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ORIGINAL ARTICLE

Operative experience of general surgery residents: Results of a cross-sectional multinstitutional study in Colombia

Experiencia operatoria de los residentes de cirugía general: Resultados de un estudio transversal multinstitucional en Colombia

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Abstract

Introduction. A critical part of training a surgical resident is achieving sufficient operating volume to achieve adequate competence in their independent practice. Both volume and autonomy are challenges for general surgery residency programs in Colombia.

Methods. A multinstitutional study was performed, with the participation of 5 specialization programs in general surgery, from different regions of the country. The electronic Logbook was used to record procedures for a period of 12 months. An analysis of the collected database was made.

Results. A total of 111 resident physicians participated in the study. There were 29,622 surgical procedures registered, corresponding to 23,206 patients. Overall, 51.7% of the procedures were elective surgeries, 46.9% were urgent surgeries and 1% were emergency. 22.6% of the procedures were performed through a minimally invasive approach. The five most frequently recorded surgical procedures were: cholecystectomy (n=4341), appendectomy (n=2558), inguinal herniorrhaphy (n=2059), umbilical herniorrhaphy (n=1225), and peritoneal lavage (n=1198). On average, each resident performed 27 surgeries per month, and in these procedures the predominant role of the resident was that of the main surgeon, from early in their training (from the second year on).

Discussion. It is possible to achieve a national record of activities through a log. Colombian resident physicians perform a number of surgeries similar or greater than those described in other countries. We must update our expectations based on the training currently received by resident physicians.

Keywords: education, medical; health postgraduate programs; general surgery; competency-based education; registries; electronic records; Colombia.

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Resumen

Introducción. Una parte fundamental del entrenamiento de un residente de cirugía es lograr un volumen operatorio suficiente para alcanzar una competencia adecuada en su vida laboral independiente. Tanto el volumen como la autonomía, son desafíos para los programas de residencia en cirugía general de Colombia.

Métodos. Se realizó un estudio multinstitucional, con la participación de 5 programas de especialización en cirugía general, de diferentes regiones del país. Se utilizó la bitácora electrónica Logbook para el registro de procedimientos durante un periodo de 12 meses. Se hizo un análisis de la base de datos recolectada.

Resultados. Un total de 111 médicos residentes participaron en el estudio. Se registraron 29.622 procedimientos quirúrgicos, que correspondieron a 23.206 pacientes. El 51,7 % de los procedimientos fueron cirugías electivas, el 46,9 % cirugías de urgencia y el 1 % de emergencia. El 22,6 % de los procedimientos se realizó a través de un abordaje mínimamente invasivo. Los cinco procedimientos quirúrgicos más frecuentemente registrados fueron: colecistectomía (n=4341), apendicectomía (n=2558), herniorrafia inguinal (n=2059), herniorrafia umbilical (n=1225) y lavado peritoneal (n=1198). En promedio, cada residente realizó 27 cirugías por mes y en estos procedimientos el rol predominante del residente fue el de cirujano principal, desde momentos tempranos en su formación (a partir del segundo año).

Discusión. Es posible lograr a nivel nacional el registro de las actividades a través de una bitácora. Los médicos residentes colombianos realizan un número de cirugías similares o mayores a lo descrito en otros países. Debemos actualizar nuestras expectativas según la formación que reciben actualmente los médicos residentes.

Palabras clave: educación médica; programas de postgrado; cirugía general; educación basada en competencias; sistema de registros; registros electrónicos; Colombia.

Introduction

A fundamental part of the training of a surgical resident is to achieve a sufficient operative volume, with the gradual acquisition of autonomy to complete surgical procedures independently, as supervision diminishes [1]. Both volume and autonomy are challenges for residency programs in general surgery [2]. These challenges can be explained, among other things, by the development of subspecialties dedicated to increasingly complex surgical techniques, by policies to reduce hospital work hours, and by growing concerns about patient-centered outcomes and organizational efficiency [3,4]. In other words, the demand for greater efficiency in the operating room may conflict with teaching processes.

