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Nursing Considerations: Prone Position for Mechanically Ventilated Patients with Respiratory Failure

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Abstract: Mortality rates for ventilated patients with ALI or ARDS are high, and there is a growing body of evidence suggesting that the position these patients are nursed in may influence clinical outcomes. However, there are no guidelines to inform nursing practice in positioning these patients. Nurses have a central role to play in the continual assessment and management of this patient group, including the position they are nursed in, not only to ensure the best clinical outcomes but also to provide care and comfort to the patient and their family. It is therefore important that their nursing practice and interventions are informed by the best available evidence. This review explored the nursing considerations relating to prone positioning in ventilated patients diagnosed with respiratory failure, including acute lung injury (ALI) or adult respiratory distress syndrome (ARDS).

Keywords: Nursing Considerations, Mechanical Ventilator, Prone position, Respiratory failure.

INTRODUCTION

Although practical and theoretical issues have been identified, which impact the way nurses can use evidence to support their clinical decisions and professional working (Thompson et al., 2001; McCaughan et al., 2002; Rolfe and Gardner, 2006; Meijers et al., 2006; Spenceley et al., 2007), the parameters of what constitutes best nursing evidence in the intensive care environment remain debatable. The complexity of the needs of patients in intensive care units (ICUs) and the nature of inter-professional working relationships make it difficult to distinguish which aspects of patient care should be the primary responsibility of any one professional group. However, positioning the patient in bed to prevent the development of pressure sores, maintain skin integrity, provide comfort and facilitate recovery has always been a key nursing responsibility, so it is arguable that this should be an area where the best evidence is used to inform nursing decision-making and care.

As a result of factors normally associated with their critical illness itself or the treatment they are receiving, many patients within ICU are nursed in a supine position. However, it is known that the prolonged use of the supine position increases the risk of complications such as thrombosis, atelectasis, pneumonia and the development of pressure ulcers (Shapiro and Broccard, 1997). Alternative positions for nursing ventilated patients include semirecumbent, left lateral, right lateral and prone. Periodic adjustment of a patient's position may be something that nurses do manually, but in the case of prone positioning the patient should be nursed on an appropriate pressure-relieving mattress (Rowe, 2004). Low air loss mattresses are preferable because of the potentially prolonged period in the prone position incorporating a 2–4 h repositioning regime using the swimmers position.

The utility of prone positioning in ventilated ICU patients was first explored in the 1970s. Piehl and Brown (1976)

found that prone positioning of patients resulted in improvements in arterial oxygenation while Douglas et al. (1977) also suggested that prone positioning, with the upper thorax and pelvis supported and the abdomen free, resulted in an increase in the partial pressure of arterial oxygen. However, it should be noted that both these early studies had small sample sizes ($n = 5$ and $n = 6$, respectively). As is often the case in research exploring new issues, these sample sizes are not necessarily representative but did offer indications for further research.

Although the maintenance of a good PaO₂ measurement is important in the care of ventilated patients, there are many other clinical benefits that are assumed to be related to prone positioning. These include increased functional residual volume, alterations in diaphragmatic movement, postural drainage of water and exudates, accelerated secretion removal, shunting of perfusion and improved ventilation (Lan and He, 2009). All these factors are important in facilitating recovery in critically ill patients, so nursing patients in the optimum position could have significant and measurable impacts on the outcome of their stay in ICU.

A particular challenge to ICU nurses is the effective care of those ventilated patients who are suffering from acute lung injury (ALI) or adult respiratory distress syndrome (ARDS). The mortality risks of these patients are particularly high, with that of ARDS reported between 35% and 45% (Phua et al., 2009). It is perhaps not surprising that more recent research exploring the effects of prone positioning in the ICU has focused on patients with these diagnoses as defined by the American-European Consensus Conference (AECC) (Bernard et al., 1994).

Although the research on prone positioning in patients who are ventilated has illustrated improvements in arterial oxygenation, the impact of prone positioning on ventilator-associated pneumonia (VAP), mortality, ICU stay and adverse events is less clear (Dodek et al., 2004; Hess, 2005;

Abroug et al., 2008; Tiruvoipati et al., 2008). This lack of clarity stimulated a review of the evidence and raised questions as to which patients would be expected to benefit from being nursed in a prone position and at what point in their ICU patient career any positional changes should be instigated.

MORTALITY

Documented mortality rates of patients nursed in the prone position vary considerably within the included studies, ranging from 5% (Voggenreiter *et al.*, 2005) to 49% (L'Her *et al.*, 2002). As a result of the study design and difficulties of recruitment, many of the included studies did not reveal any reduction in mortality, which could be conclusively attributed to the prone positioning intervention. Gattinoni *et al.* (2003) performed a retrospective analysis of high-risk patients and found no difference in overall mortality for patients nursed in the prone position, but did find a survival advantage at day 10, suggesting that multiple prone episodes may be beneficial for high risk and patients with severe ARDS. Mancebo *et al.* (2006) reported a 15% absolute decrease in ICU mortality for patients nursed in the prone position, and Fernandez *et al.* (2008) found a 15% absolute increase in 60-day survival rates. However, it should be noted that these findings were not statistically significant. The retrospective review reported by Davis *et al.* (2007) did find a statistically significant difference in mortality because of positioning. However, a large number of patients in the supine position group had severe closed head injury and when these were excluded from the analysis, the difference between the prone and supine groups were not significant.

