Clinical Outcomes of Failed Extubation in a Postoperative Intensive Care Unit

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Abstract

The causes and consequences of failed extubation in postoperative intensive care unit (ICU) patients were prospectively collected by clinical observation study in the surgical ICU Siriraj Hospital from 1st October 2000 to 31st March 2001. The failure rate was 1.7 per cent (9/477). Patients underwent the following types of surgery:- abdominal surgery 66.67 per cent, orthopedic 22.22 per cent, and head-neck surgery 11.11 per cent. Reasons for reintubation were respiratory failure 55.56 per cent (5/9), inadequate cough reflex 22.22 per cent (2/9), congestive heart failure 11.11 per cent (1/9), and acute myocardial infarction 11.11 per cent (1/9). The consequences of failed extubation were worse outcomes:- the average length of stay in these patients increased from 3.67 days to 9.3 days. The mortality rate was 33.33 per cent. Tracheostomy was required in 55.56 per cent. From these observations we conclude that extubation should be performed at the appropriate time for each patient. This will differ according to the patient and his/her circumstances.

Key word : Failed Extubation, Weaning, Postoperative ICU

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Postoperative patients usually require a short period of respiratory support and can be either successfully extubated in the operating theater, or weaned from the ventilator within the first or second postoperative day. However, there are some patients who develop postoperative complications or multiple organ failure during the convalescent period. Long-term ventilatory support may be required in these patients and subsequently, require a longer period of weaning from the ventilator. Postoperative respiratory

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complications in such patients depend on a number of factors, such as diaphragmatic dysfunction following laparotomy and surgery, pain, thoracotomy, and alteration in the ventilation/perfusion ratio, which may contribute to delayed weaning from mechanical ventilation (MV) and delayed extubation in surgical patients[1,2].

The effects of planned extubation failure on outcome as well as procedures for weaning from MV have been mainly investigated in medical ICU patients, a large percentage of whom have chronic obstructive pulmonary disease (COPD)[3,4]. A few reports are available in postoperative patients or burned/trauma ICU[5-7]. An increased mortality (40%) has been found in both medical and general surgical ICU patients who need reintubation.

The purpose of this self-report study was to identify the incidence, clinical outcomes in patients with failed extubation and the risk factors of reintubation after planned extubation in postoperative ICU patients who require prolonged MV.

PATIENTS AND METHOD

This descriptive prospective clinical observation study was conducted over a six-month period (1st October 2000 - 31st March 2001) in patients who were mechanically ventilated for more than 24 h in the general postoperative ICU of a university hospital (which excludes cardiac surgery, neurosurgery, pediatrics surgery, and trauma patients). Patients who required reintubation within 48 hours after planned extubation were recruited in this report.

Reintubation was performed when patients had one or more of the following criteria during the 48 h after extubation: (a); hypoxemia (SaO_2<90% or PaO_2<60 mmHg while breathing an FiO_2 0.5); (b) respiratory acidosis (pH<7.30 with $PaCO_2$>50 mmHg); (c) clinical signs of increased respiratory work (at least one of the following: recession of the suprasternal notch, retraction of the intercostal spaces, accessory muscle recruitment, paradoxical motion of the abdomen during inspiration); and (d) decreased consciousness with inability to protect the upper airway.

Data collection

Nine patients were identified as having failed planned extubation in this self-report study. During the same period, 477 patients were admitted to our ICU, ventilatory support for less than 48 h was required in 179 patients, while ventilatory support was required for more than 48 h in 98 patients. The mean APACHE II score for the ICU population was 10.24 (0-30), the average length of stay was 3.49 days, and overall mortality 5.66 per cent. The failure rate of planned extubation in our ICU was 1.70 per cent in patients ventilated less than 48 h (n=3) and 6.52 per cent in those ventilated more than 48 h (n=6). The patients' demographic data are displayed in Table 1. Male patients was 55.56 per cent. The mean APACHE II score was 15 (11-24), 66.67 per cent of the patients had undergone abdominal surgery, 22.22 per cent had elective orthopedic surgery, and 11.11 per cent underwent elective head and neck surgery before admission.

