Original contribution

The addition of a regional block team to the orthopedic operating rooms does not improve anesthesia-controlled times and turnover time in the setting of long turnover times

Sunil Eappen MD (Assistant Professor), Hugh Flanagan MD (Assistant Professor), Rachel Lithman (Research Associate), Neil Bhattacharyya MD (Associate Professor)

Department of Anesthesiology, Perioperative and Pain Medicine, Brigham and Women’s Hospital, and Harvard Medical School, Boston, MA 02115, USA

Department of Otology and Laryngology, Brigham and Women’s Hospital, and Harvard Medical School, Boston, MA 02115, USA

Received 1 February 2006; revised 2 April 2006; accepted 4 April 2006

Abstract

Study Objective: To determine whether a regional block team with a dedicated space for performance of regional anesthetics would decrease turnover time and shorten the working day in a busy orthopedic practice with lengthy turnover times.

Design: Prospective, randomized study.

Setting: Tertiary-care teaching hospital.

Patients: 927 orthopedic procedures over a three-month period.

Interventions: The randomized placement of a regional block team to the orthopedic operating room (OR) suite.

Measurements: We evaluated the differences in anesthesia-controlled times, first-case start times, turnover times, and OR end times using a computerized OR information system. We also surveyed surgeons regarding their perceptions of changes in turnover time and anesthesia-controlled times during the study period. Standard descriptive statistics were computed.

Results: Of a total of 927 cases, 398 cases were cared for by a regional block team and 529 cases received care in the usual manner, with the OR team providing the regional block. There was no difference between the study and control groups for on-time, first-case starts (57.73% vs 42.27%), induction time (13.2 vs 14.2 min), emergence time (8.1 vs 9.0 min), turnover time (70.3 vs 77.8 min), and OR end times. Most of the surgeons surveyed felt that the regional block team reduced turnover time significantly.

Keywords:
Anesthesia;
Regional;
Operating room management;
Turnover times
1. Introduction

Earlier studies have shown that even dramatically decreasing anesthesia-controlled times does not free up enough operating room (OR) time reliably to schedule one additional case to an average day, and that financial savings are small [1]. Other work has reported that regional anesthesia with an induction room could minimize anesthesia-controlled times [2,3]. Still another study argues that by using a second anesthesia team to overlap induction of anesthesia, significant turnover time efficiency could be realized [4]. The earlier work, which showed essentially that turnover time and anesthesia-controlled times are small factors in overall time/cost savings, had turnover times that were less than 45 minutes. The question left unanswered by this earlier work was whether an additional case could be scheduled, or money saved, in situations in which a turnover time was greater than 45 minutes when the average workday was greater than 10 hours.

One clinical area in which increased anesthesia-related efficiencies may be realized is orthopedics, where regional anesthesia is a major mode of the anesthetic care. In our orthopedic ORs, turnover times are consistently greater than one hour. This finding is believed to be due to multiple factors, including significant preoperative (and intercase) anesthesia time requirements as a result of regional blocks performed by trainees under staff supervision. We have previously shown that the introduction of new anesthesia residents does not significantly worsen turnover times or anesthesia-controlled times [5], but these were also done in cases where the average turnover time was less than 45 minutes. The anesthesia-related turnover time factors in our orthopedic ORs are thought to contribute partly to ending times that consistently lead to overtime expenses for both the nursing and anesthesia departments, and delays. Surgeons also believe that they experience a longer clinical day and reduced job satisfaction. Although Dexter et al [1] predicted that we would not be able to perform another procedure within the scheduled surgical day for an individual OR by minimizing anesthesia-controlled times, we speculated that we could save significant cumulative time and variable costs each day by adding a regional block team consisting of an anesthesia staff member and resident in this academic environment. In addition, if we could consistently reduce turnover times and reduce the allocated OR time, significant staffing costs could be saved [5]. We undertook this study in the orthopedic ORs because there our turnover time was very high, and it was believed that the performance of regional blocks contributed significantly to these elevated times.

