors affecting airway competence; magnitude of cough on command and abundant amount of E/T secretions are significant predictors of extubation failure in planned and unplanned extubation. Prolonged minute ventilation recovery time, failed DSA test and lower swallowing score are associated with an increased risk of failed planned extubation.

Recommendations

(1) Strategies to prevent unplanned extubation development can be achieved firstly by identifying patients at risk and then by use of effective sedation especially in agitated patients with special consideration for the method of fixation of E/T tube with the use of non traditional methods. (2) More efforts should be made to educate nurses about unplanned extubation and its consequences. (3) Extubation parameters which were reported in this study may be more important than traditional weaning parameters in predicting extubation outcome and should be applied routinely for patients before extubation. (4) Further studies should be done in a wide scale to ensure the validity of the extubation parameters in predicting extubation failure.

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