In response, surgical training programs have evolved towards competency-based education models, which aim to guarantee the training of competent and trustworthy surgeons for society, within educational standards and specific criteria of operative experience [5-7].

This model reflects the evolution of the criteria focused on the minimum number of surgical procedures in which the resident must participate as the main surgeon, towards comprehensive criteria for evaluating operative competence. The requirements of a minimum operative volume lack objective information and evidence that accounts for its impact on learning and professional competence [8,9]. Completing a minimum number of procedures, therefore, does not necessarily guarantee that a surgeon is technically competent. Therefore, within the comprehensive assessment of professional competence, within the framework of competence-based education, Entrustable Professional Activities (EPA) have gained relevance in Europe and North America during the last decade [10].

In Colombia, the experience is similar. The Colombian Association of Schools of Medicine (ASCOFAME, for its acronym in Spanish) proposed more than two decades ago, a minimum number of surgical procedures that a surgical resident must perform before graduating [11]. These procedures

include, for example, fifty thoracostomies, fifty thyroidectomies, twenty amputations, twenty gastrectomies, and fifty open cholecystectomies with cholangiography, among others. However, the acceptance of these requirements has been variable among the programs of the country and the exposure of the resident to this minimum number of procedures has been difficult to achieve for different reasons, among them the dynamics of the health system, the demographic variability, contracting systems and access to technology [12]. Additionally, there are no published records in the country that reflect the operative experience of a surgical resident in accordance with the ASCOFAME requirements, as well as the organizational capacity of the residency programs to guarantee them. Likewise, most programs have traditional surgical education curricula and have not migrated to models of competence-based education, focused on rigorous evaluation of operative performance (for example, through EPA).

On the other hand, a common problem that underlies the challenge of the minimums and of the evaluation of the operative competence of the surgery residents in Colombia, has to do with the scarce information on the real activity of the surgeons, compared to the demographic and epidemiological needs of the country. In other words, information is still needed to account for the most frequent procedures performed by surgeons in Colombia, to adapt the capacity of residency programs to the training of reliable surgeons in specific procedures. Some isolated projects have made it possible to know the frequency and type of procedures carried out by residents, as well as the level of autonomy and supervision they experience [13,14], but information at the national level is scarce and insufficient, for which knowledge of the regional variability of surgical activity in general surgery is scarce. This information is crucial for the twenty active residency programs in the country to channel their efforts in evaluating the operative competence of residents in specific high-prevalence procedures. On the other hand, this information can help define the limits and scope of specialization programs in general surgery with respect to those of second specialties.

The present study, carried out by the Colombian Association of Surgery, with the participation of several Colombian residency programs, aims to provide information regarding these knowledge gaps. Our objective is to describe the type and frequency of surgical procedures in which general surgery residents in Colombia participate.

Methods

Study design

Multinstitutional, cross-sectional study, carried out in June 2020, on a database collected prospectively between April 2019 and March 2020.

Participants

The study was carried out in five residency programs in General Surgery in Colombia. A total of 111 surgical residents of all levels of training, from two public and three private universities, located in three different cities of the country, as well as the directors of these programs, were invited to participate.

Collection of information and variables

The information was collected through the use of an electronic log to record surgical procedures and the Logbook platform (www.logbook.com.co) was used.

This log compiles information filled out by the resident doctor at the end of each surgical procedure in which he participates. The registration can be done from any device with internet access and the main variables it contains are:

1. Patient identification.
2. Postoperative diagnosis according to the International Classification of Diseases (ICD-10).
3. Scope of the surgical procedure: elective, urgent, or emergent.
4. Current rotation of the resident (for example: general surgery, vascular surgery, etc.)

