

Measurement of endotracheal tube cuff pressure in patients admitted to intensive care unit of a University Hospital

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Abstract

This audit was conducted in a University Hospital in United Kingdom to determine whether tracheal tube cuffs were correctly inflated and to assess whether the cuff pressure was recorded routinely by the nursing staff in the ICU. 62.5% were within the recommended cuff pressure level. Of all the ICU recordings only 72% had recorded the cuff pressure according to the local protocol. Measurement and recording can be improved by adhering to the local protocol.

Keywords: endotracheal tube, cuff pressure

Introduction

Excessive tracheal tube cuff pressure can cause mucosal ischaemia leading to tracheal stenosis or trachea-oesophageal fistulae and under-inflation of the cuff has been associated with an increased risk of ventilator-associated pneumonia. High-volume low-pressure cuffs (HVLP) were introduced in the early 1970s to enable tracheal wall pressure control. The use of a HVLP cuff does not however guarantee an acceptable mucosal pressure unless the intra-cuff pressure (CP) is maintained lower than 30 cmH₂O. CP should be measured regularly in the intensive care unit (ICU) at Princess Royal University Hospital (PRUH) and knowing the importance of maintaining the cuff pressure within acceptable limits a protocol has been introduced. This prospective audit examines the CP measurement and recording in PRUH ICU.

Objectives

General objective

1. To measure the tracheal tube cuff pressure in patients admitted to intensive care unit with the view to determining the percentage of cuffs inflated to the correct pressure.

Proposed standard or target for Best Practice

- 100% cuff pressures should be measured and documented at the start of each nursing shift.
- 100% cuffs should be correctly inflated.

The correct pressure is the minimum pressure required to prevent a leak.

Specific objective

2. To determine the associated factors of tracheal tube cuff pressure.

Methodology

Prospective descriptive study was on patients admitted to intensive care unit in Princess Royal university hospital, Bromley, UK. The sources of admission were medical wards, surgical wards, accident and emergency department and operating theatres. All intubated adult patients in the intensive care unit within the period of study were included. Patients less than 16 years and patients with airway deformities were excluded. The auditor visited the ICU without warning for 30 days during the period from 01/05/2012 to 15/06/2012. The endotracheal tube cuff pressure was measured using an analogue manometer and compared with the recommended level.

At the same time the two nearest values of recorded pressure and the method of recording in the ICU chart by the nursing staff at the beginning of the shift were noted.

The ventilator settings, size of the tube and peak airway pressure were noted and recorded in a data sheet which was based on the local guidelines for the measurement of tracheal cuff pressure. Data analysis was done by using the SPSS package. Univariate and multivariate statistical procedures were done to assess the relevant associations and effects of independent variables with dependent variables.

Results

Table 1: Measured cuff pressure

	cuff pressure cmH ₂ O
Number	64
Mean	26.00
Standard Deviation	7.850
Lowest	10
Highest	60

During this period of 30 days 64 ET tube cuff pressures were measured. The mean cuff pressure was 26.00cmH₂O with a standard deviation of 7.850. The lowest measured pressure was 10cmH₂O and the highest was 60cmH₂O.

Table 2: Measured cuff pressure distribution

cuff pressure(cmH ₂ O)	Number	Percentage
<20	11	17.18%
20-30	40	62.5%
>30	13	20.31%

Of the measured cuff pressures only 62.5% had pressures within the recommended level (20-30cmH₂O). 20.31% had cuff pressures of >30 cmH₂O while 17.18% had cuff pressures of <20 cmH₂O. During this period, 116 cuff pressure recordings were done in the ICU charts by the nurses. Immediate two values before auditor's measurements were checked for the correct recording according to the local protocol.

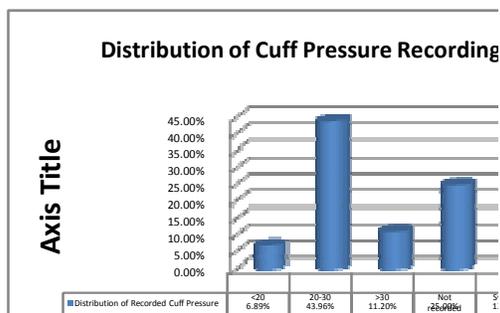


Figure 1: Distribution of cuff pressure recordings

Table 3: Summary of correct vs. incorrect recording of cuff pressure (n=116)

N=116	Number	Percentage
Correct (All numerically recorded)	72	62.06%
Incorrect (Symbol + Not recorded)	44	37.93%

Of all the ICU recordings only 72(62.06%) had recorded correctly according to the local protocol while others had recorded it incorrectly by using a symbol or not recorded at all.

