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Increased Efficiency of Endocrine Procedures Performed in an Ambulatory Room

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Abstract

Background—Thyroid and parathyroid procedures historically have been viewed as inpatient procedures. Due to advancements in surgical techniques, these procedures were transferred from the inpatient operating room (OR) to the outpatient OR at a single academic institution approximately seven years ago. The goal of this study is to determine whether this change has decreased turnover times and maximized OR utilization.

Methods—We performed a retrospective review of 707 patients undergoing thyroid (34%) and parathyroid (66%) procedures by a single surgeon at our academic institution between 2005 and 2008. Inpatient and outpatient groups were compared using student's t-test, Chi-squared test or the Kruskal-Wallis test where appropriate. Multiple regression analysis was used to determine how patient and hospital factors influenced turnover times.

Results—Turnover times were significantly lower in the outpatient OR (mean 18 min, ± 0.7 min) when compared with the inpatient OR (mean 36 min ±1.4 min) ($p<0.001$). When compared by type of procedure, all turnover times remained significantly lower in the outpatient OR. Patients in both OR's were similar in age, gender, and co-morbidities. However, inpatients had a higher mean ASA score (2.30 vs. 2.13, $p<0.001$) and were more likely to have an operative indication of cancer (23.1% vs. 9.2%, $p<0.001$). Using multiple regression, the inpatient OR remained highly significantly associated with higher turnover times when controlling for these small differences ($p<0.001$).

Conclusion—Endocrine procedures performed in the outpatient OR have significantly faster turnover times leading to cost savings and greater OR utilization for hospitals.

Keywords

Turnover time; Outpatient operating room; Ambulatory procedure; Thyroidectomy; Parathyroidectomy; Operating room efficiency; Resource utilization; Process measures

Introduction

Increasing operating room (OR) costs have driven efforts to improve OR utilization and efficiency. Estimates have shown that nearly three quarters of an OR's working day are wasted each week due to inappropriately prepared patients, unavailability or insufficient OR staff, OR assignment to emergency procedures or congestion in postoperative care units[1]. Therefore, it is economically important for medical institutions to allocate OR resources and staff efficiently.

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Turnover time, or the time required for the anesthesia staff to finish procedures on the first surgical patient and to begin procedures on the upcoming surgical patient after the surgery suite has been sterilized, is often considered an area of OR utilization that requires improvement[2]. Surgeons frequently assert that additional surgical cases could be added if turnover times were reduced. While this continues to be debated, the largest cost reductions associated with lower turnover times come from more predictable OR schedules, which allow more efficient staffing[2,3].

A common strategy for increased OR utilization has been to develop an outpatient OR that is dedicated to less complex cases with more predictable case times. Many surgeries that were previously performed as inpatient procedures, including tonsillectomies and cholecystectomies, are now routinely performed on an outpatient basis[4]. Outpatient ORs can increase operative time efficiency and therefore increase OR utilization by good patient selection and more efficient staffing[5].

Thyroid and parathyroid procedures have historically been viewed as inpatient procedures because of possible complications including hematoma, laryngeal nerve damage and airway compromise[6,7]. However, with advancements in surgical techniques outpatient thyroid surgery has been shown to be effective and safe[8–11]. Consequently, thyroid and parathyroid procedures were transferred from the inpatient OR to the outpatient OR at our academic institution approximately seven years ago. The goal of this study was to determine if this change has decreased turnover times, and hence maximized OR utilization.

Methods

We performed a retrospective review of all patients who underwent thyroidectomy or parathyroidectomy procedures by a single surgeon at the University of Wisconsin Hospital between 2005 and 2008. During this time period the surgeon operated one day per week in the outpatient OR and one day per week in the inpatient OR. There was a similar case mix in each location. The anesthesia staffing was the same in both the inpatient and outpatient ORs. The team consists of a mixture of CRNAs and residents that rotate through both ORs. Over the study period, a total of 1355 procedures during our study period. Of these, 707 met the inclusion criteria (Figure 1). Dates with three or more thyroid and/or parathyroid procedures were included in the study to provide sufficient turnover times. Dates with adrenal procedures were excluded due to lack of comparability between the groups. Additionally, surgery dates that included various general surgery procedures (appendectomy, etc.) between endocrine procedures were excluded.

Patient demographics, operative procedure performed, final pathology, and postoperative complications were obtained from our prospectively maintained Endocrine Surgery database. Electronic anesthesia reports were reviewed for American Society of Anesthesiologists (ASA) physical status classification. Additionally, time data were recorded from these records including: anesthesia start, procedure start, procedure finish, and anesthesia end times. These time data were used to calculate the following: anesthesia time before incision, operative procedure time, anesthesia time after closing, total anesthesia time, and turnover times.

