

Semi-recumbent Position in ICU

Thomas ST Li, Gavin M. Joynt, Hing Y. So, Charles D. Gomersall, Florence HY Yap

Abstract

Purpose: Positioning mechanically ventilated patients in an adequate semi-recumbent position is a low cost and apparently easy applied measure to prevent new VAP. We performed an unannounced audit to compare the actual backrest angle with the target backrest angle of 30-45 degrees, assess whether compliance was better in patients whose bed had a built-in bedside protractor, and document difficulties reported when failing to achieve the target backrest angle.

Methods: From 1/3/2007 to 30/6/2007, unannounced ad hoc inspections were made on patients receiving mechanical ventilation in the intensive care unit. During inspections, the angle of elevation of bed was formally measured by a manual technique using a hand-held protractor. The nurse at bed-side was also asked to estimate the angle of elevation of bed without referring to the built-in protractor and interviewed with a structured questionnaire.

Results: From 1/3/2007 to 30/6/2007, inspections were made on 295 occasions. The median angle of

backrest elevation was 25 degrees (interquartile range [IQR]: 20 to 30 degrees). The median angle of elevation estimated by the nurse at the bed-side was 30 (IQR: 20 to 30 degrees), ($p < 0.001$). Semi-recumbent positions meeting the 30 degree minimum target angle were observed on only 120 (41%) occasions. Reasons provided for failing to achieve the target angle included incorrect estimation of the backrest angle and interference of the semi-recumbent position with nursing procedures and nursing inconvenience.

Conclusions: This audit showed that the minimum target semi-recumbent position of 30 degrees was achieved only 40% of the time in an academic intensive care unit. Nurses at bedside consistently overestimated the angle of elevation of bed, and the presence of a built-in bedside protractor was not associated with a greater compliance with the target backrest elevation angle. Strictly enforced protocols, education programs for nurses and doctors and regular audit may improve compliance with backrest elevation targets.

Key words: “mechanical ventilation”, aspiration, “ventilator-associated pneumonia”, education, protocol.

From the Department of Anaesthesia and Intensive Care, The Chinese University of Hong Kong, Prince of Wales Hospital, Shatin, Hong Kong (Drs. Li Thomas Sing Tao, Gavin Matthew Joynt, So Hing Yu, Charles David Gomersall, Yap Florence Hiu Yi)

Address for correspondence:

Gavin M Joynt, MBBCh, FJFICM
Department of Anaesthesia and Intensive Care
The Chinese University of Hong Kong
Prince of Wales Hospital
Shatin, Hong Kong
Fax: 852 2637 2422
Email: gavinmjoynt@cuhk.edu.hk

Introduction

Ventilator-associated pneumonia (VAP) is a common complication occurring in patients in intensive care units. Positioning mechanically ventilated patients in an adequate semi-recumbent position is a low cost and apparently easy applied measure to prevent new VAP. Randomised controlled trials have demonstrated that, compared with supine position, mechanically ventilated patients positioned in the

semi-recumbent position have a lower incidence of VAP [1,2]. Currently, several expert commentaries and international consensus guidelines recommend that the semi-recumbent position be adopted in mechanically ventilated patients to reduce the incidence of VAP [3-6]. Surveys have indicated that since the year 2000, the utilization of semi-recumbent position appears to be increasing, with a compliance rate of 93% reported by respondents of a recent Spanish survey [7-9]. Nevertheless, there are relatively little data reporting the degree of compliance with guidelines to maintain patients in an adequate semi-recumbent position and a recent available randomized trial suggested that the targeted semi-recumbent angle is difficult to achieve [10]. Our intensive care unit (ICU) has a standing order to target a semi-recumbent position with a backrest angle of 30-45 degrees. To increase the likelihood of compliance, ICU beds have been progressively fitted with built-in protractors to facilitate compliance. We performed an audit to compare the actual backrest angle with the target backrest angle of 30-45 degrees, assess whether compliance was better in patients whose bed had a built-in protractor, and document difficulties reported when failing to achieve the target backrest angle.

Methods

The Prince of Wales Hospital ICU is a 22 bed, mixed medical and surgical unit of a large teaching hospital. The medical staffing consists of six specialist intensivists, three intensive care trainees, and several junior trainees from other clinical departments. Nurse staffing consists of one nurse per bed during the day and eighteen nurses for 22 beds at night. There are approximately 1400 admissions per year, the average admission APACHE II score is 16.8 and standardized mortality ratio (SMR) based on APACHE II is 0.62. Since 2001 there has been a standing order to nurse all patients in the 30-45 degree head up position unless there are specific physician orders to the contrary. There is no protocol as to how this goal is to be achieved, however recently purchased beds are all fitted with a built-in protractor to facilitate compliance. At the time of the audit approximately 80% of the beds in our intensive care unit had built-in protractors.