At time of endotracheal cuff pressure measurement 24 patients were on BILEVEL mode, 18 were on BIPAP, 10 were on CPAP and 6 were on PSV while 5 patients were on spontaneous mode.

The distributions of peak airway pressure and cuff pressure of BILEVEL group were analysed.

Table 4: Distribution of peak airway pressure and cuff pressure in BILEVEL group

	Number	Mean	SD	Range(cmH ₂ O)	P
Peak Pressure	24	23	5.5	12-32	=0.715
Cuff Pressure	24	25.6	8.4	10-60	

In the BILEVEL group mean peak airway pressure was 23cmH₂O with standard deviation (SD) of 5.5. In the same group mean cuff pressure was 25.6 cmH₂O with SD of 8.4. Calculated P value was 0.715, so there is no significant association between peak airway pressure and cuff pressure (P>0.05).

In the study group (n=64) mean cuff pressure was 26.00cmH₂O with the SD of 7.85.

Table 5: Distribution of tube sizes

Tube size	Number	Percentage
7.0mm	11	17.18%
7.5mm	13	20.31%
8.0mm	32	50%
8.5mm	8	12.5%

Table 6: Correlation between tube size and cuff pressure

		Tube size	Cuff pressure cmH ₂ O
Tube size	Pearson Correlation	1	.250*
	Sig. (2-tailed)		.046
	N	64	64
Cuff pressure cmH ₂ O	Pearson Correlation	.250*	1
	Sig. (2-tailed)	.046	
	N	64	64

Correlation between tube size and cuff pressure is significant at the 0.05 level (2-tailed) but not significant at 0.001 level (P=0.046).

Discussion

An audit done by Pervez Sultan et al¹ reveals that the pressure of the cuff against the tracheal wall depends on the compliance of the trachea and cuff. Pressure measured at the pilot balloon

of an ET tube cuff can be considered a good estimate of the pressure exerted onto the tracheal mucosa by the cuff. Sengupta et al² and Hoffman et al³ described a linear relationship between the measured cuff pressure and the volume of air inserted into the cuff. Hoffman et al described this relationship with a 97% linear correlation.

Godoy et al (2008)¹ reveals that the pressure inside the ET tube cuff is influenced by the patient position. Brimacombe et al (1999) correlated it to the head position.

A study of 85 endotracheally intubated patients in intensive care unit and post anaesthesia care unit found that patients in these areas typically had excessively high ET tube cuff pressures. 55% of ICU patients had reported pressures >40cmH₂O⁴. Our audit showed that the overall compliance on the protocol is far behind the expected levels and need immediate improvement. Although the mean cuff pressure was 26cmH₂O, 20.23% had overinflated cuff pressures exposing the patients to mucosal injury.

Only 62.5% had maintained cuff pressure within recommended level of 20-30cmH₂O. 25% of cuff pressures were not measured and 37.93% were not documented properly at the beginning of a nursing shift.

Wujtewicz et al⁵ describes an audit done on 107 ITU patients monitoring tracheal tube cuff pressure which reveals that over inflation is more frequent than under inflation in their study group. In our group over inflation was marginally more than under inflation.

An audit done in Department of Anaesthesia, The Queen Elizabeth Hospital, King's Lynn, UK⁶ showed that the mean cuff pressure in the study group was 62 cmH₂O and 20% cuff pressures were above 100 cmH₂O. The highest recorded in our audit was 60cm H₂O.

Study shows no significant relationship between tracheal cuff pressure and peak airway pressure (P>0.05). But shows a significant relationship between tube size and cuff pressure (P<0.05). This needs to be confirmed with an analytical study.

Recommendations

Possible strategies for improvement are Education of doctors and nurses on cuff pressure management and the sequelae of over or under inflation.

Emphasise the importance of correct recording of cuff pressure.

More frequent manometric assessment by trained staff, since cuff pressures change and tubes are adjusted throughout the day.

Separate study to confirm the relationship between tracheal tube cuff pressure, peak airway pressure and size of the tube.

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