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## Cuff pressure control in intensive care unit: training effects

*Controle da pressão do cuff na unidade terapia intensiva: efeitos do treinamento*

### ABSTRACT

**Objectives:** Direct cuff pressure to the tracheal wall can cause damage. This paper aimed to verify the effectiveness of nursing team training on cuff pressure control.

**Methods:** A retrospective survey was initially made on the records of cuff pressure measurements from January 2007 to June 2008 and the inadequacy percent was verified. Next, a nursing team training program was provided involving all nursing shift teams during June 2008, and after the training the appropriate cuff pressures proportion was prospectively recorded between June and December 2008. The proportion of inappropriate cuff pressure was compared between the work shifts (morning, afternoon and evening-night) and between pre- and post-training, using the qualitative Chi-square test. The

5% limit ( $p < 0.05$ ) was considered for significant differences.

**Results:** For the pre-training period, inappropriate cuff pressure measures (over 30cmH<sub>2</sub>O) during morning, afternoon and evening-night shifts were 9.2, 11.9 and 13.7, respectively. For the post-training phase, 7.6, 4.1% and 5.2 inappropriate cuff-pressures were identified for the morning, afternoon and evening-night shifts, respectively, with a significant reduction for the afternoon and evening-night shifts, respectively ( $p < 0.001$ ).

**Conclusion:** Nursing team training was effective for inadequate cuff pressure harms awareness improvement, and resulted in safer pressure levels.

**Keywords:** Blood pressure determination/methods; Intubation, intratracheal; Tracheostomy; Inservice training; Nursing, team

### INTRODUCTION

Given the growing relevance of specialized physiotherapists in intensive care units (ICUs), these professionals are progressively required to have appropriate knowledge to supply these units needs.<sup>(1)</sup> The intensive care team should understand the specific pulmonary care required for each individual patient, and work as a team to establish realistic targets.<sup>(2)</sup>

Invasive ventilation patients, with impaired respiratory function, are common in ICUs<sup>(3)</sup> and this therapy is mainly aimed to keep appropriate pulmonary ventilation<sup>(3-5)</sup> using either an artificial tracheal prosthesis (more commonly endotracheal tubes) or tracheostomy cannulas.<sup>(4)</sup> These prosthesis have a distal small balloon, also called cuff, aimed to seal the airways in order to prevent air leakage to keep appropriate ventilation<sup>(4)</sup> and to reduce aspiration likelihood.

The cuff pressure is directly transmitted to the mucosa. In order to prevent tracheal mucosa injuries, the pressure transmitted to the tracheal wall should be controlled. The blood perfusion pressure is between 24-35 mmHg, or between 20-30 cmH<sub>2</sub>O. These values are considered safe to prevent ischemic injuries and other important early tracheal mucosa changes, such as cell edema, loss of cilia and epithelium desquamation, which may be triggered by cuff hyperinflation.<sup>(6)</sup> Laryngeal and tracheal stenosis after intubation ranges between 1.5% and 19%.<sup>(7)</sup>

For some authors<sup>(8)</sup> the form to prevent or minimize future injuries is to inflate the cuff with the minimal effective pressure, just enough to seal the trachea and prevent air leakage during ventilation, without surpassing 25 cmH<sub>2</sub>O, the threshold value for tracheal mucosa perfusion. It should be kept in mind that the insufficient cuff pressure that fails to seal the airways increases the risk of oropharyngeal secretions aspiration and consequent pulmonary infections.

It was shown in several studies that cuff hyperinflation may be reduced by professionals involved in the care of severely ill patients training and awareness.<sup>(3,9,10)</sup> This study aimed to verify the effectiveness of training a nursing team on cuff pressure control.

## METHODS

A retrospective survey was carried on the adult ICU of the Hospital Geral de Itapeverica da Serra (HGIS) records for the proportion of inappropriate cuff pressure values identification from January 2007 to June 2008. In this ICU, daily measurement of the cuff pressure is an established routine since 2006. This measurement is made using the VBM CE0123 manual device (cuffometer), which measures values from 0 to 120 cmH<sub>2</sub>O.