The data for the inpatient and outpatient surgery groups that underwent thyroid and parathyroid procedures were analyzed using SPSS statistical software. All time data were measured in minutes. Continuous variables were compared using an independent student t-test using Levene’s test for equality of variability. Continuous variables in a non-normal distribution were analyzed using the Kruskal-Wallis test. Categorical variables were cross tabulated and analyzed using the chi-squared test. Multiple regression analysis was used to

determine how patient and hospital factors influenced turnover times. *P* values <0.05 were considered significant.

Results

Patients treated in the outpatient and inpatient ORs were similar in age, gender, BMI, and co-morbidities such as hypertension, diabetes mellitus, and coronary artery disease (Table 1). However, there were several factors that were significantly different between the two groups. Inpatients had a slightly higher mean ASA score (2.30 vs. 2.13, p<0.001), were more likely to have an operative indication of cancer, were more likely to have a reoperative procedure and more likely to have renal failure/insufficiency (Table 1).

The turnover times were significantly lower in the outpatient OR when compared with the inpatient OR (Table 2). The overall outpatient OR turnover times were nearly twice as fast when compared to the inpatient OR turnover times (mean 18.5 min ± 0.5 vs 36.5 min ± 1.3) (p<0.001). When compared by type of procedure performed, all turnover times remained significantly lower in the outpatient OR, with reductions of over 20 minutes recorded (Table 2).

In addition to the out of room turnover time, we also analyzed the in room anesthesia times. The anesthesia times before incision time were four minutes shorter in the outpatient OR (mean 18.5 min ± 0.3 min) than in the inpatient OR (mean 22.8 min ± 1.0 min) (p=0.005). Similarly, anesthesia times after conclusion of the surgical procedure were one minute shorter when comparing the outpatient OR (mean 9.7 min ± 0.2 min) to the inpatient OR (mean 10.8 min ± 0.5 min). Case times were longer in the inpatient OR (mean 87 min ± 2.0 min) when compared to the outpatient OR (mean 70 min ± 2.5 min) (p<0.001).

After determining the binary significance of each variable when comparing the inpatient and outpatient ORs, those variables that were significant were analyzed together using multiple regression. The variables analyzed included: patient age, ASA classification, reoperative procedures, operative indication for cancer, renal failure and whether the procedure was performed in the inpatient or outpatient OR. When analyzed using multiple regression, the inpatient OR was significantly associated with higher turnover times (Table 3). In this model, ASA classification (p = 0.032) and an operative indication for cancer (p = 0.007) were also associated with higher turnover times. However, the inpatient/outpatient OR status was the dominant factor influencing turnover times.

Discussion

This study compared turnover times of endocrine procedures performed in an inpatient and outpatient OR. We showed that turnover times decrease significantly when comparing the inpatient and outpatient ORs, with reductions of nearly 20 minutes between cases. Turnover times were significantly lower when comparing each individual procedure turnover times, and were greatest when transitioning from a thyroid to a parathyroid procedure, or vice versa (Table 2). Additionally, the anesthesia time before the incision and the anesthesia time after incision closure were both significantly lower, which further accentuates the difference in turnover times.

Our data supports others that have found reduced anesthesia in-room time in an outpatient OR when compared to an inpatient OR[12]. Our study showed a reduction in turnover times of nearly 20 minutes when comparing the inpatient to outpatient OR's, which is similar to other studies, but the magnitude of reduction was greater. Kenyon *et al* previously reported a reduction in turnover times of 7.1 minutes when changing from a standard OR to a minimally invasive suite[13]. Though our data shows a greater reduction, this correlation

between studies supports a universal reduction in turnover times when changing from an inpatient OR to an outpatient OR. These reductions in turnover times are often attributed to decreased case complexity and lower patient acuity. However, our study design showed that case mix, patient demographics and co-morbidities were similar between the inpatient and outpatient OR's. Therefore, decreased case complexity and lower patient acuity are not the only factors contributing to the decreased turnover times. While our study focused only on parathyroid and thyroid procedures, so that we could control for case mix and complexity, we feel that these findings are likely generalizable to any procedure that could be performed in either an inpatient or outpatient setting (i.e laparoscopic cases, breast cases, skin cases, etc).

The total time difference of 23 minutes between the two groups in this study indicates significantly higher OR utilization in the outpatient OR. It is estimated that the cost of a single OR to a patient or health insurance provider is approximately $20 per minute[14]. Therefore, a cost savings of $460 per procedure can be saved through overall time reductions when comparing the outpatient and inpatient ORs in this study. With an average of 3 to 4 endocrine cases performed per day in the outpatient OR during the study period, there could be a cost reduction between $1,380 and $1,840 per day through reductions in turnover times. Costs of additional medications, beds and additional staff should be added to the above[1], and can lead to an even greater cost savings.