DISCUSSION AND IMPLICATIONS FOR NURSING PRACTICE

It is acknowledged that a narrative review is limited by the often subjective nature of interpretation, nonetheless some important issues for ICU nurses caring for patients with ALI or ARDS have been highlighted, which, in the absence of conclusive guidelines for practice, may help them in contributing to the management plan for their patients or in research design. The search strategy limited studies to those published since 2000; however, the development of health technologies in the intensive care environment means that clinical research findings can be very quickly superseded by technological innovations. It may also have been helpful to contact the reviewers (Bloomfield *et al.*, 2009) who have registered a review protocol on the Cochrane database, but this review was particularly interested in interpreting the nursing implications of prone positioning of ventilated patients.

The studies included in this narrative review did not show conclusive evidence of the clinical benefits of nursing patients with ALI or ARDS in the prone position. Some of this inconsistency may be because of differences in study design, difficulties with recruitment or an absence of practical detail in the reporting of the studies. For example, within the 14 included studies, the operational definition of prone positioning was largely unclear. It is a general recommendation that ventilated patients should be nursed with the head of bed elevated to 30–45° to reduce the risk of gastroesophageal reflux and nosocomial pneumonia (Ibanez

et al., 1992). However, only Guerin *et al.* (2004) reported detail of a prone position incorporating a reverse Trendelenburg position, although the degree of incline was not documented. It was also reported in this study that the degree of elevation for the patients allocated to the control group was not accurately measured during the trial.

Nonetheless, it does appear from this review that prone positioning has an impact on the PaO₂/FiO₂ ratio. The research also seems to suggest that a short prone period may not be of great benefit to the patient and a longer period of prone positioning may be necessary to allow for postural drainage and achieve improvements in the PaO₂/FiO₂ ratio. Postural drainage may also correlate with a reduction in the incidence of VAP, which itself may have a profound impact on many aspects of critical care outcomes and an overall reduction in ICU mortality rates (Safdar *et al.*, 2005). In the day-to-day care and management of ventilated patients, an important aspect of nursing practice relates to the weaning of the patient from the ventilator. Not all the studies applied a weaning protocol to the patients, only weaning the fraction of inspired oxygen (FiO₂). Although this would demonstrate an immediate effect of the positional intervention, it may not improve the overall patient outcome as weaning should be a continuous process. The evidence reviewed here also suggests that the effect of prone positioning on mortality in patients with ALI or ARDS is not conclusive. However, considering the critical status of these patients, any improvement in their condition could perhaps be regarded as an achievement.

Despite these suggested clinical benefits, there is little evidence to suggest whether all ventilated patients may derive benefit from prone positioning. There is also a lack of conclusive evidence to indicate whether prone positioning should be routinely practiced from the outset of a patient's stay in ICU or whether this should only be an intervention given to high-risk patients, or indeed should only be implemented once a patient's condition deteriorates. If any clinical benefits can be conclusively associated with prone positioning, then it is arguable that this intervention should be offered to all ventilated ICU patients. However, this would inevitably have considerable cost and resource implications, so it may be useful to all those responsible for providing care in the ICU if future research in this area were able to explore both the clinical and economic impacts of prone positioning.

In relation to improving overall respiratory function of this critically ill patient group, it seems that one of the physical consequences of prone positioning is the reduction of abdominal pressure on the thorax. The 'free-abdomen' approach can be achieved by the use of specific prone position devices or the adjunct of pillow placement under the shoulders and pelvis (Rowe, 2004). However, only Johannigman *et al.* (2000) reported the use of a specialist proning device (Vollman Prone Positioner; Hill-ROM, Batesville, IN, USA), and none of the studies documented the use of cushions. Hering *et al.* (2001) and Rossetti *et al.* (2006) did report that no cushions or measures were taken to alleviate positional restrictions of the abdomen. This means that ICU nurses do not have clear guidance as to how best to

achieve a 'free abdomen' in patients who they position prone.

In relation to the practicalities of moving ventilated patients, all ICU nurses are aware that extra care must be taken when positioning intubated patients and although the evidence about adverse events associated with prone positioning is again inconclusive, it may be advisable for nurses to take additional precautions when moving patients from a supine to a prone position. The simple addition of extensions to all vascular lines may help ICU nurses to minimize the risk of adverse events occurring in these patients who are already severely compromised by their condition.

The potential benefits of nursing a critically ill patient in the prone position should always outweigh the potential risk in moving the patient, so ICU nurses need to ensure that enough staff with appropriate experience are involved in any manoeuvring of a ventilated patient into a prone position. In terms of the everyday practicalities of nursing patients in the prone position, it would be useful to have guidance on how nurses can manoeuvre their patients in a way that carries maximum clinical benefit and minimum patient risk.

CONCLUSION

This review suggests that prone positioning has some benefits for patients suffering from ALI and ARDS and is best applied in multiple episodes for long periods, using a reverse Trendelenburg position with a free abdomen. However, the variation in design of the reviewed studies means that the evidence is not conclusive, and it is not possible to draw robust conclusions about the effectiveness of prone positioning on clinical outcomes in this patient group. The available evidence does not provide guidelines as to when instigation of the prone position may be most beneficial to patients. It should also be noted that the reviewed evidence applied manual proning procedures and that there is, as yet, no comparative research about automated proning devices.

It would appear that more research is needed in this field, and future studies may benefit from a multicenter and multi-professional approach, together with clear operational definitions of both prone and supine conditions. If there are any benefits to be gained from nursing severely ill patients in the prone position, it is important that ICU nurses understand both the clinical and practical dimensions of this intervention, to ensure they are able to deliver the best possible care.

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