The values were collected by each shift start (morning, afternoon and evening-night) and adjusted to 25 cmH<sub>2</sub>O for endotracheal tubes and 30 cmH<sub>2</sub>O for tracheostomy cannulas, in order to prevent leakage. The pressure was considered inappropriate when surpassed 30 cmH<sub>2</sub>O, and the need of the prosthesis reposition or change was evaluated.

Later, a training program was provided by the end of the first semester 2008 for the three work shifts, focused on the nursing teams training. This was a bedside training (both theoretical and practical) delivered by the unit's physiotherapist, lasting 30 minutes and using a PowerPoint presentation as support for clari-

fication of the risks of both low pressure (aspiration) and high pressure (stenosis, tracheomalacia and tracheal-esophageal fistula); the cuff pressure measurement procedure and its relevance; cuffometer handling and orotracheal and tracheostomy tubes positioning.

The training was conducted in a single day, training the entire team (evening-night A and morning, afternoon and evening-night B), and the next day evaluations were already considered as post-training measurements.

All data were entered to the PASW Statistics (SPSS) 16.0 software, calculating the measurements inadequacy percents. The cuff pressure inadequacy percent was compared between the shifts (morning, afternoon, evening-night) and pre- versus post-training for each shift using the qualitative Chi-square test, being a p value < 0.05 considered significant.

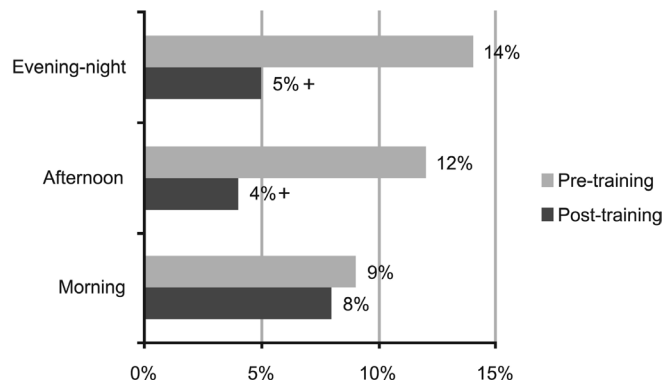
## RESULTS

Were checked 10,473 measurements in 434 patients with endotracheal prosthesis or tracheostomy cannula, averaging 27.4 patients/month. The patients' age ranged from 14 to 95 years, mean 55.44 ± 18.82 years; 186 were female and 248 male. The main diagnoses were septic shock in 36% and polytrauma in 10%. A total of 432 patients had their prosthesis connected to mechanic ventilation; only two tracheostomy patients did not require mechanic ventilation.

During the pre-training phase were evaluated 5,747 cuff pressure measurements (2007 plus first half of 2008), 4,668 in patients with orotracheal intubation and 1,079 in tracheostomy patients. Inappropriate cuff pressure (above 30 cmH<sub>2</sub>O) were identified for the morning, afternoon and evening-night shifts in 9.2%, 11.9% and 13.7% of the measurements, respectively (Figure 1), being the differences significant between the morning and afternoon shifts (p<0.05) and between the morning and evening-night shifts (p<0.001). No differences were identified for the afternoon and evening-night shifts.

Were evaluated 4,706 post-training cuff pressures (second half of 2008, from which 3,227 were in orotracheal intubation patients, and 1,479 in tracheostomy patients). Inappropriate cuff pressures (above 30 cmH<sub>2</sub>O) were 7.6%, 4.1% and 5.2% for the morning, afternoon and evening-night shifts, respectively, with significant differences identified for the morning and afternoon shifts (p<0.001) and between the morning and evening-night shifts (p<0.05). For the

afternoon and evening-night shifts no significant difference was identified. (Figure 1).



(+)  $p < 0.001$ .

**Figure 1 – Percent comparison of pre- and post-training inappropriate cuff pressure measurements.**

## DISCUSSION

In our study, in the post-training period a significant reduction of inappropriate cuff pressures was seen for the afternoon and evening-night shifts. However, this improvement was not seen for the morning shift's pre- and post-training values. When the periods were compared, better appropriateness proportion was seen after training for the afternoon and evening/night work shifts, but not for the morning shift. This finding coincides with a previously published study results. Camargo et al.<sup>(4)</sup> evaluated 72 intensive care unit patients measuring the cuff pressures in the morning, afternoon and evening-night shifts. Significant differences were seen for the morning and afternoon shifts ( $p < 0.001$ ) and morning and evening-night shift ( $p < 0.001$ ); yet, for the afternoon and evening-night shifts, no significant differences were identified. In the morning shift the adequacy percent was already higher versus the other shifts, and thus the training had a lesser impact versus the other work shifts. It should be stressed that the morning measurements reflected the night shift. We identified that this team's professionals have been long working in the institution, showing less acceptance for the training proposed changes.

