

Original Research Article

Did general surgeons surgical spectrum changed over time? A retrospective comparative study in a South Indian tertiary care centre between 2009 and 2018

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ABSTRACT

Background: General surgery discipline has fragmented into several subspecialties over the past. This division has affected the surgical spectrum of general surgeons. Studies comparing the changes in the general surgeon's work spectrum were done in the '90s but not in the recent past. Our study aims to compare the surgical spectrum of general surgeons between two time periods in our institute.

Methods: We performed a retrospective study comparing the elective surgeries performed by general surgeons in the year 2009 and 2018 in an academic tertiary care centre.

Results: There was a 28.9% rise in the total number of elective surgeries (1567 vs. 2020) in our study. There was a significant rise in the mean age of surgical patients (39.7 years vs. 41.9 years) but with no change in M: F ratio (1.7: 1). There was a significant rise in Hernia surgeries and Varicose veins surgeries ($p < 0.001$) along with a rise in anal surgeries ($p = 0.018$). There was a significant decrease in Breast surgeries ($p = 0.02$) and Thyroid surgeries ($p < 0.001$). There was a dramatic rise in the laparoscopic cholecystectomy rate (23.2% vs. 52%) and a fall in the laparoscopic appendectomy rate (26.3% vs. 8%). Open inguinal hernia surgeries were the most common surgeries performed in both the years.

Conclusions: There was an increase in the surgical volume for general surgeons but the surgical spectrum has narrowed. We recommend conducting periodic surgical audits in institutions to monitor and maintain the standards of surgeries performed by general surgeons.

Keywords: General surgeon, Elective surgery, Spectrum, Laparoscopy

INTRODUCTION

General surgery has been the main broad specialty from which many surgical specialties have derived. In the beginning, this broad specialty was purely identified as "surgery".¹ In the past, multiple subspecialties have split off from general surgery, and in the current era, there is further fragmentation. Fernández-Cruz L has even defined general surgery as education and not a specialization.² In this background, the spectrum of

surgeries performed by a general surgeon has changed significantly. To observe these changes, a study that compares the surgical audits of two different periods is essential. Studies that compare the general surgeon's surgical spectrum have been published in America but not in India.^{1,3-5} Given the increasing subspecialties and fragmentation of general surgery, there is a need to study and compare the various types of surgical procedures performed by a general surgeon in the past and the present with a significant time interval.

Our current study aims to observe the change in the varieties of elective operations performed by general surgeons in the department of general surgery in our institute between 2009 and 2018 with a time interval of 10 years.

METHODS

Study place and population

This retrospective comparative cohort study was conducted in the Department of General Surgery, Gandhi Medical College and Hospital, in our teaching tertiary care centre in Southern India.

Inclusion criteria were all the elective surgeries operative data recorded in the register of our elective operation theatre complex in the year 2009 and 2018. Exclusion criteria were emergency surgeries in 2009 and 2018, bed side elective minor surgical procedures and incomplete elective surgeries data.

The data from the year 2009 was labelled as group-I and from 2018 as group-II. The following parameters were recorded: patient's age, gender, diagnosis, and operative intervention. The outcome variables such as hospital stay, morbidity, and mortality were not analyzed due to the dearth of proper records for comparison.

Our institutional ethics review committee has exempted our study from ethics approval as our study was a retrospective study without the direct involvement of human participants.

Data collection and statistical analysis

The data was collected manually from the records maintained in the elective operation theatre complex

which was entered and analyzed in Microsoft Word & Excel (Microsoft Word & Excel 2010®, Microsoft, Redmond, USA) and statistical analysis was performed using a web-based open source software, Open Epi, version 3.01.⁶ The tests of statistical significance used in our study were Pearson's Chi-square test for categorical variables and student's t-test for continuous variables. We considered $p < 0.05$ with a confidence interval (CI) of 95% as statistically significant.