Clinical data were collected on admission: age, APACHE II score, admission type (elective or emergency admission from the surgical service; abdominal surgery, vascular surgery, orthopedic surgery, or medical), and the reason for MV. The duration of MV before and after extubation was recorded. The time of planned extubation and reintubation was recorded as a working shift; morning shift was defined as 07:01-15:00 hours, afternoon shift was 15:01-23:00 hours, and night shift was 23:01-07:00 hours.

Ventilator mode, FiO_2, and time of extubation were collected on the day of planned extubation. The arterial blood gas analysis on the day of planned extubation and before reintubation were also recorded. We also recorded follow-up time (delay of reintubation, if required, and medical reason for reintubation) and outcomes (length of stay in ICU, mortality in ICU, and requirement for tracheotomy).

Statistical analysis

Patients in whom extubation failed were compared with the total patient database. Results were analyzed descriptively and expressed as mean and median.

RESULTS

Clinical data from the patients following extubation are summarized in the Table 2. Planned extubations were mainly performed during the morning shift, however, there was one occasion when extubation was done during the night shift. Reintubations were distributed over all the shifts. The mean periods of MV support before and after reintubation were

Table 1. Demographic data of failed planned extubation patients. Characteristics at the time of admission.

Patient number	Age (years)	Sex	Admission type	Surgical service	APACHE II	Main reason for ventilation support
1	68	M	EM	Vascular	24	Respiratory failure
2	58	M	EM	Abdomen	13	Inability to cough
3	72	F	EM	Abdomen	11	Inability to cough
4	69	M	EM	Abdomen	14	Acute heart failure
5	88	F	EL	Orthopedics	12	Respiratory failure
6	66	M	EL	Abdomen	16	Respiratory failure
7	71	M	EL	Abdomen	12	Respiratory failure
8	99	F	EL	Orthopedics	13	Respiratory failure
9	61	F	EL	Head&neck	20	Acute MI

M = male, F = female, EL = elective admission, EM = emergency admission,
APACHE II = Acute Physiology and Chronic Health Evaluation, MI = myocardial infarction

Table 2. Main characteristics of the patients at the time of planned extubation and reintubation, duration of mechanical ventilation (MV) before extubation and after reintubation, delay after planned extubation until the time reintubation was performed, and the time of the shift for both extubation and reintubation.

Patient number	Planned extubation		Failed extubation and Reintubation		
	Duration of MV (days)	Extubation time (shift)	Delay before intubation (hours)	Reintubation time (shift)	Duration of MV (days)
1	6.67	M	30	M	9
2	2.54	M	21	A	6
3	1.04	M	40	N	9.63
4	1.17	M	27	M	10
5	3	M	21	M	26
6	2.15	N	0.83	N	5
7	6.63	M	22	M	10
8	7.04	M	28	A	10
9	2.75	M	7.50	A	1

M = morning shift, A = afternoon shift, N = night shift

3.67 (1.04-7.04) and 9.63 (1-26) days, respectively. The median delay before reintubation was 27.5 h (0.83-40). The major causes of reintubation were respiratory failure resulting from exhaustion (55.56%), inability to cough (22.22%), congestive heart failure and acute myocardial infarction (22.22%).

The median values of arterial blood gas analysis parameters on the day of planned extubation were; pH 7.43 (7.24-7.54), $PaCO_2$ 38 (26.2-49.9) mmHg, PaO_2 133.3 (91.1- 187.8) mmHg, and $SatO_2$ 98.7 (96.6-99.2) per cent, while before reintubation arterial blood gas parameters were; pH 7.46 (7.15-7.48), $PaCO_2$ 47.9 (32.9-64.6) mmHg, PaO_2 67.5 (47-114.7) mmHg, and $SatO_2$ 93.7 (83.3-95.5) per cent. The ventilatory mode before planned extubation were mainly synchronized intermittent mandatory ventilation (SIMV) with pressure support in 77.78 per cent and this was followed by T-piece trials. The average FiO_2 before planned extubation was 0.38 (0.3-0.5).