While the costs directly associated with reduced turnover times are significant, the largest cost savings may come from reduced OR staffing[15]. The lower turnover times achieved in the outpatient OR require less OR workload. Consequently, OR staffing costs can be reduced. It is estimated that a reduction in turnover times of 10 to 19 minutes would reduce OR staffing costs by 2.5% to 4.0%[15].

Recent studies have shown that turnover time improvement can result from a variety of factors. Turnover times were reduced by maintaining a fixed OR staff with dedicated manual tasks as well as instituting a more defined protocol for the OR staff[2,16,17]. The greatest reductions in turnover times were observed when similar procedures were performed consecutively, as was the case in this study. Also, because nurses and physicians are generally employed by different entities, their motivation for shorter turnover times might not be the same[16]. Turnover times can be reduced through OR staffing changes aimed at greater efficiency. At our institution the inpatient OR staff are on shifts. The outpatient OR uses a different staffing model that requires the staff only be present until the OR has been sterilized and prepared for the next day's procedures. We believe that this difference in incentive has driven faster turnover times and improved OR efficiency at our institution, and should be researched in the future to determine if a similar staffing model in the inpatient OR could improve turnover times.

Whether reduced turnover time can lead to additional surgical cases remains a controversial topic. In a recent study, turnover times were reduced by 16 minutes after implementing a new staffing model. This resulted in one additional 90-minute procedure during the study[16]. However, prior research showed that decreasing turnover time would only predictably allow an additional case if all procedures were consistently less than 75 minutes[3,18]. The average case time of procedures performed in the outpatient OR for this study was 70 minutes. This indicates that another case could be added reliably in the outpatient OR.

Limitations of our study include the retrospective nature, the single institution, as well as the statistical differences between the groups at baseline. The inpatient OR group had a statistically higher ASA classification, was more likely to have an operative indication of cancer, to be a reoperative procedure and to have renal failure/insufficiency. These

differences were likely due to selection bias, as the more complex cases were electively performed in the inpatient OR during the study period. While cancer and reoperative procedures likely impacted actual operative time, they should not have had a major impact on equipment needs or turnover time. Renal failure patients were done in the main operating room due to the need for dialysis in the immediate perioperative period. To try to control for these differences we did a multivariate analysis, which showed only ASA classification and indication of cancer remained significant. However, the inpatient/outpatient OR status showed a much stronger correlation to longer turnover times than either of these factors.

In conclusion, we found that thyroid and parathyroid procedures performed in an outpatient OR have shorter turnover times when compared to an inpatient OR. This improvement leads to decreased costs through reduced OR time and reduced staffing.

