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Correlation of procedural numbers with meaningful procedural autonomy in general surgery residents

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Abstract
Background: Concerns exist regarding the competency of general surgery graduates with performing core general surgery procedures. Current competence assessment incorporates minimal procedural numbers requirements.
Methods: Based on the Zwisch scale, the level of autonomy achieved by categorical PGY1-5 general surgery residents at 14 general surgery resident training programs over a period of one year. With 5 of the most commonly performed core general surgery procedures, we correlated the level of autonomy achieved by each resident with the number of procedures they had performed before the evaluation period, with the intent of identifying specific target numbers that would correlate with the achievement of meaningful autonomy for each procedure with most residents.
Results: Whereas a definitive target number was identified for laparoscopic appendectomy (i.e. 25), for the other 4 procedures studied (i.e. laparoscopic cholecystectomy, 52; open inguinal hernia repair, 42; ventral hernia repair, 35; and partial colectomy, 60), target numbers identified were less definitive and/ or were higher than many residents will experience during their surgical residency training.
Conclusions: We conclude that procedural target numbers are generally not effective in predicting procedural competence and should not be used as the basis for determining residents' readiness for independent practice.

Keywords: general surgery, procedural autonomy, residents

Introduction

Concerns have been raised about the effectiveness of current general surgery resident training in adequately preparing residents for independent practice [1, 7], including residents' ability to perform core general surgery procedures independently. Currently the final summative evaluation of each resident's operative competence, which is required in order to take the Masters of Surgery qualifying exam, is based primarily on 2 things. The first is the cumulative end-of-rotation assessments, which combine judgment of operative performance with that of other performance parameters. This assessment process is not standardized, and there is significant variability between programs, including the assessment methods used for operative performance. Within programs, operative performance assessments are typically not completed consistently or in a timely manner by faculty [8]. The second requirement is achievement of minimal procedural numbers. These number requirements are not based on individual procedures, but rather on defined categories of related procedures. No data currently exist to demonstrate that there is correlation between these defined category numbers requirements and individual resident competence with specific procedures within the same defined category [9] Furthermore, there is limited evidence supporting reliable correlation between the numbers of a specific procedure that trainees are exposed to and the achievement of procedural competence for that specific procedure [10, 11].

Competency-based training requires that trainees achieve an acceptable level of competence with specific entrustable professional activities (EPAs) [12, 13] before they can be entrusted to perform this activity independently in clinical practice. This determination is therefore not necessarily dependent on the number of procedures they have performed. Performance of core operative procedures is perhaps the most essential EPA for surgical training. Resident autonomy in performing core operative procedures is a critical indicator of competency because supervising surgeons are unlikely to grant significant autonomy to a resident unless they believe he or she is competent. In this study we will attempt to determine if there is correlation between the numbers of core procedures performed by surgery residents and the level of competency they achieve with that procedure.

Methods

This study was conducted in the Department of General Surgery, Government Medical College, Srinagar after taking the permission from the institutional ethical committee. Resident operative performance assessments were collected between August 1, 2018, and November 31, 2019, at 14 general surgery residency training programs belonging to the Procedural Learning and Safety Collaborative (PLSC). Data were collected using SIMPL, a smart phone app-based system that was developed to facilitate timely assessment of residents' operative autonomy and performance with every procedure they participate in [14, 17]. SIMPL assessments include 3 scales used to determine 1) the autonomy level achieved by the resident during the procedure using the Zwisch scale 2) the performance level of the resident during

the operative procedure; and 3) the patient-related relative complexity of the case compared with other identical/similar procedures. After the completion of a surgical procedure the SIMPL assessment process is initiated by the resident (or the supervising surgical faculty member) who first identifies the faculty surgeon (or resident) that they just operated with from a drop-down list in the app. Next they identify the procedure that was performed from a procedure list derived from the ACGME case log taxonomy. To ensure that assessments are performed in a timely manner, those that are not completed within 72 hours of initiation cannot be entered into the SIMPL database.

This study included data collected from all participating categorical general surgery residents (PGY1-5). For each individual resident participating in the study, a mean Zwisch score was determined based on the autonomy level they achieved during their total experience with each of these 5 procedures they performed during the entire study period. Only residents who had performed the procedure being evaluated at least 3 times were included in the analyses for that specific procedure. Additionally, the number of each of these procedures each resident had performed from the start of their residency until the start of the study period was collected.

For each of the 5 core procedures evaluated, individual residents' mean Zwisch scores achieved during the study period were plotted against the number of procedures they had performed before the study period. We determined the best fitted linear line to summarize the relationship between prior procedural experience and autonomy level achieved.

Meaningful autonomy was defined as having achieved a mean Zwisch score of ≥3 (based on numerical conversion of the Zwisch scale: i.e. Show and Tell = 1, Active Help = 2, Passive Help = 3, Supervision Only = 4) for the procedure in question during the study period.

Results

During the study period we collected SIMPL assessments for 10,130 total surgical performances (332 different types of procedures) by 536 surgical residents who were assessed by 444 supervising surgical faculty. Of the SIMPL assessments performed, 73.4% (7,437) involved procedures categorized as "core" for general surgery [18]

For laparoscopic appendectomy, 55 residents performed ≥3 procedures during the study period. Of these, 31 (56.4%) achieved a mean autonomy level of ≥3. Based on the best-fit line of the intersection point with the meaningful autonomy line, the "transition point" was determined to be at 25 procedures, and all 22 (100%) of the residents who performed more than 25 laparoscopic appendectomies achieved meaningful autonomy.