Table 3 shows the main clinical outcomes of the patients with failed extubation. The average length of ICU stay was 17.67 (4-46) days which was significantly longer in these patients compared to the overall patient database (3.49 days). The mortality rate was also significantly higher in this patient group (33.33%) compared to the overall database (5.66%). Tracheostomy was required in more than half of these patients. In patient number 9, an emergency tracheostomy was required because of diffi-

Table 3. Main clinical outcomes of patients with failed extubation; length of stay (LOS) in ICU (days), mortality in ICU, and requirement for tracheostomy.

Patient number	LOS (days)	Mortality	Tracheostomy requirement
1	22	No	No
2	8	Yes	Yes
3	20	No	No
4	13	No	No
5	46	No	Yes
6	8	Yes	No
7	19	No	Yes
8	19	No	Yes
9	4	Yes	Yes

cult and failed tracheal intubation. Finally after perioperative myocardial infarction, she had a cardiac arrest and cardiopulmonary resuscitation was performed immediately.

DISCUSSION

This study shows that postoperative patients are at risk of failed planned extubation, which was not dependent on the type of ICU admission. Patients who needed reintubation had a longer ICU stay, an increased mortality rate, and were more likely to require tracheostomy.

This study used an interval of 48 hours between planned extubation and reintubation as has been used previously[8-10], because patients are still vulnerable to develop complications especially of the cardiovascular system as a result of weaning failures in this dynamic period. They must reassume spontaneous breathing as well as possess adequate protective airway reflexes. However, there are some studies[11-13] which used an interval of 72 hours, or 12 hours in one report performed in cardiac surgical patients[6].

This study demonstrates the consequences of fail planned extubation on clinical outcomes. These were an increase in the overall length of ICU stay, an increase in the number tracheostomies required, and an increased mortality rate. Failed extubation increased the average length of ICU stay by approximately two weeks compared to the average overall length of ICU stay. It has been shown that failed extubation patients are more likely to be discharged to the long-term respiratory care facilities[12]. The rate of tracheostomy was more than 50 per cent which is much higher than in a recent report[14]. This patient group also showed an increased mortality rate (33.3%) which was nearly 6-times the overall mortality for our ICU population. However, it was not different from outcomes reported in previous studies[5,6,12,13]. An increased risk of nosocomial pneumonia after reintubation has been reported in previous studies[14].

SIMV with pressure support was the most common mode used before planned extubation in this study which is different from the Assisted/Control (AC) mode in a recent retrospective report performed in surgical ICU patients[14]. They demonstrated that the AC mode was an independent risk factor of reintubation. While spontaneous breathing trials with a T piece for 2 hours are commonly used in most investigations examining weaning from ventilatory support in ICU patients, however, the duration of T piece trial can be reduced to half an hour without producing different clinical outcomes[9]. Bultler et al have shown that weaning from ventilatory support in difficult to wean patients is not dependent on the mode used during the weaning period. Therefore, the screening process to select patients who can tolerate spontaneous breathing is far more important[15].

This study has limitations. The main limitation is the study design. It was a clinical observation study which meant that only a handful of patients were included. Initially we had considered a case-control study. However, matching was difficult to achieve as there were not many patients who required long-term ventilatory support in our postoperative ICU, and it was difficult to know what criteria should

be used for patient selection. Therefore, we decided to focus the incidence when failed planned extubation occurred. The rate of extubation failure in our study was 6.52 per cent in patients in whom more than 48 hours ventilatory support was required which was comparable to cardiac surgical ICU patients (6.6%), and in trauma ICU patients (7%), but higher than studies of surgical ICU patients (4.4%) and in burned ICU patients (3%)[5-7].