The goals of this prospective study were to evaluate whether the addition of a block team would modify the following: (1) turnover time, (2) anesthesia-controlled times, (3) end times of the orthopedic ORs, (4) number of orthopedic ORs running beyond 4:00 PM, (5) on-time start of first cases, and (6) perception of surgeons on our contribution to turnover time.

2. Materials and methods

The Brigham and Women’s Hospital, Boston, Massachusetts, is a 743-bed, academic tertiary-care hospital with its main operating suite comprising 40 ORs. Of these, 6 are designated for orthopedic surgery in which 99% of the approximately 2000 yearly orthopedic surgical procedures take place.

Previous internal analysis showed that approximately two thirds of these procedures are performed with regional anesthesia or regional anesthesia plus general anesthesia.

During the 18-week study period, the regional block team was randomly assigned to work on 30 nonholiday weekdays (6 weeks, experimental group). The other 12 weeks of the study period consisted of 4 staff and 6 residents covering the 6 orthopedic ORs (12 weeks, control group). The regional block team consisted of one attending staff member who was facile with regional blocks and one senior resident (CA-2, CA-3, or regional anesthesia fellow, ie, CA-4) who had no responsibility to cover any room in the operating suite.

The regional block team was assigned to start one orthopedic room and then was charged with identifying potential regional anesthetic cases for the orthopedic services. Once identified, the regional block team would at their discretion call for the patient to be brought into the preoperative holding area while the preceding case was still underway in the OR. Typically, the patient would be placed onto a stretcher approximately one hour before the scheduled start time. In addition, a specific location was designated in the preoperative area with three bed-slots, monitors, and all anesthesia equipment needed to facilitate regional blocks. The blocks provided by the regional block team included epidurals, interscalene brachial plexus blocks, subclavian perivascular brachial plexus blocks, axillary blocks, and popliteal fossa blocks. All epidural blocks were administered in the preoperative area, and these patients were then ready for incision when taken to the OR. The regional block team relinquished control of the patient to the anesthesia team assigned to the particular OR once the patient was brought to

Conclusion: A regional block team in this environment does not reduce anesthesia-controlled times and turnover times in an orthopedic OR suite with long turnover times, and it would be virtually impossible to recover the associated extra cost. The surgeons’ perspective of turnover time is inaccurate.
the OR. Spinal anesthetics were always administered in the OR. General anesthesia was administered at the discretion of the assigned intraoperative anesthesia team.

Calendar week days were randomly assigned to be staffed with a regional block team versus a traditional single anesthesia team per OR on the evening before (Fridays before Mondays). Therefore, on days randomized to be without the regional block team, the anesthesia team for a given room was charged with administering the regional block either outside the operating suite or within the OR for orthopedic cases, as well as administering the anesthesia for the operative portion of the case.

For the period under study, anesthesia-controlled time and total turnover time measures were obtained from a real-time concurrent logging system for OR times. This system has been described previously [6] and is routinely used to measure OR times. At the conclusion of the period, two sets of data were available: one set of times for days in which a regional block time was available to assist with orthopedic case turnover, and one set of data for days without regional block team availability. This action allowed direct comparison for the impact of the regional block team on anesthesia-related OR times, first-case start times, and turnover times.

Operating room measures were obtained using the data entered in real time by the nurses into the OR information system. Neither the nurses nor surgeons were made aware of the availability of the regional block team in advance, and surgeons did not have this information available when they made their surgical bookings. During any given day of the trial, no effort was made to blind the surgeons to the presence or absence of the regional block team.

At the conclusion of the study period, the 10 orthopedic surgeons with the largest volume of surgery during the study period were identified and asked the following questions: (1) Did the block team reduce turnover time, and if so, how much time per case? (2) Is the block team worthwhile to continue? (3) Any other comments? Each surgeon’s identity was coded to identify whether he/she responded, but the answers themselves were not linked. Thus, the answers were anonymous, but up to three written requests were made to increase compliance with the request to answer the short questionnaire.