From 1/3/2007 to 30/6/2007, unannounced ad hoc inspections were made on patients receiving mechanical ventilation in the intensive care unit. The target semi-recumbent position was defined as elevation of head of bed at least 30 degrees above horizontal. During inspections, the angle of elevation of bed was formally measured by a manual technique using a hand-held protractor. The nurse at bed-side was also asked to estimate the angle of elevation of bed without referring to the built-in protractor and the angle displayed on the built-in protractor was documented by the audit officer during inspection. At the time of the inspection, if the patient was not found to be in semi-recumbent position, the nurse at bed-side was interviewed with a structured questionnaire. The nurse was also given the opportunity to freely express her opinion regarding reasons for the observed patient position. All inspections and measurements were performed by a single audit officer to ensure consistency.

Statistics

All analyses were performed with the use of SPSS version 14.0 software. Comparisons between measured and estimated angle of elevation and the differences in measured angle of elevation in different patient groups were evaluated using the Mann-Whitney U test. All tests of significance were two-tailed. Statistical significance was defined as $p \leq 0.05$.

Results

During the 4-month period of audit, from 1/3/2007 to 30/6/2007, inspections were made on 295 occasions for patients receiving mechanical ventilation in the intensive care unit. The median angle of backrest elevation of all the patients measured by hand-held protractor was 25 degrees (interquartile range [IQR]: 20 to 30 degrees). The median angle of elevation estimated by the nurse at the bed-side was 30 (IQR: 20 to 30 degrees). There was a statistically significant difference between measured and estimated angles ($p < 0.001$). Semi-recumbent backrest positions meeting the 30 degree minimum angle were observed on only 120 (41%) occasions.

On 230 (78%) occasions, patients were in beds fitted

with a built-in protractor. There was no significant difference in the measured angle of elevation with or without built-in protractor in patient's bed. The majority of observations 185 (63%) were made when patients were receiving enteral feeding. Although there was a trend towards a higher bed elevation in patients receiving enteral feeding, this difference did not reach statistical significance ($p=0.13$).

The frequency distribution of all observations is shown in **Figure 1**. The median angles of elevation measured by hand-held protractor in various patient groups are shown in **Table 1**. The main reasons provided by nurses for not achieving the ideal semi-recumbent position are shown in **Table 2**.

Discussion

This audit showed that the minimum target semi-recumbent position of 30 degrees was achieved only 40% of the time in our intensive care unit. Nurses at bedside consistently overestimated the angle of elevation of bed, and the presence of a built-in bedside protractor was not associated with a greater compliance with the target elevation angle. The presence of enteral feeding was also not significantly associated with an improved angle of bed elevation.

While the results of this unannounced audit are disappointing, they are not dissimilar to reported results from a recent randomized controlled trial of backrest elevation. In this study, the target backrest angle was 45 degrees, however, despite regular reminders from dedicated research nurses and labels at bedside, in the target semi-recumbent position could only be achieved 15% of the time [10]. The median angle of elevation achieved in our audit (25 degrees) was similar to that achieved in the intervention group of this study (28.1 and 22.6 degrees at day one and seven respectively). Although the control group was not supine, but inclined at 10 degrees or more, it is interesting to note that in contrast to a previous randomized controlled trial [2], this study did not show a difference in VAP rates between the intervention and control groups.

It appears surprising that despite documented guidelines, an apparently simple manoeuvre like

a target semi-recumbent position is so difficult to achieve. There are however, several reasons that may explain this finding. Our nurses reported that the angle of elevation was often not achieved because of need for nursing procedures, perceived patient discomfort and technical reasons, such as concern regarding the use of femoral intravascular catheters. While there may be legitimate indications for the supine position, such as acute lumbar spinal injury or hypovolaemia in the acute phase, none of the reasons provided during the audit were considered medically justified by the audit officer and medical supervisor and this suggests that perceived nursing inconvenience is an important impediment to correct positioning. Nurse inconvenience has also been reported by others as being responsible for a failure to implement the semi-recumbent position [7], and this suggests that providing, or improving, explicit and detailed nurse education may have an impact on compliance.

Other barriers to achieving an appropriate head up position have also been identified. In a two recent studies it was reported that doctors tended to think that backrest position was the result of the preference of nurses whereas nurses tended to think that doctors were responsible for determining the patient's position [7,11]. Other reported barriers include risk of decubitus ulcers, perceived haemodynamic instability, fear of the patient falling out of bed and a lack of beds suitable for facilitating the head up position [7,11]. A number of nurses could not provide any specific reason for not being able to maintain their backrests in semi-recumbent position. This might reflect lack of awareness of importance of semi-recumbent position for prevention of VAP and again stresses the probable need for educational intervention.