Diaphragmatic dysfunction after abdominal surgery may play an important role in postoperative course for ventilatory mechanics, and so is the contribution of rib cage and abdominal movement to ventilation[16]. However, diaphragmatic fatigue alone cannot explain why weaning failures happened in our orthopedic and head & neck patients, when laparotomy was not needed.

In conclusion, in postoperative patients there is a risk of failed planned extubation which is not dependent on type of ICU admission or surgical procedure. The ventilatory mode chosen during the weaning from mechanical ventilation may not be as important as the selection criteria for appropriate patients. If failed extubation occurs, it may have an impact on the length of ICU stay, mortality, and requirement for tracheostomy especially when resources are limited. Further prospective randomized studies are needed to investigate the role of the ventilatory mode on the weaning process of postoperative patients and its outcomes.

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ผลการดำเนินโรคระยะสั้นของผู้ป่วยที่ไม่ประสบความสำเร็จในการถอดท่อหายใจในหออภิบาลศัลยกรรม

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ภูมิหลัง : ผู้ป่วยที่ไม่ประสบความสำเร็จในการถอดท่อหายใจ ภายหลังการวางแผนล่วงหน้าเพื่อยุติการช่วยหายใจและถอดท่อหายใจ แต่ต้องการใส่ท่อหายใจกลับเข้าไปใหม่ภายหลังการถอดท่อหายใจนั้น มีผลแทรกซ้อนได้สูง

วัตถุประสงค์ : เพื่อที่จะศึกษาผลการดำเนินโรคระยะสั้นในผู้ป่วยที่ไม่ประสบความสำเร็จในการถอดท่อหายใจภายหลังการวางแผนล่วงหน้า ในหออภิบาลศัลยกรรม

วิธีการ : เลือกผู้ป่วยศัลยกรรมที่ใช้เครื่องช่วยหายใจมากกว่า 24 ชั่วโมงในหออภิบาลที่ประสบปัญหาถอดท่อหายใจแล้วไม่สามารถหายใจได้เพียงพอและต้องใส่ท่อหายใจกลับเข้าไปใหม่ภายใน 48 ชั่วโมงหลังถอดท่อหายใจ ข้อมูลพื้นฐานผู้ป่วย ลักษณะของการรับไว้ในหออภิบาล ระยะเวลาในการใช้เครื่องช่วยหายใจ ระยะเวลาในการครองเตียงในหออภิบาล เวลาที่ผู้ป่วยต้องได้รับการใส่ท่อหายใจกลับเข้าไปใหม่ และอัตราการเจาะคอผู้ป่วย ได้รับการบันทึกและวิเคราะห์ ในระยะเวลาศึกษา 6 เดือน

ผลการศึกษา : ตั้งแต่ตุลาคม 2543 ถึง มีนาคม 2544 มีผู้ป่วย 9 รายที่ต้องใส่ท่อหายใจกลับเข้าไปใหม่ภายใน 48 ชั่วโมง หลังการวางแผนถอดท่อหายใจ ผู้ป่วย 4 รายรับไว้ในหออภิบาลภายหลังการผ่าตัดฉุกเฉิน ระยะเวลาเฉลี่ยในการใช้เครื่องช่วยหายใจก่อนถอดท่อหายใจ 3.67 วัน และหลังการใส่ท่อหายใจใหม่ 9.63 วัน ผู้ป่วย 5 รายได้รับการเจาะคอและมีอัตราตายร้อยละ 33.33

บทสรุป : ผู้ป่วยที่ต้องได้รับการใส่ท่อหายใจกลับเข้าไปใหม่ ภายหลังการวางแผนถอดท่อหายใจนั้นมีผลแทรกซ้อนสูง และควรดูแลผู้ป่วยที่เคยใช้เครื่องช่วยหายใจหลายวันอย่างใกล้ชิด เมื่อเริ่มขบวนการยุติการใช้เครื่องช่วยหายใจ

คำสำคัญ : ถอดท่อหายใจไม่สำเร็จ, ลดการช่วยหายใจ, หออภิบาลศัลยกรรม

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