The data extracted from the OR time entry log database after removing patient identifiers included the following:\(^1\): (a) the room is deemed ready by the OR nurses (RR); (b) the patient is in the room (PIR); (c) anesthesia induction is complete and surgical preparation may start (AR); (d) end of surgery (PF); (e) patient ready for transfer (PRT); and (f) time out of room (POR).

Anesthesia-controlled time was considered to be \[1\] induction time and emergence time and was calculated as (AR – PIR) and (PRT – PF), respectively.

Turnover time (PIR2 – POR1) was calculated as the time from when one patient left the room until the next patient entered the room. Turnover time was calculated only for scheduled cases and needed to be less than 120 minutes and occurring before 4:00 PM to be included in the data analysis. In addition, the individual orthopedic cases were examined and classified as to whether they were amenable to regional block cases, then further classified as either minor or major cases. Major cases included all total joint replacements, ligamentous surgery of the knee, and rotator cuff surgery, whereas minor surgeries included diagnostic arthroscopies, short (less than 90 minutes) hand procedures, and removal of hardware. Earlier internal analysis had shown that greater than 95% of cases amenable to regional anesthesia actually received a regional anesthetic for surgery. The number of first cases in each room that started on time, time that each orthopedic room ended, and number of orthopedic rooms running beyond 4:00 PM were recorded. We used 4:00 PM as our cutoff time because it is the hour when our overtime clock starts for the anesthesiologists. Given that different institutions may have different cutoff times that define a “full day” in the OR, the cost economics of the block team might be sensitive to the chosen cutoff time for desired room ending time (ie, a fully allocated OR day). To provide data that might be meaningful across institutions, additional analyses were performed to determine if the addition of the block team decreased the percentage of rooms running beyond hourly markers at 2:00, 3:00, 4:00, and 5:00 PM.

Power analysis showed that we would need 900 cases to show a 15-minute reduction in turnover time and a 20% decrease in the number of ORs running after 4:00 PM, to achieve 90% power.

Post hoc power analysis showed that this study exhibited a power of 0.815 to detect a mean difference in turnover time between block team present and block team absent cases of 10.0 minutes, with a pooled SD of 52.7 and sample sizes of 529 and 398 for block team present and block team absent cases, respectively (\(z = 0.050\), two-tailed). Power analysis for proportions indicated that for the given effect size (population proportions of 0.78 vs 0.63, block-team present and block team absent cases, respectively) and the given sample sizes (200 and 150 room ending days, respectively), with an \(z\) of 0.050 (two-tailed), power was 0.864 to show a statistically significant difference in proportion of rooms running beyond 4:00 PM.

3. Results

Of the total of 927 cases studied, 529 cases were performed without block team availability (control) and 398 cases were performed with block team availability (block). Among these 927 cases, 664 were amenable to

regional block anesthesia for the orthopedic procedure. The distribution of block-amenable cases was equivalent during the block period and the control period (71.6% and 71.6%, respectively, \(P = 0.874, \chi^2\)). There was also a similar distribution of major vs minor cases between the two periods (major cases, 63.9% and 62.8%, respectively, \(P = 0.852\)). On average, there were 0.7 turnovers per room per day evaluated (Table 1).

Table 1 displays the results for the anesthesia-controlled times for cases performed with and without block team availability. For cases that were not amenable to regional block anesthesia, no significant differences were noted in the distribution of block-amenable cases was equivalent during the two groups in the types of cases, the number of major cases, or of block amenable cases.

Table 2 shows the results of secondary outcome measures of successful 7:30 AM start times, average “room end” time, and percentage of rooms running beyond the anticipated 4:00 PM standard end time for each calendar day. Successful 7:30 AM start times were actually slightly diminished when the block team was available. However, room ending times were slightly better when the block team was available, but the fraction of rooms running beyond the anticipated/planned 4:00 PM end time was not significantly better for the block team available days.

