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Tamara Welle  
*St. Cloud Hospital, CentraCare Health*, WelleT@CentraCare.com

Roberta Basol  
*St. Cloud Hospital, CentraCare Health*

Naomi Schneider  
*St. Cloud Hospital, CentraCare Health*, schneidern@centracare.com

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Evaluating the Need for Routine Supplemental Oxygen in Postoperative Total Joint Replacement Patients

Tamara Welle, BSN, RN, ONC, Roberta Basol, MA, RN, NE-BC, Naomi Schneider, MBA, BSN, ONC

IF YOU GLANCE around the postanesthesia care unit (PACU), you will see the routine use of postoperative supplemental oxygen. Most postoperative recovery room and inpatient orthopaedic nurses continue the administration of supplemental oxygen after surgery regardless of whether or not the patient’s oxygen saturation (SpO2) readings are acceptable. However, administering oxygen may be falsely reassuring. This column presents an example of an evidence-based practice (EBP) project examining the effectiveness of the routine use of postoperative oxygen in total joint patients.

Purpose/Rationale

The purpose of this EBP project was to examine the appropriate use of routinely administered supplemental oxygen to maintain SpO2 in postoperative total joint replacement patients. Initially, nursing practice included the administration of supplemental oxygen after surgery, often continuing oxygen therapy to the next day, regardless of SpO2 readings. The culture of routine oxygen administration and undefined acceptable SpO2 values was identified as a nursing practice concern.

Team

A multidisciplinary EBP team was formed including stakeholders and change champions. The team was led by a staff nurse and included direct care nurses, the department director, unit educators, a clinical nurse specialist, anesthesiologists, and an orthopaedic surgeon. The team reviewed the literature and baseline data and then developed the EBP pilot.

Synthesis of the Evidence

A literature review was completed by searching CI-NAHL, MEDLINE, the Cochrane Database, Google Scholar, and the National Guideline Clearinghouse for articles including any of the following terms or a combination of terms: preoperative, postoperative, oxygen, routine oxygen, supplemental oxygen, oxygen therapy, total joint replacement, total joint arthroplasty, respiratory depression, respiratory monitoring, pulse oximetry, and/or sedation. The literature was graded according to the American Association of Critical Care Nurses’ evidence-leveling hierarchy.1

Supplemental oxygen is simple to use, seemingly inexpensive, and well tolerated by most patients, and so has become a routine practice.2,3 Oxygen is known to double the subcutaneous tissue oxygenation, can halve the risk of infection, and may decrease the nausea and vomiting that some postoperative patients may experience.3

However, oxygen may be administered out of habit by the nurse regardless of patient need. Oxygen should be reserved for those who demonstrate a need for it at various times during their hospital stay.4,5 Providing unnecessary oxygen may be falsely reassuring for caregivers; it can prevent the detection of atelectasis, transient apnea, and
hypoventilation because of adequate SpO2 readings observed on pulse oximetry.7-9 Subsequently, this may also lead to failure to recognize elevated or impending high CO2 levels, which are not routinely monitored.5,10 With or without routine supplemental oxygen, respiratory monitoring protocols must be developed with the following in mind: staffing, patient placement, equipment, the environment, policy and procedure, and staff education in caring for post-operative patients.11

Common themes in previous studies2,4,5,8,12-14 of postoperative oxygen use and hypoxia revealed that the first 20 minutes after surgery are the most critical for patient instability. Patients with preexisting pulmonary disease have a risk that may contribute to the need for routine supplemental oxygen.2,12,13 Most evidence recommends the use of supplemental oxygen only if SpO2 drops to 90% or less than 94% on room air on arrival to the PACU.2,4,8,12 Factors related to an increased risk of hypoxic episodes include age greater than 40 years, obesity, anesthesia duration greater than 90 minutes, higher American Society of Anesthesiologists (ASA) scores, and more than 1,500 mL of intravenous fluids in the operating room.14 Hypoxic episodes are common after surgery, presenting in 14% to 55% of patients.12,14 General anesthesia is noted to be a precursor to supplemental postoperative oxygen use.12,14

Practice Change

Before the EBP change, nurses routinely administered supplemental oxygen to all postoperative total joint replacement patients. The PACU and the inpatient orthopaedic nurses maintained SpO2 levels at 95% or higher and 90% or higher, respectively. Unit standards for vital signs and routine assessment were followed. Most staff nurses simply allowed patients to continue oxygen therapy until the morning after surgery unless the patient asked to have it removed.