RESULTS

Age and gender

A total of 1567 patients were operated in the year 2009 (group-I) and 2020 patients in the year 2018 (group-II). Out of 1567 patients (age range=8 to 88 years) in group-I, 62.73% (n=983) were males (age range=8 to 88 years) and 37.27% (n=584) were females (age range=8 to 83 years) giving M:F ratio of 1.68:1. Out of 2020 patients (age range=12 to 83 years) in group-II, 62.47% (n=1262) were males (age range=12 to 83 years) and 37.53% (n=758) were females (age range=12 to 83 years) giving M:F ratio of 1.66:1. The mean age of patients in group-I was 39.7 ± 16.03 years whereas in group-II it was 41.9 ± 15.20 years. The difference in mean age was 2.2 years which is significant ($p < 0.001$). The mean age of males in group-I was 41.6 ± 16.45 years whereas in group-II it was 43.7 ± 15.53 years ($p = 0.002$). The mean age of females in group-I was 36.5 ± 14.75 years whereas in group-II it was 38.9 ± 14.14 years ($p = 0.003$). The median age of group-I and group-II was 38 years and 41 years respectively. The median age of males in Group-I and group-II was 40 years and 44.5 years respectively. The median age of females in group-I and group-II was 35 years and 38 years respectively (Table 1).

Table 1: Comparing the demographics of patients operated in group-I & group-II with p values.

| Demographics | Group-I (Year 2009) | Group-II (Year 2018) | P value |
|---------------------------------------------|---------------------|----------------------|----------------------------|
| Range (years) | | | |
| Male | 8 to 88 | 12 to 83 | |
| Female | 8 to 83 | 12 to 83 | |
| Total | 8 to 88 | 12 to 83 | |
| Mean age \pm SD (years) | | | |
| Male | 41.6 ± 16.45 | 43.7 ± 15.53 | 0.002 (two sample t-test) |
| Female | 36.5 ± 14.75 | 38.9 ± 14.14 | 0.003 (two sample t-test) |
| Total | 39.7 ± 16.03 | 41.9 ± 15.20 | <0.001 (two sample t-test) |
| Median age (years) | | | |
| Male | 40 | 44.5 | |
| Female | 35 | 38 | |
| Total | 38 | 41 | |
| Gender | | | |
| Male | 983 (62.73%) | 1262 (62.47%) | |
| Female | 584 (37.27%) | 758 (37.53%) | |
| Total | 1567 (100%) | 2020 (100%) | 0.875 (Chi-square test) |
| M:F ratio | 1.68 : 1 | 1.66 : 1 | |

The most common age group in group-I was 20-29 years (23.1%, n=362) followed by 30-39 years (20%, n=313) (Table 2) whereas in group-II, the most common age group was 30-39 years (22.22%, n=449) followed by 40-49 years (21%, n=424) (Table 3). The comparison between age groups of group-I & II is given in (Table 4). There was a significant change in all the age groups ($p < 0.05$) except 70-89 years and 30-39 years age group ($p > 0.05$).

Table 2: The gender-wise distribution of different age groups in group-I.

| Age group (years) | Male group-I N (%) | Female group-I N (%) | Total group-I N (%) |
|-------------------|--------------------|----------------------|---------------------|
| 0-9 | 2 (0.2) | 1 (0.17) | 3 (0.21) |
| 10-19 | 69 (7) | 65 (11.13) | 134 (8.5) |
| 20-29 | 212 (21.56) | 150 (25.7) | 362 (23.1) |
| 30-39 | 171 (17.4) | 142 (24.31) | 313 (20) |
| 40-49 | 161 (16.36) | 104 (17.8) | 265 (16.9) |
| 50-59 | 173 (17.6) | 54 (9.24) | 227 (14.53) |
| 60-69 | 147 (15) | 55 (9.42) | 202 (12.9) |
| 70-79 | 41 (4.17) | 10 (1.72) | 51 (3.23) |
| 80-89 | 7 (0.71) | 3 (0.51) | 10 (0.63) |
| Total | 983 (100) | 584 (100) | 1567 (100) |

Table 3: Showing the gender-wise distribution of different age groups in group-II.

| Age group (years) | Male Group-II N (%) | Female Group-II N (%) | Total Group-II N (%) |
|-------------------|---------------------|-----------------------|----------------------|
| 0-9 | 0 | 0 | 0 (0) |
| 10-19 | 58 (4.6) | 57 (7.53) | 115 (5.7) |
| 20-29 | 196 (15.53) | 149 (19.66) | 345 (17.08) |
| 30-39 | 260 (20.61) | 189 (25) | 449 (22.22) |
| 40-49 | 255 (20.21) | 169 (22.3) | 424 (21) |
| 50-59 | 256 (20.3) | 122 (16) | 378 (18.7) |
| 60-69 | 161 (12.75) | 54 (7.13) | 215 (10.64) |
| 70-79 | 63 (5) | 13 (1.72) | 76 (3.76) |
| 80-89 | 13 (1) | 5 (0.66) | 18 (0.9) |
| Total | 1262 (100) | 758 (100) | 2020 (100) |

