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Analysis of operating room efficiency between a hospital-owned ambulatory surgical center and hospital outpatient department☆

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ABSTRACT

Background: Ambulatory surgery centers (ASCs) are frequently utilized; however some ambulatory procedures may be performed in hospital outpatient departments (HOPs). Our aim was to compare operating room efficiency between our ASC and HOP.

Methods: We reviewed outpatient general surgery procedures performed at our ASC and HOP. Total case time was divided into five components: ancillary time, procedure time, exit time, turnover time, and nonoperative time.

Results: Overall, 220 procedures were included (114 ASC, 106 HOP). Expressed in minutes, the mean turnover time (29.8 ± 9.6 vs. 24.5 ± 12.7; $p < 0.01$), ancillary time (32.2 ± 7.0 vs. 22.2 ± 4.5; $p < 0.01$), procedure time (77.4 ± 44.9 vs. 56.2 ± 23.0 $p < 0.01$), exit time (11.8 ± 4.4 vs. 8.5 ± 4.3; $p < 0.01$), and nonoperative time (62.9 ± 21.9 vs. 48.7 ± 15.0; $p < 0.01$) were longer at the HOP than at the ASC.

Conclusion: ASC outpatient procedures are more efficient than those performed at our HOP. A system evaluation of our HOP operating room efficiency is necessary.

Introduction

Developments in surgical care and technology have provided an opportunity to perform a variety of outpatient operations. Procedures such as laparoscopic cholecystectomy are now considered safe in the outpatient setting.[1] These and other commonly performed general surgery operations are typically performed in ambulatory surgery centers (ASCs) or hospital outpatient departments (HOPs).[2] ASCs, which have been referred to as "focused factories," are appealing to surgeons as they potentially provide an opportunity to achieve maximum productivity that may not be achieved in HOPs.[3]

Despite the perceived increase in productivity gained from performing operations at ASCs, there is a paucity of data comparing them to their HOP counterparts, especially when both units are owned by the same hospital system. When comparing freestanding ASCs to hospital-based surgical centers, perioperative times at the ASCs have been shown to be significantly shorter,[4] which may lead to an increase in the number of cases that can be performed in a standard workday.

In our hospital system, outpatient general surgery procedures are performed at our hospital-owned ASC and HOP. Yet even with similar case complexity, operating room (OR) workflow is variable in these facilities. In this study, we aimed to compare OR efficiency between these centers. Specifically, we sought to quantify the various components of an operation from patient arrival to the operating suite to patient exit. We hypothesized that all operative components would be shorter in the ASC than the HOP.

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Methods

A retrospective review of all adult outpatient general surgical procedures from May 2017–December 2017 was performed. Institutional review board approval was obtained. The primary inclusion criterion was all outpatient operations performed using general anesthesia by eleven surgeons at our ASC and HOP. Operations that required admission after elective surgery, or those done under local, regional, or monitored anesthesia care were excluded. The total number of patients excluded from the study due to admission to the hospital after outpatient surgery was 38. All of these patients had their surgery performed at the HOP and no patients at the ASC required admission.

Total operative time was divided into five components: ancillary time, procedure time, exit time, turnover time, and nonoperative time (Table 1). These were calculated using information obtained from the OR and anesthesia logs in the electronic medical record. Other data collected included the type of operation performed, American Society of Anesthesiology class, and presence of an attending surgeon delay to the OR. Statistical analysis was performed using the independent sample *t*-test and χ^2 where appropriate. Categorical data were represented as numbers with proportions. Continuous data were summarized using means ± standard deviation (SD). Significance was set at $\alpha = 0.05$. Statistical analysis was performed in SPSS (version 23.0.0.0, IBM, Redmond, WA).

Results

Overall, 220 procedures were performed (114 ASC, 106 HOP). When comparing OR efficiency (in minutes) between the two centers, the mean HOP ancillary time was longer than the ASC (32.2 ± 7.0 vs. 22.2 ± 4.5; $p < 0.01$). In addition, procedure time (77.4 ± 44.9 vs. 56.2 ± 23.0 $p < 0.01$), exit time (11.8 ± 4.4 vs. 8.5 ± 4.3; $p < 0.01$), turnover time (29.8 ± 9.6 vs. 24.5 ± 12.7; $p < 0.01$), and nonoperative time (62.9 ± 21.9 vs. 48.7 ± 15.0; $p < 0.01$) were longer at the HOP than the ASC (Table 2). The average total time per case at the HOP was 140 min while at the ASC it was 104 min. In a 10-h workday this would allow 5.7 cases to be done at the ASC versus 4.2 cases at the HOP.

Both centers had a similar percentage of ASA class II patients (59% ASC, 57% HOP); however, there was a higher percentage of patients with an ASA class III at the HOP than at the ASC (31% vs. 9%; $p < 0.01$). No patients required arterial monitoring or central line placement prior to the procedure. The mean body mass index (BMI) was slightly higher at the HOP than the ASC, (32 kg/m^2 vs. 29 kg/m^2; $p < 0.01$). There were 77 patient at the HOP with a BMI <35 and 104 at the ASC. In patients with a BMI <35 the mean HOP ancillary time was longer than the ASC (31.3 ± 6.3 vs. 21.9 ± 4.4; $p < 0.01$). Attending surgeon delays to the OR occurred more often at the HOP than at the ASC (70% vs. 30%; $p < 0.01$).

