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Patients With Rib Fractures

Use of Incentive Spirometry Volumes to Guide Care

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ABSTRACT

Rib fractures pose significant risk to trauma patients. Effective pain control and the ability to take deep breaths are crucial for optimal recovery, and these are key elements in current clinical guidelines. These guidelines use incentive spirometry volumes along with other assessment values to guide patient care. However, despite current guidelines, nurses do not routinely document inspired respiratory volumes. This article provides trauma nurses with the rationale for documenting and tracking incentive spirometry volumes to improve outcomes for patients with rib fractures. This promotes early detection of respiratory decline and early interventions to improve pain control and pulmonary function.

Key Words

Incentive spirometry, Inspired Lung Volume, Rib fractures, Thoracic trauma

Rib fractures are common and serious injuries. Incentive spirometry (IS) is a well-known form of lung expansion therapy used among patients with rib fractures. In using the incentive spirometer, nurses instruct patients to take a sustained, maximum inspiration, followed by a breath hold of 5 to 10 seconds. This inexpensive respiratory modality can provide nurses with information that is useful in planning care for patients with rib fractures.

The purpose of this article was to (*a*) provide the nurse with an in-depth understanding of the significance of rib fractures, (*b*) review clinical guidelines, (*c*) identify nursing implications for managing both pain and complications in patients with rib fractures, and (*d*) discuss the use of IS as part of overall clinical assessment in patients with rib fractures.

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RIB FRACTURES: MARKERS OF WORSE OUTCOMES

Rib fractures are common. More than 160 000 patients with rib fractures were admitted to US hospitals in 2008.[1] However, the actual number may have been even higher. Wanek and Mayberry[2] indicated that national surveys often include only the top-3 primary diagnoses for patients with multiple injuries and may not accurately reflect the total number of patients with rib fractures. In addition, researchers suggest that up to 50% of rib fractures are not detected on standard chest radiographs.[3,4]

Recent studies report that rib fractures occur in 7% to 9% of trauma patients and the mortality rate for these patients is 10% to 12%.[5,6] These findings are similar to a frequently cited historical report by Ziegler and Agarwal[7] that showed 10% of trauma patients had rib fractures and that 12% of those patients died. Investigators in these 3 studies concluded that rib fractures are markers of worse outcomes.[5-7] In fact, a linear association between mortality rates and the number of ribs fractured has been reported.[5,6] Flagel et al[5] found a significant increase in mortality ($P < .02$) for every additional fractured rib.

Rib fractures pose significant risk, especially in older adults. In their retrospective analysis of more than 27 000 trauma patients, Stawicki et al[8] found a significantly higher rate of mortality in elderly patients (65 years or older) with rib fractures than younger patients (younger than 65 years) with rib fractures (20.1% vs 11.4%). Mortality rates went up as the number of rib fractures increased for both age groups. Stawicki et al concluded that the number of rib fractures might be a useful predictor of outcomes, especially for elderly trauma patients.

A retrospective study involving elderly patients with rib fracture suggests that measuring vital capacity (VC) lung volumes may be more useful in predicting outcomes than the number of ribs fractured.[9] *Vital capacity* is the maximum amount of air that can be exhaled or inhaled from the lung.[10] Bakhos et al[9] reported that patients with a VC of 1.4 L or less, or less than 55% of their predicted VC, had extended hospital length of stay. Investigators in this study also demonstrated a strong correlation between VC and disposition at discharge (ie, home vs extended care facility).

PAIN MANAGEMENT GUIDELINES

Pain control is crucial. The importance of pain control for patients with rib fractures is both intuitive and well-recognized in the literature.[2,3,11] Pain impairs ventilation because it interferes with deep breathing and low inspiratory volumes lead to hypoxia.[12] The development of atelectasis and pneumonia has been directly correlated with the number of fractured ribs and with the severity of pain.[7,8,13]

Simon et al[3] published guidelines developed by the Eastern Association for the Surgery of Trauma for controlling pain in patients with blunt thoracic trauma. Blunt thoracic trauma includes soft tissue and bony chest wall injuries. Epidural analgesia is recommended as the best possible modality for pain control in patients with severe blunt chest wall injuries. Authors of this extensive evidence-based review maintained that failure to control pain along with the subsequent need for mechanical ventilation contributed to progressive respiratory morbidity and mortality. Simon et al[3] reported that thoracic epidural anesthesia significantly improved pain control and pulmonary function tests. Guideline developers have ascertained that the key benefit of epidural analgesia is its ability to control pain without causing sedation and its associated ability to improve inspired lung volumes. Guideline developers recommended that clinical performance measures such as pain scale, pulmonary function, and arterial blood gas be carried out at regular intervals as judged appropriate for each patient. Furthermore, epidural analgesia may improve outcomes for patients with chest wall injuries as measured by mechanical ventilator days, intensive care unit days, and hospital length of stay.

The study by Flagel et al[5] also supported the use of epidural analgesia. Researchers in this large retrospective review found that epidural analgesia was associated with a reduction in mortality, especially when 4 or more ribs were fractured. These researchers also concluded that epidural analgesia may be underutilized as a mode of treatment in patients with rib fractures because it was used only in 2.2% of patients.

IDENTIFYING PATIENTS AT RISK

Todd et al[13] and Winters[11] developed clinical algorithms aimed at improving outcomes for at-risk patients with rib fractures. These guidelines screen patients on the basis of age and number of ribs fractured. Their goal is pain control and early consideration of epidural analgesia.