Given that different institutions may have different cutoff times denoting a full day in the OR, the cost economics of the block team might be sensitive to the chosen cutoff time for desired room ending time (ie, a fully allocated OR day). To provide data that might be meaningful across institutions, additional analyses were performed to determine if the addition of the block team decreased the percentage of rooms running beyond hourly markers at 2:00, 3:00, 4:00, and 5:00 PM, as presented in Table 4. For each of these hourly instances, the percentage of rooms running beyond a certain time was not influenced by the presence or absence of the block team.

The results of the questionnaire distributed to the 10 surgeons who were requested to comment on the value of regional block team group was statistically significant. For all cases combined (looking at the overall effectiveness of the block team), no statistically significant improvements in anesthesia-related efficiency could be demonstrated.

Table 3 shows the results of secondary outcome measures of successful 7:30 AM start times, average “room end” time, and percentage of rooms running beyond the anticipated 4:00 PM standard end time for each calendar day. Successful 7:30 AM start times were actually slightly diminished when the block team was available. However, room ending times were slightly better when the block team was available, but the fraction of rooms running beyond the anticipated/planned 4:00 PM end time was not significantly better for the block team available days.

Table 4 Alternative end times and effect of regional block team

The table shows the percentage of orthopedic operating rooms (ORs) running beyond the time indicated. The regional block team made no difference to the number of ORs running late over ending periods ranging from 2:00 to 5:00 PM.
the block team are listed in Table 5. There were 27 attending orthopedic surgeons who performed surgery during the study period, but the 10 surgeons represented 80% of the case volume.

### 4. Discussion

The factors involved in turnover time and anesthesia-controlled time are complex and multifunctional, but specific anesthesia-related modifications improve on the overall time efficiency in the OR. Sokolovic et al [4] showed that anesthesia-controlled time and turnover time could be reduced by providing an additional anesthesia team in a small (5 ORs) surgical suite. More recently, a nonrandomized, prospective study by Armstrong and Cherry [3] showed that the use of a block room where regional anesthesia was induced before entry into the OR did save anesthesia-controlled time. In that study, a separate area was made available to perform blocks rather than using the OR before the start of the case. Armstrong and Cherry were thus able to save 20 minutes per case in anesthesia-controlled time. We attempted to improve on this result by providing a dedicated second anesthesia team in a preoperative block area to prepare orthopedic patients to enter a 6-room surgical suite. We chose this scenario to study because it included specific types of surgical procedures accompanied by long turnover times that conceivably could have been due to the anesthesia-related work of placing regional anesthetics in an academic environment. Earlier work had shown that reduction of turnover times of greater than 40 minutes possibly could reduce staffing costs in environments where surgical durations were lengthy [1,7]. We attempted to study an environment where turnover times generally exceeded 60 minutes and ORs ran into overtime routinely (overuse). We hope, therefore, to maximize the potential benefits of additional staffing. In addition, we believe that it is a commonly held belief that the delays caused in orthopedic ORs where regional anesthesia is performed are due to the anesthesia service.

Our results show that there was no meaningful difference in turnover time, induction time, or emergence time for the orthopedic cases with or without the addition of a dedicated regional block team. Even when only the 72% of cases that were amenable to regional anesthesia were evaluated, it appeared that turnover time was unchanged by the addition of a block team (76 vs 67 min, \( P = 0.06 \)). The only statistically significant difference that we found was that the emergence time was reduced by one minute in the block team group, a contextually meaningless finding. Not surprisingly in this framework, the presence of a regional block team did not lead to a decrease in the numbers of ORs running beyond 4:00 pm nor did it change the average time that any given OR finished.