Another potential reason for the failure to achieve an adequate backrest position is that the angle of elevation was frequently overestimated by nurses at bedside. Two previous studies have also reported that angle of elevation was often overestimated by nurses and doctors in absence of proper measuring tool [12,13]. It is interesting that, in our audit, the target semi-recumbent position was not achieved more frequently even when there was built-in protractor in patient's

bed. This finding is difficult to explain, but might reflect that our nurses were either not sufficiently aware of the importance of meeting the target backrest position or were unaware of the importance of use of objective measuring tool to ensure proper semi-recumbent position. To facilitate accurate measurement a recent study proposed the use of a novel device for the continuous electronic measurement of angle of backrest elevation [14].

The results of our audit also suggest that a standing order without a strict and supervised protocol for implementation does not ensure compliance with a target semi-recumbent position. A recent study showed that addition of standardized order for nurse to put patient in semi-recumbent position in computerized clinical information record system, requirement of the nurse to acknowledge the order electronically every 6 hours, and a nurse and doctor education program improved backrest angle compliance [15].

It should be noted that there is some debate about the best angle of backrest elevation to prevent VAP. While some degree of elevation from zero degrees is almost certainly required, the minimum elevation required to prevent VAP is uncertain. Although it is possible that a smaller angle is sufficient, currently a target of 30-45 degrees appears reasonable and in keeping with expert recommendations [4-6]. The frequency distribution

of our observations suggests that we did not meet the minimum recommended backrest angle of 30 degrees in the majority of our patients (**Figure 1**).

Given the worrisome results of this audit and the results of other studies, how can we improve the rate of compliance with a target semi-recumbent position? It appears that simple measures such as standing orders and even the provision of built-in bedside protractors are not sufficiently effective, and therefore it is likely that a multi-dimensional program including education, protocol, audit and feedback is needed. This might include regular educational seminars that should be provided for nurses and doctors stressing the importance of achieving the target semi-recumbent position to maximize the prevention of ventilator-associated pneumonia. Formal protocols to guide the process of achieving target elevations should include the requirement to regularly use a measurement device such as a protractor for measuring angle of elevation. Regular documentation of angle of elevation on charts and need for handover the angle of elevation achieved during change of shifts should be enforced. Computerized clinical information systems may help in this situation. Audit in the form of unannounced inspections and feedback to individual health-care workers who fail to comply with protocols may also be important.

Figure 1. THE FREQUENCY DISTRIBUTION OF ALL OBSERVATIONS OF BACKREST ANGLE

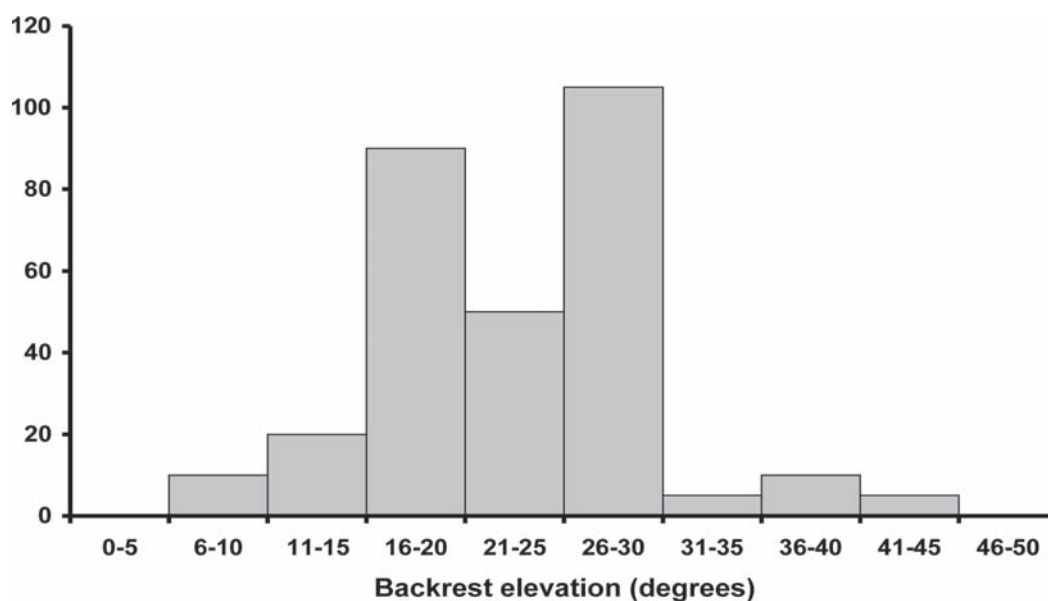


Table 1. ANGLE OF BACKREST ELEVATION IN DIFFERENT PATIENT GROUPS

	Number of observations	Median of angle of elevation (Interquartile range)	Range of angle of elevation	P value
All	295	25° (20°-30°)	10°-44°	
Observations with protractor present	230	25° (20°-30°)	10°-44°	0.338
Observations with protractor absent	65	25° (20°-30°)	20°-30°	
Observations on patients receiving enteral feeding	185	25° (20°-30°)	10°-44°	0.130
Observations on patients not receiving enteral feeding	110	25° (20°-30°)	10°-30°	

