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The educating enigma: Does training level impact postoperative outcome in bariatric surgery?☆

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ABSTRACT

Background: Bariatric procedures are complex, and the acceptance of complications by the general public is exceedingly low. Using the database of the Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program, outcomes in bariatric surgery were evaluated to determine the effect of trainees.

Methods: The following data on postoperative complications for patients undergoing bariatric surgery in 2015 were collected: surgical site infections, sepsis, urinary tract infection, duration of hospital stay, operative time, renal failure, pulmonary embolus, deep vein thrombosis, pneumonia, and re-operation. These were analyzed against presence and level of trainees, using analysis of variance after normalizing the data.

Results: Of 168,093 procedures, 125,078 were performed without trainees, 14,883 were performed with a fellow, and 28,132 were performed with a resident. Cases without trainees were 25% Roux-en-Y gastric bypass, 59% sleeve gastrectomy, and 16% other. Cases with fellows were 35% Roux-en-Y gastric bypass, 51% sleeve gastrectomy, and 13% other; cases with residents were 27% Roux-en-Y gastric bypass, 59% sleeve gastrectomy, and 15% other. Patient demographics were similar. Average operative time differed between groups as follows: without trainees, 85 minutes; with residents, 105 minutes; and with fellows, 117 minutes ($P < .001$). Although not dramatically so, infections tended to be a bit more likely with fellows (2% vs 1%; $P < .001$), and the rate of urinary tract infection and hospital stay tended to be greater with either fellows or residents (1% vs 0%; $P < .001$; 2.0 days vs 2.1 days vs 1.8 days; $P < .001$, respectively).

Conclusion: Fellow involvement resulted in the greatest operative times, and the rate of infections, urinary tract infections, and prolonged hospital stay, although statistically greater, were only mildly increased and of questionable clinical importance. These mild increases in postoperative complications may be attributed to prolonged operating room time.

Introduction

Much has changed in medical education since Dr William Halstead developed the concept of residency toward the end of the nineteenth century; however, the system of graduated responsibility remains fairly constant. As the science of medicine and surgery has advanced rapidly, all fields have witnessed increasing subspecialization. In addition, work-hour restrictions decrease the amount of time residents can spend in the hospital. Simultaneously, societal demands have placed increasing emphasis on the quality of patient care and increased involvement at the attending level in patient care. As a result, many have questioned how resident involvement affects patient outcomes.[1] Research on this topic has been particularly robust in the surgical realm, utilizing the database of the American College of Surgeons National Surgical Quality Improvement Program. This database is designed to measure "risk-adjusted surgical outcomes" to improve delivery of quality patient care.[2] Most studies indicate that residents are more likely to be involved with more complex cases, and that this involvement is associated with longer operative time and greater morbidity, but not greater mortality.[3-5]

Bariatric procedures are among the most complex laparoscopic, general surgery cases performed. Because these cases are primarily elective, the threshold for acceptance of complications is low in both the public eye and in an academic center. Previous research

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Table 1
Distribution of personnel involved in bariatric surgical procedures from the MBSAQIP database 2015 (number of cases).

	Roux-en-Y gastric bypass	Sleeve gastrectomy	Other procedures
Performed with resident	7,605 cases	16,589 cases	3,939 cases
Performed with fellow	5,249 cases	7,685 cases	1,949 cases
Performed without a trainee	31,270 cases	73,796 cases	20,012 cases

has demonstrated that the learning curve for these complex cases is high.[6] Thus, a fellowship is generally required to attain adequate surgical skills to perform these procedures. Residents are often involved in bariatric procedures; as such, their participation in cases have become commonplace. The degree to which residents are involved, however, is variable.

In 2012, the American College of Surgeons and the American Society for Metabolic and Bariatric Surgery combined their efforts to create the Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program (MBSAQIP).[7] This database tracks outcomes in bariatric surgery, as well as the level of trainees and assistants involved in surgical cases. The purpose of this study was to determine the effect that resident and fellow involvement in bariatric procedures may have on overall patient outcome at accredited bariatric centers.