The findings analyzed show the relevance of the cuff pressure measurement in the morning and night shifts, confirming the Brazilian Mechanic Ventilation Consensus recommendations suggesting every 12 hours measurements. The multidisciplinary team training has been shown effective to improve both the

cuff pressure management and awareness, as shown by Chan et al.<sup>(10)</sup> These authors trained 98 nurses and anesthesiologist physicians; initially they were requested to inflate the cuff using a syringe (the usually used technique). Next, the cuff pressure was evaluated using a cuffometer and then the trainees were asked to feel the pilot balloon with the cuffometer-regulated pressure at 25 cmH<sub>2</sub>O. Then a new syringe inflation maneuver was made until the pressure judged appropriate by the professional, and then its adequacy checked using the cuffometer. This was performed immediately following the training, and one week and one month later. Initially 32.7% of inadequacy was identified, with significant drops either immediately, 1 week or 1 month after the training.

Juliano et al.<sup>(3)</sup> performed in 2007 cuff pressures measurements follow-up and identified average inappropriate measures in 80% of the cases. After training, there was a 20% reduction in the inadequacies. In this study were compared the cuff pressure measurements between the morning and afternoon shifts, with a significant inter-shifts difference. From this findings, cuff pressure measurement during the evening-night shift was implemented as a prophylactic measure. Our study agrees with their findings, as a significant post-training reduction in inadequacies was seen for the afternoon and evening-night shifts, and thus the afternoon shift was excluded of the cuff pressures measurements.

## CONCLUSION

The nursing team training was shown effective for inappropriate cuff pressure dangers awareness, leading to safer levels. A routine was implemented with cuff pressure measurement only performed in the morning and evening-night shifts, with half-yearly nursing team training cycles.

## RESUMO

**Objetivos:** A pressão do *cuff* é transmitida de forma direta na parede da traquéia e isto pode ocasionar lesões. O objetivo deste trabalho foi verificar a eficácia de um treinamento com a equipe de enfermagem no controle da pressão do *cuff*.

**Métodos:** Foi realizado um levantamento retrospectivo das mensurações da pressão de *cuff* de janeiro de 2007 a junho de 2008, verificando-se o percentual de inadequação. Posteriormente, foi elaborado um programa de treinamento da equipe de enferma-

gem durante o mês de Junho 2008 em todos os três turnos de trabalho. Após o encerramento dessa fase de treinamento, o percentual de adequação na pressão de *cuff* foi verificado prospectivamente durante os meses de Julho a Dezembro. Foi comparado o percentual de inadequação da pressão do *cuff* entre os turnos de trabalho (matutino, vespertino e noturno) e entre os períodos pré-treinamento e pós-treinamento pelo teste qualitativo de qui-quadrado, considerando-se como significativa diferença acima de 5% ( $p < 0,05$ ).

**Resultados:** No período pré-treinamento as medidas inadequadas das pressões do *cuff* (acima de 30cmH<sub>2</sub>O) nos períodos matutino, vespertino e noturno foram respectivamente 9,2; 11,9 e 13,7%.

Após o treinamento foi verificada inadequação de 7,6; 4,1 e 5,2%, nos mesmos períodos, observando-se diminuição significativa no tocante aos períodos vespertino e noturno pré e pós ( $p < 0,001$ ).

**Conclusão:** O treinamento realizado com a equipe de enfermagem demonstrou-se efetivo na conscientização dos malefícios da pressão do *cuff* inadequada, acarretando na utilização de níveis de pressão mais seguros nos pacientes.

**Descritores:** Determinação da pressão arterial/métodos; Intubação intratraqueal; Traqueostomia; Capacitação em serviço; Equipe de enfermagem

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