Spectrum of surgeries

A good number of surgeries were done in 2009 and 2018. Most commonly the surgeries were performed on the gastrointestinal tract in group-I (27%, n=422) closely followed by hernias (26.35%, n=413) whereas, in group-II, surgery for hernia (31.5%, n=636) was most commonly performed followed by gastrointestinal tract (25.9%, n=523). While there was a significant increase in the number of hernia surgeries from group-I to group-II ($p < 0.001$) there was no significant change in GIT surgeries from group-I to group-II (Table 5). All the surgeries are discussed under separate headings.

Table 4: Comparing different age groups in group-I and group-II.

| Age group (years) | Group-I N (%) | Group-II N (%) | P value | Change (%) |
|-------------------|---------------|----------------|---------|------------|
| 0-9 | 3 (0.21) | 0 (0) | 0.049 | ↓0.21* |
| 10-19 | 134 (8.5) | 115 (5.7) | <0.001 | ↓2.8* |
| 20-29 | 362 (23.1) | 345 (17.08) | <0.001 | ↓6.02* |
| 30-39 | 313 (20) | 449 (22.22) | 0.101 | ↑2.22** |
| 40-49 | 265 (16.9) | 424 (21) | 0.002 | ↑4.1* |
| 50-59 | 227 (14.53) | 378 (18.7) | <0.001 | ↑4.17* |
| 60-69 | 202 (12.9) | 215 (10.64) | 0.037 | ↓2.26* |
| 70-79 | 51 (3.23) | 76 (3.76) | 0.414 | ↑0.53** |
| 80-89 | 10 (0.63) | 18 (0.9) | 0.393 | ↑0.27** |
| Total | 1567 (100) | 2020 (100) | <0.001 | ↑28.9* |

*Significant increase/decrease, **Insignificant increase/decrease.

Hernia

A Total of 413 (26.35%) patients got operated for hernia in 2009 and 636 (31.5%) patients got operated in 2018 (table-5). These hernias include inguinal (direct, indirect) and ventral (epigastric, umbilical, Para umbilical, incisional) hernias. Inguinal hernia surgeries include open herniorrhaphy and hernioplasty and Laparoscopic (Lap) meshplasty. Ventral hernia surgeries include open meshplasty and anatomical repair (Table 6). The proportion of ventral hernias increased from 2009 to 2018 (20.8% vs. 36.2%). Laparoscopic hernia surgeries have reduced (4.9% vs. 1.7%) from group-I to group-II.

Gastrointestinal tract

A total of 422 patients (27%) got operated on the gastrointestinal tract in 2009 compared to 523 patients (25.9%) in 2018. There was a significant decrease in gastric surgeries (7.8% vs. 3.6%, $p=0.005$), Lap appendectomies (26.3% vs. 8%, $p<0.001$), diagnostic laparoscopy (6.4% vs. 3.3%, $p=0.022$) and miscellaneous procedures (5.9% vs. 2.9%, $p=0.02$) from 2009 to 2018. There was a significant increase in lap cholecystectomies (23.2% vs. 52%, $p<0.001$) from 2009 to 2018. There was no significant change in elective splenectomies, bowel surgeries, and rectal surgeries from group-I to group-II ($p>0.05$). Abdominal surgeries are summarized in (Table 7).

Table 5: comparing the spectrum of elective surgeries in group-I & II.

| Surgery On | Group-I (2009) N (%) | Group-II (2018) N (%) | P value | Change (%) |
|--------------------------|-------------------------|--------------------------|---------|------------|
| Hernia | 413 (26.35) | 636 (31.5) | <0.001 | ↑5.15* |
| GIT | 422 (27) | 523 (25.9) | 0.483 | ↓ 1.1** |
| Breast | 152 (9.7) | 152 (7.5) | 0.02 | ↓2.2* |
| Varicose veins | 58 (3.7) | 129 (6.4) | <0.001 | ↑2.7* |
| Hydrocele | 122 (7.8) | 130 (6.43) | 0.116 | ↓1.37** |
| Swelling excision | 102 (6.5) | 86 (4.25) | 0.002 | ↓4.25* |
| Anus | 93 (6) | 161 (8) | 0.018 | ↑2* |
| Thyroid | 64 (4) | 41 (2) | <0.001 | ↓2* |
| Uro-genital | 47 (3) | 30 (1.48) | 0.002 | ↓1.52* |
| SSG | 18 (1.15) | 18 (0.9) | 0.442 | ↓0.25** |
| Salivary Glands | 9 (0.6) | 19 (0.94) | 0.216 | ↑0.34** |
| Pilonidal sinus | 7 (0.4) | 18 (0.9) | 0.112 | ↑0.5** |
| Others | 60 (3.8) | 77 (3.8) | 0.978 | |
| Total | 1567 (100) | 2020 (100) | <0.001 | |