Methods

To explore our hypothesis, the MBSAQIP database was queried for all patients undergoing bariatric surgery from January 1, 2015, until December 31, 2015, from 791 centers of excellence, with a total of 168,092 patients. The database does not distinguish between the various centers of excellence in terms of an academic or strictly clinical setting.

Cases were categorized as either Roux-en-Y gastric bypass (RYNGB), sleeve gastrectomy (SG), or other. This third category consisted of a variety of bariatric procedures, including revisions, duodenal switches, and conversions. Laparoscopic gastric band procedures were not included in this study secondary to a preponderance of incomplete outcome data.

The level of assistant was recorded for each case and divided into 3 groups: no trainee involvement, fellow involvement, or resident involvement. The level of resident involved could not be gleaned from the database. The group without trainees consisted of another surgeon or a surgical assistant.

Data were collected regarding postoperative complications, including surgical site infections (SSIs), sepsis, urinary tract infection (UTI), duration of hospital of stay, operative time, renal failure, pulmonary embolism, deep vein thrombosis, pneumonia, and re-operation. These variables were then analyzed against the presence and level of trainees, using the analysis of variance test (IBM SPSS Statistics for Windows, v 22.0, IBM Corp, Armonk, NY).

Results

Of the 168,092 procedures that met inclusion criteria, 125,078 were performed without trainee involvement, 14,883 with a fellow, and 28,132 with a resident. Of the cases without trainees, 25% were RYNGB, 59% were SG, and 16% were other, the category of miscellaneous cases previously described. Cases in which fellows were involved consisted of 35% RYNGB, 51% SG, and 13% other. Cases with residents consisted of 27% RYNGB, 59% SG, and 15% other (Table 1). The 3 groups were similar with regard to patient age, body mass index, and comorbidities.

The duration of the operations differed significantly ($P < .001$), depending on trainee involvement. The presence of fellows resulted in the greatest duration of operation, which averaged 117 minutes. The average case that utilized residents took 105 minutes. Cases performed with neither resident nor fellow involvement were the shortest in duration: an average of 85 minutes. The operative time with fellows was consistently greater regardless of the type of procedure performed (Fig. 1). The standard deviations were 61.66, 56.85, and 50.25 minutes, respectively, because of the highly skewed nature of the data. Analysis of variance was performed after the data were normalized with a log10 transformation. The mean operative time was 2.02 ± 0.21 with fellow involvement, 1.97 ± 0.20 with resident involvement, and 1.88 ± 0.22 without trainee involvement.

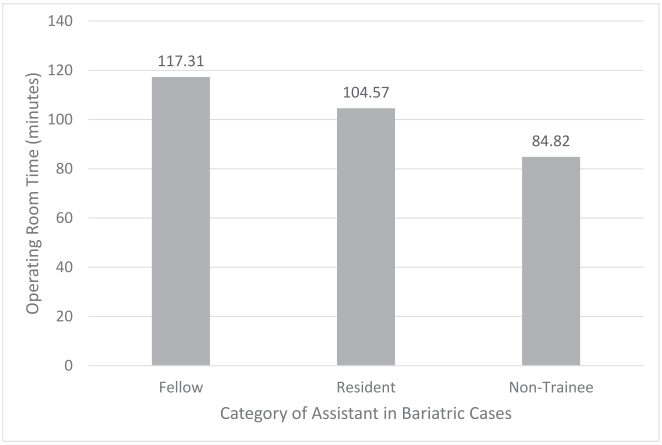

Fig. 1. Variability in operating room time, based on category of bariatric case assistant.

Postoperative complications were reviewed for all cases. Postoperative infectious events were further categorized as either UTIs or SSIs. The rate of UTI was similar clinically with both fellow and resident involvement compared with cases performed without trainees (1% vs 0%; $P < .05$). In terms of SSIs, the database included superficial, deep, and organ-space infections within this same group. SSIs were also slightly more likely with fellow involvement (2%) compared with cases performed with either residents (1%) or solely practicing surgeons and their assistants (1%; $P < .05$). No difference in leak or bleeding rates were identified.