The type of outpatient procedures performed at the HOP and ASC can be found in Table 3. Laparoscopic cholecystectomy and open inguinal hernia repair represented 66% of the outpatient procedures. A comparison of the ancillary, turnover and nonoperative time between the HOP and ASC for these procedures can be found in Table 4.

Table 2
Ambulatory surgery center vs. hospital outpatient department operative time components.

Variable	HOP (minutes)	ASC	*p*
Mean ancillary time	32.2 ± 7.0	22.2 ± 4.5	<0.01
Mean procedure time	77.4 ± 44.9	56.2 ± 23.0	<0.01
Mean exit time	11.8 ± 4.4	8.5 ± 4.3	<0.01
Mean turnover time	29.8 ± 9.6	24.5 ± 12.7	<0.01
Mean nonoperative time	62.9 ± 21.9	48.7 ± 15.0	<0.01

ASC, ambulatory surgery center; HOP, hospital outpatient department.

Discussion

In our current study, we demonstrate that outpatient operations at our HOP have a longer mean ancillary time, exit time, turnover time, and higher nonoperative time when compared to the ASC. These results suggest that outpatient operations are more efficiently performed at a dedicated surgery center such as an ASC. This trend was also present when evaluating our most commonly performed operations individually (Table 4). Moreover, we have identified that attending surgeon delays to the OR occurred more often at the HOP. Although this factor can be contributing to the increase in nonoperative time, it does not account for the differences observed across all time components.

A sound understanding of the elements that drive OR inefficiency is paramount. This is necessary to provide adequate quality improvement and improve OR utilization in both hospitals and ASCs. We have previously shown that a significant portion of total operative time in our burn suite is nonoperative, and have identified both patient turnover and patient preparation as the two key components of this inefficiency.[5,6] Similar to our previous studies, here we found that a significant amount of time spent in our outpatient operating suites is nonoperative; however, unlike burn operations, these outpatient procedures do not have extensive patient preparation needs. Our calculated ancillary time was the total time spent preparing the patient for the operation, including both for general anesthesia and patient preparation. The HOP had a 10-min average longer ancillary service time than the ASC. The reason for this is not entirely clear, but may be partly due to our anesthesiologist supervising multiple rooms at once with the possibility for this to affect an on-time induction. Reasons for attending surgeon delays are likely multifactorial and include being involved in other nonelective surgeries at the HOP during days when ambulatory surgeries are taking place or having to evaluate patients on the wards between operations. In our experience, at the ASC there are few, if any, distractions or obligations that may cause delay to the operating suite. Early attending presence to the operating room may affect ancillary time by being available for patient

Table 1
Operating room time components.

Time Component	Definition
Ancillary service time	Time in OR to surgery start
Procedure time	Surgery start to end
Exit time	Surgery end to room exit
Turnover time	Patient out of room to entry of next patient
Nonoperative time	Total time in OR (including turnover time) minus procedure time
Attending surgeon delay	Entry into OR > 10 min after patient arrival

OR, operating room

Table 3
Total outpatient operations performed.

Procedure	HOP, n (%)	ASC, n (%)
Laparoscopic cholecystectomy	28 (26)	52 (46)
Inguinal hernia repair	34 (32)	32 (28)
Umbilical hernia repair	6 (6)	19 (17)
Ventral hernia repair	21 (20)	3 (3)
Mass excision	14 (13)	7 (6)
Laparoscopic peritoneal dialysis catheter placement	2 (0)	0 (0)
Skin grafting	1 (1)	1 (1)

positioning, ensuring that the proper equipment is present for the procedure, and other factors that would lead to improved operating room efficiency. Prior work at our institution has shown that early attending presence improves time to incision in endocrine surgery,[7] and it appears that this factor may be necessary to evaluate across all our specialties.

The total number of outpatient surgeries performed in the United States has grown considerably since the 1980s with the creation of the Medicare inpatient prospective payment system,[8] and over 60% of all surgeries in 2013 were outpatient operations.[9] In a study evaluating over 5 million Medicare outpatient procedures nationwide, components such as surgery time have been shown to be shorter in freestanding ASCs compared to HOPs.[4] However, potentially more complex cases may be done at the HOPs, and in our study this likely explains the significant difference in procedure time between the two. In a single-center study, Trentman et al. showed that total time in the facility after breast surgery was significantly shorter in the ASC than HOP. However, they included patients who were admitted to the hospital postoperatively, which could impact generalizability.[10] One of the few studies evaluating surgical procedures at a hospital-owned ASC versus HOP showed that anterior cruciate ligament repair in orthopedic patients are more cost-effective and efficient when performed at an ASC versus a HOP.[11] The authors believed that the difference observed may be due to the OR system, as well as inconsistent surgical teams, especially in the HOP setting. At our ASC, the OR staff remains until all cases for that particular OR suite are completed, and usually remain consistent throughout the day. Whereas in the HOP, the staff can change throughout the day due to a more shift-based model.