Table 2. NURSES' EXPLANATIONS FOR NOT ACHIEVING AN ADEQUATE BACKREST ANGLE

Main reasons	Number
Incorrect estimation of angle of elevation	46 (26%)
Inconvenient because of need for nursing procedures	25 (14%)
No specific reason given	25 (14%)
Nurses perceived that patients were uncomfortable in semi-recumbent position	19 (11%)
Nurses believed that inserting pillows was adequate to achieve "semi-recumbent" positions	16 (9%)
Position contra-indicated because of use of femoral intravascular catheter	11 (6%)

References

1. Combes A (2006) Backrest elevation for the prevention of ventilator-associated pneumonia: Back to the real world? *Crit Care Med* 34:559-561
2. Drakulovic MB, Torres A, Bauer TT, Nicolas JM, Nogue S, Ferrer M (1999) Supine body position as a risk factor for nosocomial pneumonia in mechanically ventilated patients: a randomized trial. *Lancet* 354:1851-1858
3. Kollef MH (2004) Prevention of hospital associated pneumonia and ventilator-associated pneumonia. *Crit Care Med* 32:1396-1405
4. American Thoracic Society; Infectious Diseases Society of America (2005) Guidelines for the Management of Adults with Hospital-acquired, Ventilator-associated, and Healthcare-associated Pneumonia. *Am J Respir Crit Care Med* 171:388-416
5. Dellinger RP, Levy MM, Carlet JM, Bion J, Parker MM, Jaeschke R, Reinhart K, Angus DC, Brun-Buisson C, Beale R, Calandra T, Dhainaut JF, Gerlach H, Harvey M, Marini JJ, Marshall J, Ranieri M, Ramsay G, Sevransky J, Thompson BT, Townsend S, Vender JS, Zimmerman JL, Vincent JL; for the International Surviving Sepsis Campaign Guidelines Committee (2008) Surviving Sepsis Campaign: International guidelines for management of severe sepsis and septic shock 2008. *Crit Care Med* 36:296-327
6. Lorente L, Blot S, Rello J (2007) Evidence on measures for the prevention of ventilator-associated pneumonia. *Eur Respir J* 30:1193-1207
7. Cook D, Ricard J-D, Reeve B, Randall J, Wigg M, Brochard L, Dreyfuss D (2000) Ventilator circuit and secretion management strategies: A Franco-Canadian survey. *Crit Care Med* 28:3547-3554
8. Heyland DK, Cook DJ, Dodek PM (2002) Prevention of ventilator-associated pneumonia: current practice in Canadian intensive care units. *J Crit Care* 17:161-167
9. Sierra R, Benítez E, León C, Rello J (2005) Prevention and diagnosis of ventilator-associated pneumonia: a survey on current practices in Southern Spanish ICUs. *Chest* 128:1667-1673
10. Van Nieuwenhoven CA, Vandenbroucke-Grauls C, van Tiel FH, Joore HC, van Schijndel RJ, van der Tweel I, Ramsay G, Bonten MJ (2006) Feasibility and effects of the semirecumbent position to prevent ventilator-associated pneumonia: a randomized study. *Crit Care Med* 34:396-402
11. Cook DJ, Meade MO, Hand LE, McMullin JP (2002) Toward understanding evidence uptake: Semirecumbency for pneumonia prevention. *Crit Care Med* 30:1472-1477
12. McMullin JP, Cook DJ, Meade MO, Weaver BR, Letelier LM, Kahmamoui K, Higgins DA, Guyatt GH (2000) Clinical estimation of trunk position among mechanically ventilated patients. *Intensive Care Med* 28:304-309
13. Peterlini MAS, Rocha PK, Kusahara DM, Pedreira ML (2006) Subjective assesment of backrest elevation : Magnitude of error. *Heart Lung* 35:391-396
14. Balonov K, Miller AD, Lisbon A, Kaynar AM (2007) A novel method of continuous measurement of head of bed elevation in ventilated patients. *Intensive Care Med* 33:1050-1054
15. Helman DL, Sherner JH, Fitzpatrick TM, Callender ME, Shorr AF (2003) Effect of standardized orders and provider education on head-of-bed positioning in mechanically ventilated patients. *Crit Care Med* 31:2285-2290