The duration of stay varied depending on whether residents or fellows were involved in patient care. With residents, the average duration of stay was 2.0 days, whereas with fellows, the average length of stay was 2.1 days. Cases performed without trainees resulted in an average of 1.8 days in the hospital ($P < .05$). No differences were noted with regard to sepsis, renal failure, pulmonary embolism, deep vein thrombosis, pneumonia, or re-operation rate when comparing the presence or absence of trainees.

Discussion

In this retrospective review of the MBSAQIP database, trainee involvement in bariatric surgery cases was associated with greater operative times, mildly prolonged duration of stay, and statistically

significant but clinically similar risk of infectious events. Of interest, the presence of fellows that increased time in the operating room more profoundly than residents when compared with nontrainees. This finding may at first glance be somewhat counterintuitive, because technical advancement in surgical training is associated typically with improved manual dexterity and, therefore, operative speed, as well as improved sterile technique.

It is generally well established that fellowship training is imperative to establish proficiency as a bariatric surgeon; as such, it is becoming increasingly important to obtain credentialing.[8] Bariatric procedures are technically demanding, implying that, on average, autonomy is most likely obtained during the course of such a fellowship. The greater operative time observed with fellow involvement in bariatric surgery cases, more so than resident involvement, is most likely the result of increased participation and the development of such autonomy. The presence of residents and fellows has also been used as a surrogate for a learning environment in general.[9] Thus, prolonged operating room time may be related to nursing students, certified registered nurse anesthetist students, and residents in other specialties, participating throughout the operating room in various capacities. This latter explanation, however, does not fully explain why cases involving fellows are significantly greater than cases involving residents. It is our belief that the prolonged operative time seen in cases involving fellows is most likely the result of fellow performing the majority or entirety of the procedure.

Although the increase in duration of hospital stay seen with trainee involvement was statistically significant, the difference between 2.1 or 2.0 days and 1.8 days is not likely to be clinically important. This increase may, however, affect hospital charges associated with the procedures. Bariatric procedures are elective by nature, which typically results in standardized postoperative pathways. There is concern that readmission rates may increase if patients are discharged too early; however, this fear has not been borne out in the literature.[10,11] The time of discharge should be carefully assessed to ensure that patients can stay hydrated adequately to avoid future admissions. Increased durations of stay in training centers may be the result of inherent systemic inefficiencies within such a hospital environment that delay discharges.

Additionally, the increased duration of stay, as well as the mild differences in rates of infection and UTI, may be the result of variations in perioperative care. Previous studies have demonstrated that the increased morbidity seen in bariatric surgery patients cared for by residents is more likely influenced by perioperative management strategies than surgical technique.[12] As such, a system of graduated autonomy for patient management similar to that utilized in the operating room was suggested. Whether the statistically significant but small differences in morbidity seen in large database studies is clinically relevant has been questioned, and we acknowledge these concerns.[13] The previously discussed possible correlation between the presence of residents and fellows and the inclusion of other learners in the operating room may also explain the increased incidence of UTIs observed in patients cared for by trainees.

Several studies have demonstrated an increased risk of SSI with prolonged operating room time.[14-17] Trainee involvement has been shown to be associated with longer case length, although conclusions regarding the impact on patient outcomes, particularly the effect on surgical site infections, have varied.[3,9,18,19] This study is interesting in that trainee involvement was further divided by level, either resident or fellow. As such, confounding variables, such as technical skill, propensity of attending surgeons to spend time teaching, and the general learning environment, may be at least partially negated. Bariatric procedures utilizing fellows were significantly longer and slightly more likely to result in SSI.