Like most hospital systems, in our institution, certain patient criteria must be met in order to proceed with outpatient surgery. Moreover, patients seen in clinic must have a certain BMI and ASA class to have their surgery at the ASC. Those who do not meet these requirements typically have their outpatient surgery performed at the HOP instead. This is evidenced by the higher percentage of ASA class III patients at the HOP than at the ASC (31% vs. 9%). In our study, patients who underwent surgery at the HOP had a slightly higher mean BMI when compared to those at the ASC, however the difference is likely not clinically significant. Moreover, in patients with a BMI <35, there was a mean difference of almost 10 min in ancillary time between the HOP and ASC likely indicating that the BMI of our patients was not a main driving factor in the difference in time observed.

Table 4
Ambulatory surgery center vs. hospital outpatient department operative time components for LC and IH.

Variable	HOP (minutes)	ASC	*p*
LC mean ancillary time	34.3 ± 6.4	25.4 ± 3.3	<0.01
LC mean turnover time	33.3 ± 9.3	25.8 ± 20.6	<0.01
LC mean nonoperative time	66.1 ± 27.1	45.3 ± 18.1	0.01
IH mean ancillary time	30.2 ± 6.5	20.0 ± 3.9	<0.01
IH mean turnover time	28.1 ± 5.0	23.3 ± 7.3	0.06
IH mean nonoperative time	60.6 ± 17.2	52.2 ± 9.7	<0.01

ASC, ambulatory surgery center; HOP, hospital outpatient department; IH, inguinal hernia repair; LC, laparoscopic cholecystectomy.

Beyond certain patient characteristics dictating the location for an outpatient operation, it has been suggested that physician ownership in freestanding ASCs may have contributed to the shift in outpatient surgery from the hospital setting to the ASC.[12,13] The majority of ASCs continue to be physician owned, however over time hospitals have increased their ownership. This is likely due to the push to deliver surgical care in the lower cost, higher margin ASC setting. In our study, the surgeons had no ownership in either the ASC or HOP, which minimizes any potential bias or financial incentive to perform the surgery at the ASC. However, it is worthwhile to point out that continued physician ownership in ASCs is important. Joint physician and hospital ownership affords the opportunity for physicians to be involved in leadership, quality improvement practices, and profit sharing, which can improve overall patient care.[3]

In our current healthcare system, the OR can account for up to 40% of hospital costs and up to 70% of the revenue generated.[14] Improvement in OR efficiency can have a considerable economic impact, as OR charges are estimated be between $29-$80 a minute, not including anesthesia or surgeon fees.[15] As the number of outpatient procedures continue to rise in the United States, minimizing inefficiency will become even more important. Due to the difference in average total case time between the ASC and HOP, based on our data, it would be possible to do an additional case per day at the ASC in a 10 h work day. On average we are performing outpatient general surgical procedures three days a week at our ASC, which translates into roughly 150 additional procedures per year.

Various methods have been used to improve OR efficiency, including adopting manufacturing principles such as Lean and Six Sigma to minimize waste and improve workflow, and to standardize certain procedural steps.[16,17] Patient preparation and anesthesia induction have also been evaluated for areas to improve nonoperative time.[18,19] Procedure time is difficult to control as there are variations in difficulty based on disease type or patient anatomy. However, there are many common OR processes, including ancillary and janitorial services, as well as anesthesia induction and delivery to the post-anesthesia care unit after operation that can be improved to provide more efficient care. An underappreciated aspect of operating room efficiency includes proper preoperative patient evaluation to minimize surgery cancellations and improve throughput in the outpatient surgery setting. This is achieved through the use of preoperative patient clinics, and more recently telephone-based pre-anesthesia evaluation.[20–22]

Our study has several limitations. As a retrospective study, we were not able to determine all the factors contributing to the various time components. Moreover, we did not gather information on preoperative patient processing (financial, nursing, anesthesia, and surgical consenting) or post-anesthesia care unit length of stay, which could potentially impact OR efficiency. Although we attempted to evaluate similar case types between the HOP and ASC, there was likely an impact from the triage of cases to the HOP that would be considered more difficult or those which had a higher likelihood of requiring postoperative admission. In the future, we plan to prospectively observe a sample of outpatient operations to determine in more detail what the inefficiencies in our general surgery ORs are. We hope to implement new OR processes to improve efficiency and the utilization of OR resources at both facilities that perform outpatient operations.

Conclusion

ASC outpatient procedures are more efficient than those performed at the HOP, specifically with regards to nonoperative time. Attending surgeon delays may be one contributing factor to the increased nonoperative time observed at the HOP compared to the ASC. This data suggests the need for a system evaluation in our hospital system to further improve OR efficiency.

Disclosure

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