Before addressing this routine practice, several issues were taken into account. Careful consideration was given to which total joint replacement patients could be safely included. The anesthesiologists assisted in establishing patient criteria based on the review of the evidence. Total knee or hip replacement patients were included who were aged younger than 75 years; receiving any type of anesthesia, including a general, spinal, femoral block, and/or intrathecal; and with an ASA Level 1 or 2. Patients with Level 3 ASA scores were accepted if they had no history of chronic obstructive pulmonary disease or reactive airway disease.

The practice change was intended to maintain the SpO2 levels in patients at 90% or higher across postoperative patient, the PACU and general care areas. Orthopaedic surgery postoperative order sets were revised for the use of supplemental oxygen and/or weaning of oxygen to maintain SpO2 levels at 90% or higher.

Implementation Strategies

The revised order set was added to the established postoperative orders for total knee and hip replacement patients as a preselected item. This supported the standardized use of oxygen and could be used to meet individual patient needs. Nurses caring for these patients were educated about the impact of oxygen administration and hypoventilation.

During the pilot, the PACU charge nurse selected patients fitting the project criteria. Data collection was initiated by PACU nurses who recorded the amount of oxygen administered, SpO2 readings, medications administered, and any patient events such as attempts on room air or vomiting. Pilot guidelines were developed for the type of anesthesia received; patient condition; and vital sign monitoring, including SpO2. For example, if the patient had general anesthesia, oxygen was administered for the first 30 minutes after extubation and then room air trialed as recommended by the anesthesiologists. Patients who received a spinal or femoral nerve block began attempts on room air immediately on arrival to the PACU. The PACU nurses were asked to use and/or wean oxygen for all patients to maintain SpO2 levels at 90% or higher. Application or removal of oxygen therapy was documented on the data collection tool. Continuous monitoring of SpO2 was completed and documented on the tool every 10 minutes and included any change in flow rate or method of oxygen delivery.

Patients in the pilot were identified in handoff reports from the PACU and the tool sent with
the patient for continued data collection. The inpatient orthopaedic nurse followed the EBP protocol, continuing and/or weaning oxygen administration to maintain SpO2 levels at 90% or higher. Nurses recorded SpO2 levels on arrival to the room, at 30 minutes, 1 hour, 4 hours, and with any change in oxygen flow rate or method of oxygen delivery. For patients who received an intrathecal injection, continuous monitoring of SpO2 was done for 15 hours as per the organization’s policy.

Awareness was raised about the routine use of oxygen for postoperative patients, regardless of SpO2 readings. The staff nurse-project director served as the project lead. Other nurses participating on the team served as change champions or provided leadership based on their clinical position. Staff education included information about the evidence, pilot, data collection, and order set changes. Nurses were educated via unit meetings, posters, and a computer-based education module before the pilot start date. A week into the pilot, additional education was provided to staff through an optional question-and-answer session. Reminders were provided periodically through one-on-one discussions with staff.

**Evaluation**

The evaluation included 64 patients, baseline (n = 20) and pilot (n = 44) groups. The data collected were analyzed using descriptive statistics. Patient’s medical records were reviewed for expected and adverse outcomes. There were no adverse outcomes reported in the pilot population. Demographics are summarized in Table 1. Patients in the pilot group were on average 8.1 years younger than the baseline group and 2 kg heavier. Preoperative SpO2 readings were 95.8% in the baseline and 96.4% in the pilot group with postoperative SpO2 readings at 96.7% and 95.6%, respectively. Significant differences were noted in the average hours oxygen was administered per patient, with 42 hours in the baseline group and 10.7 hours in the pilot group. Also, 4 of 20 (20%) patients in the baseline group compared with 23 of 44 (52%) patients in the pilot group did not receive supplemental oxygen. All patients maintained SpO2 levels at 90% or higher.