5. Year of residence.
6. Type of surgical procedure: open or minimally invasive.
7. Surgical procedure performed. The platform has a predetermined list of more than three hundred surgical procedures from which the resident can choose one or more procedures per patient. The platform allows the inclusion of non-predetermined procedures through the option Other procedure.
8. Role of the resident during the surgical procedure: main surgeon, first assistant or second assistant.
9. Self-evaluation of the resident on his operative performance. This self-evaluation is carried out based on a Likert Scale (1: poor performance, 5: excellent performance).

The information collected was stored in the Logbook database and reports were sent periodically to the universities for review by the directors of each residency program. Additionally, each resident had access to their records from their user profile.

Statistical analysis

The information obtained is presented in totals, means, averages and percentages. All analyses were performed in Excel (Microsoft Corp).

The residents were not in the same year of residence during the study period, so atypical values were found in the initial data that could be a source of noise for the analysis. To eliminate bias when calculating the averages, the interquartile range method was used, which eliminates those values much higher than the third quartile and those much lower than the second. After applying it to the data set, the calculation of the monthly and annual averages could be carried out.

Results

A total of 111 residents participated in the study. Among the participants, 72.9% registered at least five procedures per month. 29,622 surgical procedures were registered, corresponding to 23,206 patients, considering that several procedures were performed in each patient (1.3 procedures per patient). 65.7% of the procedures were performed during general surgery rotations, 51.7% of the procedures were elective surgeries, 46.9% were urgent surgeries, and 1% were emergency surgeries. 22.6% of the procedures were performed through a minimally invasive approach (31.4% laparoscopically).

The characteristics of the procedures reported by each participating program are presented in table 1, and the distribution of procedures by type of rotation is presented in table 2. The five most frequent surgical procedures recorded were: cholecystectomy (n=4341), appendectomy (n=2558), inguinal herniorrhaphy (n=2059), umbilical herniorrhaphy (n=1225), and peritoneal lavage (n=1198). The percentage of these procedures performed by minimally invasive approach was as follows: cholecystectomy (77.5%), appendectomy (33.5%), and inguinal herniorrhaphy (16.1). The list of the most frequent procedures and diagnoses is presented in the tables 3 and 4.

The distribution of procedures by year of residence was as follows: first year 6181 (20.9%), second year 9570 (32.3%), third year 7980 (26.9%), and fourth year 5891 (19.9 %)%). The role of the resident during the first year of residency was first assistant in 55% of the procedures, and from the second year, the predominant role was the main surgeon (58.3% second year, 63.8% third year, and 72,7% in fourth year) (Figure 1). In 70.9% of the procedures, the residents self-assessed their performance as Excellent (Figure 2).

With the information available, it was inferred what the training of the average resident would be year by year. Thus, at the end of the residency, the median number of procedures would be 1,297 records (Table 5).

Discussion

The main findings of this study were:

1 On average, each resident performed 27 surgeries per month; more than 50% of these procedures were elective and were performed in general surgery rotations;

Table 1. Procedures carried out in the participating programs.

Program	1	2	3	4	5
Type	Public	Public	Private	Private	Private
Number of residents of General Surgery	27	11	21	36	16
Total records	3104	4626	3353	9626	2497
Total procedures	3954	6335	3957	12,369	3007
Number of elective procedures (%)	2436 (61.6%)	3035 (47.9%)	1999 (50.5%)	5704 (46.1%)	1958 (65.1%)
Number of urgent procedures (%)	1306 (33%)	3130 (49.4%)	1896 (47.9%)	6561 (53%)	1004 (33.4%)
Number of urgent procedures (%)	122 (3.1%)	170 (2.7%)	62 (1.6%)	102 (0.8%)	45 (1.5%)
Number of minimally invasive procedures (%)	1042 (26.4%)	1067 (16.8%)	979 (24.7%)	2528 (20.4%)	1065 (35.4%)
Average records per resident per month	9.6	35	13.3	22.3	13
Average number of procedures per resident per month	9.6	35	15.7	28.6	15.7

Table 2. Number and percentage of procedures per rotation.