With laparoscopic cholecystectomy, 89 residents performed ≥3 procedures during the study period. Of these, 41 (46.1%) achieved a mean autonomy level of ≥3. The transition point was determined to be at 52 procedures, and 17 (73.9%) of the 23 residents who had performed this many procedures achieved meaningful autonomy.

With open inguinal hernia repair, 54 residents performed ≥3 procedures during the study period. Of these, 21 (38.9%) achieved a mean autonomy level ≥3. The transition point was determined to be at 42 procedures. However, only 2 (28.6%) of the 7 residents who performed this many procedures achieved meaningful autonomy. For ventral hernia repair, 40 residents performed ≥3 procedures during the study period. Of these, 14 (35%) achieved a mean autonomy level of ≥3. The transition was determined to be at 35, although only 2 (50%) of the 4 residents who performed this many procedures achieved meaningful autonomy for partial colectomy, 39 residents performed ≥3 procedures during the study period. Of these, 11 (28.2%) achieved a mean autonomy level of ≥3. The transition point was determined to be at 60, but only 2 residents performed this many procedures, although both (100%) achieved meaningful autonomy (Fig 2E). These results are summarized in Table 1.

Table 1: Relationship of Procedural Numbers with Meaningful Autonomy in Surgical Residents

Procedure	Residents #s	Inception point procedure #s	Transition point procedure #s	%Meaningful autonomy IP—TP (n)	% Meaningful autonomy beyond IP (n)	% Meaningful autonomy beyond TP (n)
Laparoscopic Appendectomy	55	13	25	60% (9)	83.8% (31)	100% (22)
Laparoscopic Cholecystectomy	89	19	52	56.4% (22)	62.9% (39)	73.9% (17)
Open Inguinal Hernia Repair	54	9	42	58.1% (18)	52.6% (20)	28.6% (2)
Ventral Hernia Repair	40	20	35	63.2% (12)	60.9% (14)	50% (2)
Partial Colectomy	39	23	60	40% (8)	45.5% (10)	100% (2)

Discussion

The findings in this study suggest that specific procedural target numbers that correlate with the achievement of procedural competency in surgical residency training may be identifiable for some core surgical procedures, but will likely be difficult to define for most of the 132 core procedures. We identified what appear to be reliable target numbers for laparoscopic appendectomy and laparoscopic cholecystectomy, the two most commonly performed procedures. With laparoscopic appendectomy, the target number was most reliable, as all (100%) residents who performed at least 25 procedures.

With open inguinal hernia, ventral hernia, and partial colectomy, the target numbers identified using the "best-fit" process need to be further refined once additional observations are available. With open inguinal hernia and ventral hernia, the target numbers did not clearly identify a transition point beyond which the majority of residents achieved meaningful autonomy. For partial colectomy, technically this transition point was identified by the target number, although the majority of residents who achieved meaningful autonomy beyond the target number consisted of only 2 residents. These analyses may be further enhanced by increased data collection.

Another concern is that the procedural target numbers identified using this approach may be higher than the numbers that most residents may experience during their entire residency. We have previously shown that in the last 6 months of their training PGY5 residents achieve meaningful autonomy, with only 69% of the core general

surgery procedures they perform, 17 although higher percentages (≥85%) are achieved with the 4 most frequently performed procedures. For less frequently performed core procedures, it may be unrealistic to expect all surgical trainees to achieve these defined targets during their training [10, 11].

One limitation of this analysis is the lack of a widely accepted objective standard for defining procedural competence. The criteria we have chosen for this study are based on the mean level of autonomy achieved by the resident performing the procedure in question during the defined study period. Because the autonomy level achieved by the resident is entirely dependent on the autonomy level granted by the supervising faculty, higher levels of autonomy are typically granted only when the resident has gained the trust of the supervising faculty based on their demonstration of competence. One might argue that there is no stronger endorsement of a resident's competence by a supervising surgeon than to let the resident do the procedure with a high level of autonomy. Still, other factors, including procedural complexity, programmatic culture, and individual faculty demeanor, may also influence the amount of autonomy granted, and this may confound our results [17]. Although procedural numbers are easy to monitor and evaluate, if these numbers are not used in conjunction with a system that accurately monitors progressive competence, they can be misleading in determining who is ready for independent practice. There appears to be some correlation between procedural numbers and progressive autonomy, but there is such a high degree of variability between individual residents that it is likely not possible to select a single procedural target number that would reliably be used to predict procedural competence for all trainees. Therefore serious consideration needs to be given to converting to a system that is based primarily on assessment of competence in the clinical workplace rather than based solely on a procedural target number.

Conclusion

Finally, with ongoing monitoring of residents' progressive autonomy, problems can be identified at the level of individual residents, at the level of programs, and at a national level. To address problems that are identified at any of these levels, interventions can be deployed and their impact monitored. Faculty can also be monitored to identify problems in granting autonomy and initiate appropriate faculty development initiatives to resolve these problems.

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