Because this study is a retrospective database review, there are several limitations. Most important, it is impossible to draw conclusions regarding cause and effect. In addition, several variables of interest are not included in the database. Bariatric procedures involving fellows were compared with cases involving either residents or nontrainees, but the postgraduate year of the resident and the degree of training of the surgeon's assistant could not be ascertained. The degree to which and duration of which the fellows, residents, and nontrainees actually participated in the operation was not available. Hospitals participating in the MBSAQIP may not adequately represent all sites at which bariatric surgical procedures are performed. The inability to differentiate between academic centers that may provide care for patients with more comorbidities versus strictly clinical centers in the community may lead to selection bias in which residents and fellows are operating on more complex patients. Nevertheless, this study presents the novel finding that operative times in bariatric procedures utilizing fellows are prolonged with some slight effects on duration of hospitalization and SSIs and UTIs.

Academic medical centers have the obligation to train the next generation of surgeons, but also the responsibility of ensuring a high level of patient care. The association between resident involvement in bariatric procedures and increased risk-adjusted complication rates has been reported previously.[9] There are various potential avenues for improvement. The Fundamentals of Endoscopic Surgery and the Fundamentals of Laparoscopic Surgery are now required by the American College of Surgeons before completion of surgical residency. These programs, which combine didactic and simulator learning, have resulted in improved technical skills.[20] Similarly, time dedicated to cadaver dissection has been demonstrated to decrease operative time and increase trainee autonomy.[21] Similar programs may be a beneficial adjunct in advanced laparoscopy or bariatric surgery training programs. These should be considered for more training outside the operating room for fellows to improve efficiency before assuming the primary surgeon role.

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Discussion

Dr Gary Dunnington (Indianapolis, IN): Congratulations to Dr Bonner and her group for an important addition to the literature. While there is a growing body of literature on this issue of resident impact on surgical outcomes, this paper is unique in that it examines specifically the impact of fellows. I think there is a good conclusion as to why times may have been longer for fellows even compared with residents, greater autonomy, but as well, the case index was clearly greater for that group.

I think one of the challenges for reviewing studies like this on the impact of trainee involvement on outcomes is the challenge of whether the outcome examined is the result of intraoperative factors or perioperative care. There is another large series in the literature by Haskins, for example, that lists a large number of complications, such as cardiac events, pulmonary events, et cetera, that may be as much a result of postoperative care, the presence of advanced practice providers, or other factors. In both studies, issues like postoperative bleeding and leak rates, which are more likely to be specific to intraoperative factors, are unchanged with this group of trainees.

The other issue in this paper, of course, is autonomy. As the authors have identified, it's very difficult to assess the degree of autonomy in these large databases. It seems going forward this problem could be answered by the now readily available Zwisch scale or the simple app that will hopefully will make these studies going forward much more precise in assessing the autonomy of either the resident or the operating fellow.

As we look at autonomy, I think there are clearly two kinds of autonomy. No autonomy comes without its cost, and we've recognized that for years, but there is an acceptable, appropriate level of autonomy that comes when residents and fellows have been adequately trained on all of the substeps in the surgical skills laboratory and those skills have been verified as meeting proficiency standards. Then there is the kind of autonomy that I was granted in my residency where none of those things were taught ahead of time and we learned them all in the operating room. So, it does raise questions about whether or not there needs to be more specific training, maybe even for fellows. We've sort of disregarded that in most of our skills curriculum. So, I have these questions.

Since there are no described skills curriculum for fellows, such as MIS bariatric, should we reconsider that in light of your findings?

Second, most would acknowledge that complex procedures, such as bariatric surgery or even HPB surgery, warrant graduated autonomy in residency training. In your own program, how do you sequence this graduated autonomy before a senior resident or a fellow is allowed to do the entire procedure, with only passive assistance on the Zwisch scale or supervision only?

Finally, clearly, it's been demonstrated that there are a number of bariatric centers of excellence and training programs without MIS and bariatric fellows. What would you recommend for the senior resident involvement in bariatric cases at these programs as it is unlikely that these non-fellowshipâ€"trained general surgeons will ever perform bariatric surgery in their practice subsequently?

Thanks very much for the privilege of discussing the paper.

Dr Gwen Bonner: Thank you, Dr Dunnington, for your thoughtful questions. I'll start at the beginning.