Rotation	Number of procedures	%
General surgery	15247	65.7
Head and neck surgery	1125	4.8
Pediatric surgery	888	3.8
Vascular surgery	737	3.2
Laparoscopic surgery	732	3.2
Colon and rectal surgery	581	2.5
Trauma surgery	444	1.9
Hepatobiliary surgery and transplants	441	1.9
Breast and soft tissue surgery	354	1.5
Thoracic surgery	348	1.5
Other rotations (Cardiovascular, Gastrointestinal, Oncological, Plastic, Gastroenterology, Intensive Care, Bariatric, Urology)	2309	10

2 The main procedures in which the residents participated were: cholecystectomy, appendectomy, hernia repairs of the abdominal wall, and peritoneal lavage (these procedures were performed predominantly open, with the exception of cholecystectomy);

3 In these procedures, the predominant role of the resident was that of the main surgeon from early moments in their training (from the second year on).

There are several explanations for the first finding. With a median of 306.6 registrations per year, a resident would graduate with 1,226 registrations at the end of their training. These data are similar to that reported in the literature. It is important to remember that surgical experience and exposure can vary even within several programs in the same city, depending on the places of rotation, focus of the university curriculum, and method of measurement, among others [1,9,13,15,16]. At the national level, Niño evaluated the logs of

Table 3. More common procedures.

Procedure	Number	%
Cholecystectomy	4341	14.7
Appendectomy	2558	8.6
Inguinal herniorrhaphy	2059	7
Umbilical herniorrhaphy	1225	4.1
Peritoneal lavage	1198	4
Exploratory laparotomy	970	3.3
Diagnostic laparoscopy	816	2.8
Thoracostomy	725	2.4
Total thyroidectomy	642	2.2
Safenectomy	587	2
Varicectomy	516	1.7
Simple ventral hernia repair	448	1.5
Implantable venous catheter	434	1.5
Soft tissue abscess drainage	394	1.3
Lipoma resection	394	1.3
Lysis of adhesions	348	1.2
Subclavian central venous catheter	339	1.1
Central neck dissection	326	1.1
Tracheostomy	285	0.9
Small bowel anastomosis	267	0.9

Table 4. Most frequent diagnoses (ICD-10).

Diagnosis	Number	%
Acute appendicitis, unspecified	1993	8.6
Gallbladder stone with acute cholecystitis	1594	6.9
Unilateral or unspecified inguinal hernia, without obstruction or gangrene	1421	6.1
Other cholelithiasis	1166	5
Umbilical hernia without obstruction or gangrene	1092	4.7
Gallbladder stone without cholecystitis	800	3.4
Malignant tumor of the thyroid gland	670	2.9
Ventral hernia without obstruction or gangrene	565	2.4
Venous insufficiency (chronic) (peripheral)	487	2.1
Bilateral inguinal hernia, without obstruction or gangrene	447	1.9
Acute cholecystitis	389	1.7
Malignant tumor of breast, unspecified section	312	1.3
Acute peritonitis	278	1.2
Gallbladder stone with other cholecystitis	258	1.1
Acute appendicitis with peritoneal abscess	242	1
Other peritonitis	235	1
Bowel fistula	227	1
Benign lipomatous tumor of the skin and subcutaneous tissue of the torso	209	0.9
Acute appendicitis with generalized peritonitis	197	0.8
Malignant tumor of the rectum	193	0.8
Malignant tumor of the ascending colon	175	0.8

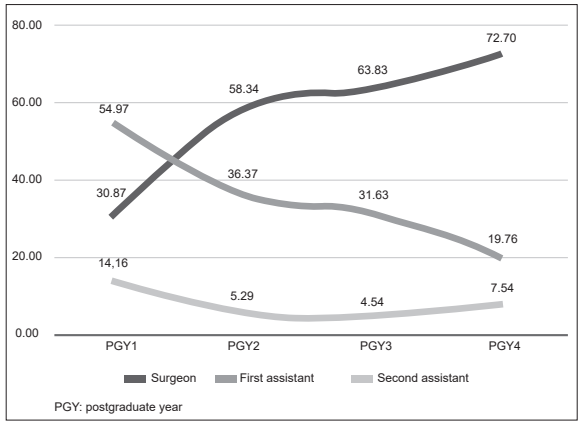

Figure 1. Role of the resident according to year of residence.