A cost comparison was conducted for all the total joint replacement in medical severity diagnosis-related groups (MS-DRGs 461, 462, 466, 467, 468, 469, and 470) seen in our organization (Table 2). The MS-DRGs were used to compare like patients before and after the oxygen practice change. Baseline data were collected for 4 months before the team formation. The pilot was conducted for 1 month, based on the expectation of a higher total joint patient population at this time, to achieve a higher sample size. The data indicated a reduction in average hospital cost of $830 per patient between the baseline and pilot period. There was also a reduction in hospital length of stay from 3.4 to 2.9 days. When reviewing all total joint replacement patients, 19% of

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Baseline</th>
<th>Pilot</th>
<th>Difference</th>
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<tbody>
<tr>
<td>Sample, n</td>
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<td>44</td>
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<tr>
<td>Age (y)</td>
<td>70.2</td>
<td>62.1</td>
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<tr>
<td>Weight (kg)</td>
<td>93.5</td>
<td>95.5</td>
<td>+2</td>
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<td>Preoperative SpO2 (%)</td>
<td>95.8</td>
<td>96.4</td>
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<tr>
<td>Postoperative SpO2 (%)</td>
<td>96.7</td>
<td>95.6</td>
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<td>ASA level (%)</td>
<td>1 (0)</td>
<td>1 (5)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 (25)</td>
<td>2 (50)</td>
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<tr>
<td></td>
<td>3 (70)</td>
<td>3 (45)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4 (5)</td>
<td>4 (0)</td>
<td></td>
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<tr>
<td>Duration of anesthesia (min)</td>
<td>146.6</td>
<td>133.1</td>
<td>-13.5</td>
</tr>
<tr>
<td>Average hours of O2 administration (per patient)</td>
<td>42</td>
<td>10.7</td>
<td>-31.3</td>
</tr>
<tr>
<td>Length of stay (d)</td>
<td>4</td>
<td>3.5</td>
<td>-0.5</td>
</tr>
<tr>
<td>Patients on room air (%)</td>
<td>4 (20)</td>
<td>23 (52.3)</td>
<td>+32.3</td>
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Table 1. Baseline and Pilot Sample Description

SpO2, oxygen saturation; ASA, American Society of Anesthesiologists.
the patients in the baseline and 32% during the pilot period did not receive any supplemental oxygen. The reduction in oxygen use may have occurred, in part, because of the possible influence education had on routine postoperative oxygen administration.

A further cost analysis was completed based on total joint replacement MS-DRG patients by fiscal year (FY). To calculate the savings, the pilot average cost per case was subtracted from the actual baseline costs with the associated inflationary factor. This difference was multiplied with the projected number of patients in a FY. In FY2011, the cost of care per patient was $17,920. Given the organization’s inflationary cost adjustment factor of 2.68%, the expected cost for FY2012 was $18,400. The actual average cost during the pilot was $17,570, a savings of $830 per patient. With 1,122 total joint replacement patients projected for FY2012, the total cost savings to the organization was projected to be $931,260.

**Implications for Practice**

Challenging and changing the existing culture and habitual use of postoperative oxygen in the total joint replacement population revealed that some patients may not require oxygen to maintain adequate SpO2 readings. Efforts are currently underway to revise postoperative oxygen orders in other general surgical patients to apply and/or wean oxygen to maintain SpO2 levels at 90% or higher based on demonstrated patient safety and cost savings. Avoiding unnecessary supplemental oxygen may allow for increased patient mobility, which was previously limited by oxygen tubing. With the risk of CO2 retention, removal of supplemental oxygen with SpO2 90% or more is a safe practice.

**Conclusion**

An EBP project was completed to determine the necessity of routine supplemental oxygen therapy for postoperative total joint replacement patients. This EBP project team completed a literature review, created an EBP protocol, and implemented a practice change. A pilot was conducted, which revealed that a reduction in supplemental oxygen use was safe and created a significant cost savings for the organization. Staff nurse-led EBP can lead to significant improvements in patient care.

**Acknowledgments**

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**References**

5. DiBenedetto RJ, Graves SA, Gravenstein N, Konicek C. Pulse oximetry monitoring can change routine oxygen administration.

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**Table 2. MS-DRG Joint Replacement Data**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Baseline (July 1 to September 30, 2010)</th>
<th>Pilot Period (November 15 to December 14, 2011)</th>
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<tbody>
<tr>
<td>Number of encounters</td>
<td>374</td>
<td>111</td>
</tr>
<tr>
<td>Average cost per hospital stay ($)</td>
<td>17,920</td>
<td>17,570</td>
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<tr>
<td>Length of stay (d)</td>
<td>3.4</td>
<td>2.9</td>
</tr>
<tr>
<td>Received no supplemental oxygen (%)</td>
<td>70 (19)</td>
<td>36 (32)</td>
</tr>
<tr>
<td>Received some supplemental oxygen (%)</td>
<td>304 (81)</td>
<td>75 (68)</td>
</tr>
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</table>

MS-DRG, medical severity diagnosis-related group.


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