The clinical guideline developed by Winters[11] is aimed specifically at patients older than 65 years and is focused on interventions related to pain control. Winters suggested the use of IS with each pain assessment to ascertain the patient's ability to take deep breaths. This guideline lists the following as inclusion criteria for consideration of epidural analgesia: (*a*) patients with 4 or more fractured ribs, (*b*) those determined to have poor pain control, or (*c*) patients who are unable to effectively use the incentive spirometer.

Todd et al[13] developed a clinical guideline that uses an interdisciplinary approach to care for patients older than 45 years with more than 4 ribs fractured. Assessment parameters include IS volumes, pain scale scores, and subjective evaluation of the patient's cough as either weak or strong. Patients with one of the following are considered failures and are entered into a multidisciplinary clinical pathway: (*a*) pain score of 7 or more on a scale of 1 to 10, (*b*) inspiratory volume less than 15 mL/kg, or (*c*) the presence of a weak cough. These at-risk patients were then targeted for aggressive interventions related to pain control, mobility, respiratory therapy, and nutrition. Implementation of this interdisciplinary clinical algorithm improved outcomes related to mechanical ventilator days, hospital length of stay, the development of pneumonia, and mortality.

INCENTIVE SPIROMETRY

Incentive spirometry involves having the patient take a sustained, maximal inspiration. It is considered a type of lung expansion therapy.[14] There is very little information about IS in the nursing literature. Some nursing textbooks have provided instruction related to respiratory modalities such as the use of IS. The *Brunner and Suddarth's Textbook of Medical Surgical Nursing*[14] describes the nursing management of patients using IS as patient instruction, goal setting, and documentation of therapy results.

The medical textbook *Trauma: Critical Care*[15] describes the incentive spirometer as an inexpensive and effective tool for preventive and therapeutic pulmonary hygiene. According to the authors, the patient must be cooperative, motivated, well-instructed on the procedure, and able to obtain an inspiratory capacity greater than 15 mL/kg in order for IS to be effective. The authors also stated that IS may be useful in the detection of acute pulmonary pathologies. A sudden decrease in the patient's ability to achieve previously established inspiratory volume levels could signal the development of severe atelectasis, pneumonia, or other pulmonary problems.

An informal review of practice at our institution identified an opportunity for advancing nursing practice related to the pulmonary assessment of patients with rib fractures. Nurses at our level II trauma center do not routinely assess or document IS volumes as an indicator of the patient's pulmonary status. The lack of emphasis by nurses on the evaluation of IS volumes may be due to either a poor understanding regarding the development of respiratory failure in patients with rib fractures or a gap in knowledge or education regarding current clinical guidelines.

A trauma protocol similar to the guideline by Todd et al[13] is in place at our institution. Our protocol also

targets elderly patients with more than 4 rib fractures and those with a weak cough, pain score of more than 6, or IS volume of less than 15 mL/kg as candidates for epidural analgesia. Pain scores, cough strength, and IS volumes are assessed daily by the trauma service physicians. Most bedside nurses are not aware of the protocol.

DISCUSSION

Nurses play a critical role in promoting optimal outcomes for patients with thoracic trauma.[12] There is a clear implication for nurses to provide ongoing respiratory and pain assessments for this population. The nurse identifies at-risk patients so that appropriate interventions can be planned, implemented, and evaluated. Peruzzi and Candido[15] supported the notion that IS may be a useful technique in detecting the declining pulmonary status. All of the aforementioned clinical guidelines[3,11,13] stress the importance of frequent monitoring of respiratory parameters and pain levels for patients with rib fractures. These guidelines use IS volumes along with other assessment values to guide clinical care and pain management decisions.

Nurses provide care to patients 24 hours per day, more than any other member of the health care team. This places nurses in the best position to detect subtle changes in the respiratory status of patients. The importance of nurses in the care of these patients cannot be overstated.

Since its introduction by Bartlett et al[16] in the early 1970s, the disposable bedside incentive spirometer has proven to be a simple, low-tech, and inexpensive tool for promoting pulmonary hygiene. However, health care professionals often overlook its utility in assessing inspired lung volumes in patients with rib fractures. Tracking IS volumes can provide nurses with information that is helpful in (*a*) identifying patients at risk, (*b*) determining appropriate levels of care, (*c*) evaluating the efficacy of pain interventions, (*d*) facilitating the use of thoracic epidural anesthesia when appropriate, and (*e*) screening patients regarding readiness for discharge. Trends in inspiratory volumes could be tracked for individuals and cohorts. Nursing researchers could find these data elements useful in determining whether correlations exist between inspiratory volumes, pain control interventions, and outcomes for patients. To date, this research has not been done.

Increasing the documentation burden for nurses is a conceivable downside to tracking IS volumes. Researchers should rate the value of monitoring and tracking this measurement for patients with rib fractures. Perhaps, the future will bring technology that enables the nurse to download information directly from the patient's spirometer. Until such a time, manual entry of data will be required.

CONCLUSIONS

This article updates the nurse on the importance of respiratory assessment for patients with rib fractures. The advantages of tracking inspiratory volumes in the overall clinical picture are discussed. With heightened awareness and another tool at their disposal, nurses may enhance outcomes for patients with rib fractures by early detection of declining respiratory status and timely interventions to improve pain control and pulmonary function.

Prospective research studies are needed both to determine the value of having nurses assess, document, and evaluate trends in IS volumes for patients with rib fractures and to measure the contribution this makes to overall patient outcomes.

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