Surgeons continue to rate turnover times as the most important attribute when evaluating the performance of academic anesthesiology departments [8]. Our study adds to the body of literature that shows that anesthesiologists do not specifically control turnover time, and that unilateral attempts by the anesthesia department to modify our clinical practice will not necessarily have an appreciable change in overall OR efficiency. Interestingly, most surgeons at our institution who were surveyed for this study thought that the regional block team decreased their turnover times. We can only speculate as to the reasons for their perception, in the context of our results. One possibility is that when they visited their patient in between cases, they felt that more rapid entry into the OR would be likely due to the active involvement of an anesthesia team with their patient. Perhaps simply seeing their patient already up in a stretcher with an intravenous catheter placed at an earlier time, gave them the perception that their next case was moving into the OR faster. Regardless of their perception, the reality was that neither first-case starts nor

### Table 5  Surgical response to regional block team effectiveness

<table>
<thead>
<tr>
<th>Surgeon</th>
<th>RBT effective</th>
<th>Reduction in TOT (minutes)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yes</td>
<td>60</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>Yes</td>
<td>45</td>
<td>Changes the quality of my day</td>
</tr>
<tr>
<td>3</td>
<td>No</td>
<td>N/A</td>
<td>This could possibly work depending on the anesthesiologist</td>
</tr>
<tr>
<td>4</td>
<td>Yes</td>
<td>No answer</td>
<td>Small difference noticed</td>
</tr>
<tr>
<td>5</td>
<td>Yes</td>
<td>15</td>
<td>Allows me to leave by 5 PM</td>
</tr>
<tr>
<td>6</td>
<td>No</td>
<td>N/A</td>
<td>Regional blocks always slow down turnover time regardless of additional anesthesiologist</td>
</tr>
<tr>
<td>7</td>
<td>No answer</td>
<td>No answer</td>
<td>No answer</td>
</tr>
<tr>
<td>8</td>
<td>Yes</td>
<td>No answer</td>
<td>Seems to make a difference</td>
</tr>
<tr>
<td>9</td>
<td>Yes</td>
<td>60</td>
<td>Saves me three h per day. Should have the block team every day</td>
</tr>
<tr>
<td>10</td>
<td>No response</td>
<td>No response</td>
<td>No response</td>
</tr>
</tbody>
</table>

The 10 busiest orthopedic surgeons were asked to respond to questions regarding the effectiveness of a regional block team (RBT). The first question simply asked whether or not he/she noticed a decrease in turnover time (TOT) on the days where they noticed the RBT, and if they thought the block team was effective. The second question asked them to indicate the amount of time saved between their cases when a RBT was present. Surgeon no. 7 returned the questionnaire unanswered. Surgeon no. 10 did not respond despite three notices. These 10 surgeons represented 80% of the case volume during the study period. There were 27 attending surgeons who performed orthopedic surgery during the same period. N/A = not applicable.
turnover times improved with the addition of anesthesia staff to our orthopedic ORs.

In our case, an investment of approximately $2000 per day for one additional staff and one additional resident would have needed to save 10 hours of overtime OR time over 6 rooms per day to break even financially. Even adding the potential nursing and technician cost savings would not make a dramatic difference to the cost savings. The contributing factors involved with turnover time are multifactorial and include nurses, surgeons, equipment, and patient-related issues. Only if all these groups work together can turnover time be minimized. Even then, it has been estimated that only when turnover times are cut by 10 to 20 minutes can savings of 2.5% to 4% from staffing costs be appreciated [1]. These savings would not originate from scheduling additional cases, nor from incremental daily savings, but in the actual reallocation of resources in tactical planning for staff. In our ORs, every 15-minute increment beyond 4:00 PM costs the anesthesia department $50 in overtime expenses. Therefore, if turnover time were reduced even by 10 minutes, it could lead to each room that runs beyond 4:00 PM to end 20 minutes earlier each day (assuming three cases per room). This situation would lead to a potential savings of $300 per day, or $75,000 per year.² These savings have to be taken into consideration when determining the initial cost of implementation. Of course, significant savings could occur if OR time could be reallocated into larger blocks so that overtime charges would not start until later in the day. For example, if there were a shift anesthesiologist who worked from noon to 8:00 PM, and OR time were allocated to end at that time, there would be little or no overuse expense. Each department would have to do its own analysis to calculate the optimal OR allocation for expenses [5,9,10]. In Table 4, we show an example of how much “overtime” would result in our orthopedic ORs based on ending times between 2:00 and 5:00 PM. In our model, it would be impossible to save the $2000 per day expense of our block team. Other methods of saving turnover time that did not involve such high expense would be needed to show true overall cost savings. For example, methods such as changing from a standard OR to a minimally invasive one, personal public recognition of excellence, identifying and targeting the major cause of delays, and simply presenting OR efficiency data to the OR staff decrease turnover times 5 to 15 minutes per case [11-13].