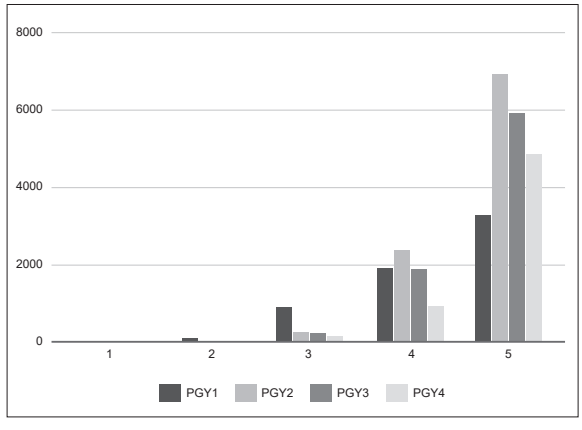

Figure 2. Self-evaluation according to year of residence.

Table 5. Distribution of procedures by year of residence.

Year of residence	Average entries / month	Average entries / year
First year	23.4	280.8
Second year	23.3	279.5
Third year	36.6	439.2
Fourth year	24.8	298.2
Total		1297.7

thirty-seven residents of the Universidad del Rosario over a period of 11 years and found, with significant variability, an average of 496 (+ 230) surgeries per year in his program [13]. Being the present study a joint effort, carried out in 3 cities of the country, this information is an important addition to the existing data aggregate.

On the other hand, in two Spanish reports on the Surgical resident's computer book, Gómez-Diaz and Serra-Aracil described an average of 250 and 265 surgeries per year of residence in Spain, respectively [17,18]. For their part, Elsey et al, carried out a detailed review of the surgical experience at the end of the residency worldwide and analyzed the differences between countries [9]. Among their most relevant findings they describe a scarcity of data in countries other than the United States, due to the marked variability in the total surgeries performed at the end of the residency and due to the lack of agreement on the minimum number of surgeries required in the programs. In the United States, for example, a range of 600–2785 procedures per resident is reported, while in the United Kingdom it is 783–3764 (at the end of residency).

The average number of surgeries per year of residence in the countries evaluated in the meta-analysis was 307 and 319 in two studies in Great Britain, 232 in the Netherlands, 183 in the United States, and 196 in Thailand. It is extremely important to bear in mind that the duration of residence is different in each of these countries. Their meta-analysis yielded an estimate of 1366 (95% CI 1026-1707) surgeries per resident at the completion of their residency, with significant heterogeneity (I2 99.6%).

Several countries have a minimum number of surgeries as evaluation, promotion and graduation criteria. Among them, the examples of the United States (minimum of 850 surgeries, with 200 of them in the last year) [19], the United Kingdom (1600 surgeries) [9], and Spain (423 surgeries as main surgeon) [18] stand out. In Chile, for example, the Society of Surgeons of Chile suggests for its programs at least 300 major operations as a surgeon and another 400 as an assistant [20]. In the country, the minimum number of procedures is not a grade requirement or a quality measurer. With the information presented here, it is not yet possible to suggest a minimum expected number and it is necessary to carry out a longer data collection and a more in-depth analysis of these results.

When analyzing the other results, we show that residents are exposed, almost in equal proportion, to urgent and elective surgery, and very infrequently to emergent surgery. The general surgery rotation contributes the vast majority of registered cases and possibly has to do with the great percentage destined for this rotation during residency programs in Colombia. The second specialty rotations have a homogeneous distribution of the number of records, all much lower than the general surgery rotation, possibly due to the complexity of the procedures, the presence of Fellows in the rotations and the shorter time for these rotations in the postgraduate curriculum.