Yes, I think fellowship programs should utilize the simulation lab for skills training. I think my generation is very comfortable in the simulation lab since the introduction of FLS and FES. We spend hours there. I don't think there's any substitute for learning on real patients in the operating room, but certainly familiarizing yourself with the instruments and getting down that muscle memory will help you be more successful in the operating room when you are given a chance to operate with your attending and perform key components of the case.

For your second question, I think without knowing it, my fellowship program does quite well adhering to the Zwisch scale of autonomy. I know for the first couple of cases that I did with the attending I usually operated with, I started out observing. They were explaining the key components of the case, why they do things in a certain sequence with a certain set of techniques, and then from there graduating to assisting and attempting to anticipate their moves in order to be helpful in the case. Finally, to the passive assistance and supervision only. I think at this point with about five months left in fellowship, I'm probably between the two with more straightforward cases. I can usually get through the case, correct my mistakes by myself with a little guidance, but with more complicated cases still requiring some guidance.

I think that is an appropriate way to teach residents and fellows, and I think it's safe for the patient and should be utilized in the future at other programs. I think this is a natural thing that a lot of people do, but without knowing it and calling it the Zwisch scale of autonomy.

Then for your last question, I actually came from a residency program that had a bariatric center of excellence for busy bariatric surgeons and no fellow. I think that the experience the residents had on that service was very variable. Some residents were not very interested and only performed EG at the end of the case. Some of us who spent a little more time in the operating room in the clinic got to do a little bit more. But I think an appropriate

goal for a general surgery resident on a bariatric service would be to learn those skills that can be translatable across general surgery.

So, learning appropriate tissue handling when we run the bowel for Roux-en-Y gastric bypass or performing an extracorporeal anastomosis, which we do in general surgery as well, those would be appropriate goals for a resident to get out of their bariatric surgery rotation.

Dr R. Matthew Walsh (Cleveland, OH): I like the title. It's also an enigma for patients. Now that you know these data, do you think it changes your informed consent of what you tell your patient if you're part of a training program?

Dr Gwen Bonner: Sure. I've had patients ask that on several occasions. Who is going to be in the operating room? Who is going to be performing the procedure? I think it's very appropriate to say that a Roux-en-Y gastric bypass and a sleeve gastrectomy is a two-surgeon procedure and that I will perform it with my attending. I usually leave it at that without too much explanation.

I do think it's important that we all recognize that the attending is not going to let the trainee do anything unsafe and is going to be there to correct any mistakes or fix any problems. As long as we're adhering to the Zwisch scale of autonomy in which there's appropriate supervision, I think that is safe and appropriate for patients.

Dr R. Matthew Walsh (Cleveland, OH): Since so many of these things are directly related to time, apparently, do you think you should have more of a time-focus approach to the operation where, if you don't succeed in doing a certain part of a step in a certain amount of time, that staff should take over?

Dr Gwen Bonner: I think that's reasonable. If it's taking forever, I think it's reasonable.

Dr R. Matthew Walsh (Cleveland, OH): Do you do that? As a result of your study, have you changed how the fellows are trained? In some MIS programs for advanced HPB and MIS/HPB, there are certain definite time points at which you have to get things done to be the operating surgeon.

Dr Gwen Bonner: Well, that might be a question that's better answered by my fellowship director and associate director. But I think it's important to look at the clock and make sure you're not taking too long in the procedure, but, without even looking at the clock, you can tell if you're making progress in a case. Every attending surgeon is going to have a different level of tolerance for how long they are willing to let the trainee struggle, and I think it's just important that the case continues to make progress, that the trainee is not struggling.

Dr R. Matthew Walsh (Cleveland, OH): The length of stay is interesting, but my specific question is, do you know how many patients were discharged on day number 1?

Dr Gwen Bonner: No. That data could potentially be ascertained from the database, I believe. But with 168,000 cases, breaking that down case by case would probably be challenging. In our practice, sleeves usually stay for one day. Roux-en-Y gastric bypasses usually stay for two, but I can't extrapolate that data for all 168,000 cases.