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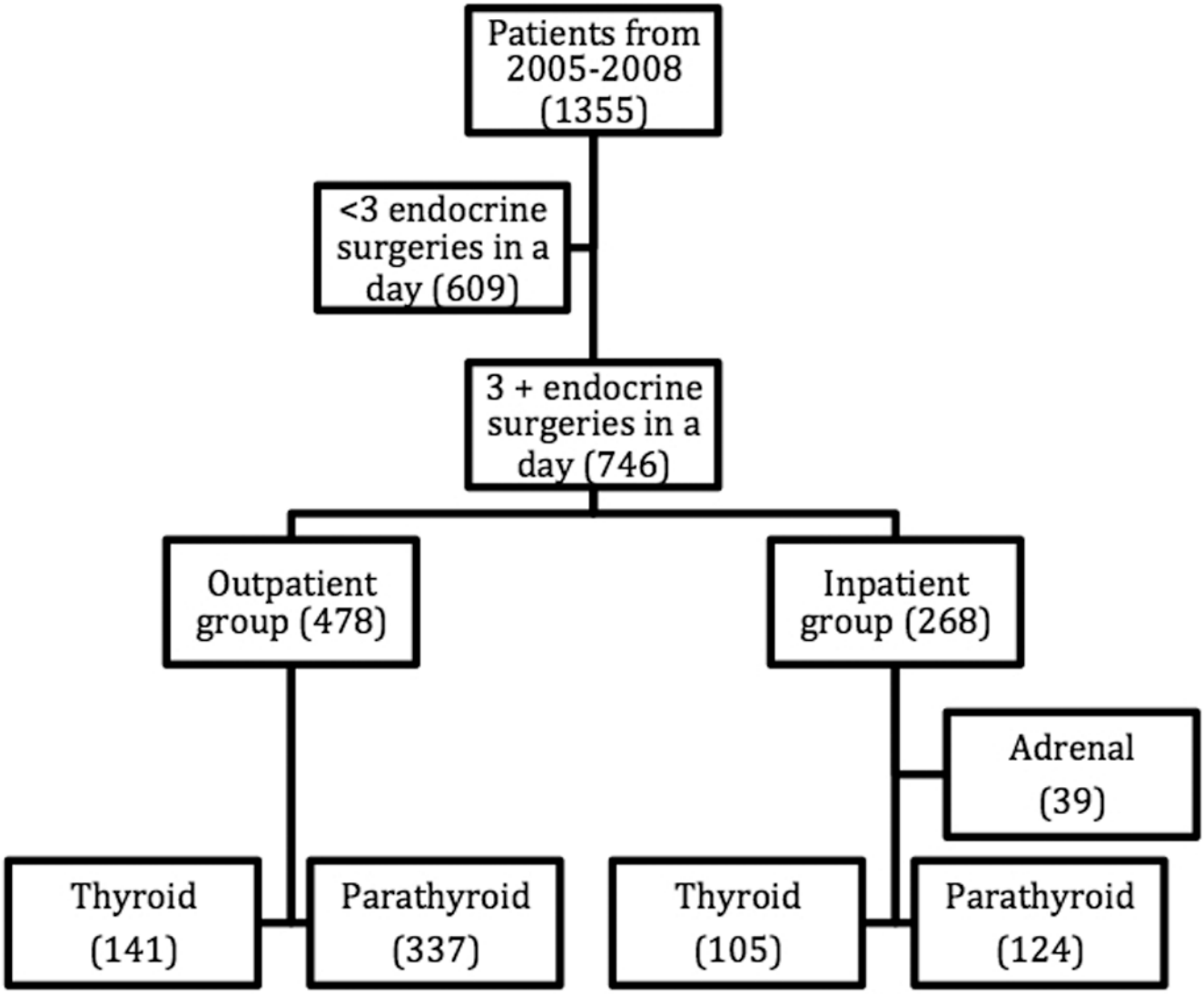

Figure 1.
shows the exclusion criteria for the study. Days with less than 3 endocrine surgeries that ran consecutively were excluded from the study due to insufficient turnover times. Adrenal procedures were only performed in the inpatient OR over the study time period, so these procedures were excluded due to no comparative group in the outpatient OR.

Table 1

Patient demographics

Variable	Inpatient	Outpatient	p-Value
N	229	478	-
Age	57.1 ± 1.1	57.2 ± 0.7	0.97
Female	74.7% (171)	75.3% (375)	0.29
BMI	30.6 ± 0.5	29.8 ± 0.4	0.18
Indication of cancer	23.1% (53)	9.2% (44)	<0.01
Reoperative procedure	17.9% (41)	10.3% (49)	0.005
Hypertension	59.0% (135)	55.2% (264)	0.37
Diabetes mellitus	18.3% (42)	15.5% (74)	0.33
Coronary artery disease	8.7% (20)	7.3% (35)	0.55
Smoking	34.9% (80)	35.4% (169)	0.93
Alcohol consumption	42.4% (97)	46.0% (220)	0.38
Sleep apnea	14.0% (32)	15.7% (75)	0.58
Renal failure	18.8% (43)	6.7 % (32)	<0.01

Table 2

Turnover Times

	Inpatient (min ± SEM)	Outpatient (min ± SEM)	Difference (min)	p-value
Overall	36.5 ± 1.3 (n = 164)	18.5 ± 0.5 (n = 348)	18.0	<0.001
Thyroid/thyroid	34.0 ± 2.5 (n = 29)	17.0 ± 1.2 (n = 26)	17.0	<0.001
Parathyroid/parathyroid	35.6 ± 2.0 (n = 56)	19 ± 1.0 (n = 205)	16.6	<0.001
Different neck procedure	38.1 ± 3.1 (n = 79)	17.8 ± 1.4 (n = 117)	20.3	<0.001

Table 3

Multiple regression analysis

Variable	Coefficient	p-Value	95% CI
Age	−0.02	0.57	[−0.10, 0.06]
Inpatient/Outpatient	17.0	<0.01	[14.4, 19.6]
ASA Classification	2.5	0.03	[0.22, 4.85]
Reoperative	1.6	0.37	[−1.93, 5.22]
Cancer	5.5	<0.01	[1.48, 9.46]
Renal Failure	−0.8	0.66	[−4.56, 2.89]

* Overall p-value for this model <0.001