Regarding the second finding, the most frequently performed surgeries reflect what is possibly the day-to-day life of a general surgeon in the country and could definitely be included as tracer or index surgeries during surgical training, in order to have a follow-up on the participation of residents in these procedures. The minimally invasive route was reported in 22.6% of the total surgeries, a figure higher than the 16% reported in the Spanish experience [18]. It should be clarified that this data is taken from all the available procedures. By reducing this list to procedures in the abdomen and even more for more frequent procedures, we see a significant percentage in their use, in accordance with the current trend

regarding management standards in highly prevalent diseases, both urgent (appendicitis, cholecystitis) and elective (cholelithiasis, inguinal hernias).

Regarding the last finding, related to autonomy, it is important to mention that the residents of the evaluated programs played a main role in more than half of the cases reported in their registries, acting as a "surgeon" in a large number of patients. This role increases, as the resident progresses in his level of training.

However, the role that a resident assigns to their participation in a procedure does not fully measure the competence to carry it out. As mentioned before, compliance with a minimum number of procedures does not ensure that a resident is able to perform it independently upon graduation. There is a constant interest in improving the current deficiencies in autonomy and confidence to achieve a safe independent surgical practice. An adequate balance between autonomy and supervision, as the training progresses, has positive effects on the academic, professional and clinical performance of the resident. In 2018, Domínguez et al, compared the perceptions, between surgeons and residents, on autonomy and supervision for some surgical procedures. Although there was congruence in most of them, in some of the most frequent procedures, there were statistically significant differences, attributed among others to novel techniques, patients undergoing complex surgeries and institutional policies that lead to the resident ultimately not achieving the expected autonomy under less supervision [1]. That being said, it is valuable in the future to add the instructor feedback tracking to the resident's records for a more objective evaluation of their performance.

Strengths and limitations of the study

This study has several strengths, such as the participation of several surgery programs from different regions of the country, the use of a standardized tool (Bitácora Logbook), which favors comparisons between programs and individuals and is customizable to each program according to their lists of instructors, hospitals and rotations, and finally, the adequate adherence of residents, with records during the 12 months of the study.

However, the study also has limitations. One of these is the veracity of the data, which in most cases depends on the resident, since each record is not directly validated by a supervisor (this is a common problem in most logs). Likewise, the statistics shown depend exclusively on a correct completion of the electronic log. Finally, the evaluation period is short (12 months) and the self-evaluation is subjective and does not involve the instructor feedback.

Implications for practice and future research opportunities

We hope to be able to increase the participating universities and achieve a longer period of time in the future. Likewise, it is ideal to involve the supervising surgeon, so that he or she can review the information in the records and optimize the self-assessment measure of the resident's performance, according to validated scales for this. If possible and knowing the experiences of other countries, to also be able to log not only its surgical activity but also academic and research participation, which allows to know a more comprehensive profile of the resident.

Conclusions

It is possible to achieve a logbook registry at the national level. For this, the participation of the general surgery programs' directors and residents is important, as well as the use of a user friendly tool that can be molded to the needs. Colombian residents perform a number of surgeries similar or greater than those described in other countries and play a leading role in most of them. The statistic states that we must update our expectations based on the training that residents currently receive.

Compliance with ethical standards

Informed consent: The work did not involve experiments with human beings and the norms of the Declaration of Helsinki of 1975 were observed, for which reason no informed consent was required by the patients.

Conflict of interest: The authors declare no conflict of interest.

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Authors' contributions:

- Conception and design of the study: Sebastian Sierra, Luis Carlos Domínguez, Lilian Torregrosa.
- Data acquisition: Sebastian Sierra.
- Data analysis and interpretation: Sebastian Sierra, Luis Carlos Domínguez, Lilian Torregrosa.
- Drafting the manuscript: Sebastian Sierra, Luis Carlos Domínguez, Lilian Torregrosa.
- Critical review: Sebastian Sierra, Luis Carlos Domínguez, Lilian Torregrosa.

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