Although the current study failed to realize time-based resource advantages with a dedicated regional block team, there may have been a number of qualitative or intangible advantages to having the regional block team that we did not evaluate. For example, residents’ educational experience may have been enhanced because they had more time to perform the regional blocks without the time pressure of a ready room, surgeon, and OR personnel all waiting. Furthermore, because the anesthesiologist in the OR was relieved of the responsibility of performing the block, he or she may have had more time to spend with the residents in the OR, enhancing teaching opportunities. In addition, we did not evaluate whether the regional block team had a higher success rate of blocks, or greater patient satisfaction. Finally, the regional block team introduces a break in the continuity of care for the patient that may be viewed as undesirable for both the patient and the caregiver. Unfortunately, we did not evaluate these measures and can make no specific comments about the possible benefits or disadvantages of a regional block team. Individual departments would need to evaluate these intangibles according to cost constraints and educational goals to determine the relative merits of a dedicated regional block team in the scope of their residency training program.

It is unclear why our orthopedic OR has such lengthy turnover times. Our study did not attempt to answer that question. We can speculate about the reasons, including the fact that the cases require extensive nursing setup, the greater variability in equipment and setup between cases, the need for radiology equipment availability, unique equipment needs, differing prosthesis/devices, longer cleanup times, and an environment in which efficiency historically has not been valued. Even the time of day of the turnover may contribute to the longer than expected turnover time [14]. This study determined only that in this type of environment, the time taken to provide regional anesthesia does not contribute to increased anesthesia-controlled times or turnover times.

Moreover, although our survey seems to indicate that most surgeons appreciated the efforts of the regional block team, and many actually (mistakenly) felt that their turnover times were reduced, ours was not a rigorous, scientific survey. The number of surgeons involved was small, and for that reason, we cannot reach confident conclusions sufficiently to extrapolate our data to surgeons at other institutions or departments. Interestingly, the overall perception of surgeons regarding the anesthesiologist’s influence on turnover times and the relative importance that they place on it may mean that what they really value is the effort of the anesthesiologist. That is to say, regardless of how (little) anesthesiologists contribute to overall turnover times, if it appears as if the anesthesiologist is not “working,” the surgeon believes this to be part of the source of the perceived inefficiency in the overall OR function. More work needs to be done to further illuminate these findings, as they may have important effects in other areas in the hospital where surgeons and anesthesiologists interact (eg, insurance contract negotiations).

In summary, we have shown that the addition of a regional anesthesia block team to a busy orthopedic anesthesia service does not improve turnover time or other measures of OR efficiency. Careful consideration and education of all OR personnel must be undertaken before embarking on a unilateral endeavor to save time. Methods to decrease anesthesia-controlled times simply may increase

---

² Seventy-five percent of 6 rooms run beyond 4:00 PM each day. Therefore, we would save 20 minutes per day in 4.5 rooms on average, or 90 minutes per day on average, leading to a savings of $300 per day.
anesthesia-related costs but bring no overall savings to the OR. Anesthesiologists, surgeons, and other OR personnel need systematically to collaborate on careful evaluation processes to attempt to improve OR efficiency and resultant cost savings. Surgeons continue to perceive that anesthesiologists’ efforts can modify turnover times significantly.

References