*Significant increase/decrease; **Insignificant increase/decrease

Table 6: Comparing the hernia procedures between group-I & II.

| Hernia surgeries | Group-I N (%) | Group-II N (%) |
|------------------------|------------------|-------------------|
| Inguinal Hernia | 327 (79.2) | 406 (63.8) |
| Open | 307 (74.3) | 395 (62.1) |
| Lap | 20 (4.9) | 11 (1.7) |
| Ventral Hernia | 86 (20.8) | 230 (36.2) |
| Total | 413 (100) | 636 (100) |

Breast surgeries

Out of 1567 cases in 2009, 152 (9.7%) patients got operated on the breast. We classified breast surgeries broadly into lump excision (fibroadenomas, undiagnosed lumps, duct ectasia excisions) and mastectomies (includes all types of mastectomies). In 2009 there were 5.56% (n=87) lump excisions and 4.14% (n=65) mastectomies. In 2018, out of 2020 cases, 152 (7.5%) patients got operated on mammary gland out of which

4.75% (n=96) were lump excisions and 2.75% (n=56) were mastectomies. There was a significant decrease in the number of breast surgeries from 2009 to 2018 (p=0.02)

Varicose veins

3.7% (n=58) cases got operated for varicose veins in 2009. Various surgeries for varicose veins include flush ligation at saphenofemoral junction, stripping, and perforator ligation. In 2018, 6.4% (n=129) patients underwent varicose veins surgery, out of them only 5 patients underwent Radiofrequency ablation surgery. There was a significant increase in operative cases of varicose veins from 2009 to 2018 (p<0.001).

Hydrocele

7.8% (n=122) cases got operated for hydrocele in 2009. In 2018, 6.43% (n=130) patients underwent hydrocele surgery. There was a slight decrease in the proportion of hydrocele surgeries from 2009 to 2018 but the change was insignificant (p=0.116).

Swelling excision

6.5% (n=102) cases underwent swelling excision in 2009. In 2018, 4.25% (n=86) patients underwent swelling excision. These cases include sebaceous cysts, lipomas, fibromas, and other cutaneous and subcutaneous swellings. There was a significant decrease in the proportion of swelling excision from group-I to group-II (p=0.002).

Anal surgeries

In group-I, 6% (n=93) cases underwent anal and perianal surgeries whereas in group-II they constitute 8% (n=161). Anal surgeries include surgeries for perianal fistulas, hemorrhoids, and fissures. (Table 8) compares the different surgeries on the anal canal in group-I and group-II.

Thyroid

4% (n=64) of cases underwent surgeries on thyroid gland in 2009 compared to 2% (n=41) in 2018. Thyroid gland surgeries include all thyroidectomies, lobectomies, thyroglossal cyst excision. There was a significant decrease in the rate of thyroid surgeries from 2009 to 2018 (p<0.001).

Urogenital surgeries

Urogenital surgeries constitute 3% (n=47) of cases in 2009 and 1.48% (n=30) of cases in 2018. In 2009 the spectrum of urogenital surgeries include orchidectomy (n=10), varicocele ligation (n=13, open=8, lap=5), circumcision (n=12), penectomy (n=3), epididymal cyst, urethroplasty, hair tourniquet syndrome (n=2 each) and

orchidopexy, suprapubic cystostomy, meatotomy (n=1 each). In 2018 the spectrum include orchidectomy (n=4), varicocele ligation (n=18, open=16, lap=2), circumcision (n=1), penectomy (n=4), epididymal cyst (n=1) and

orchidopexy (n=2). Hydrocele surgeries were not included in this list, it was classified separately. There was a significant decrease in urogenital surgeries from group-I to group-II (p=0.002).

Table 7: Comparing the spectrum of gastrointestinal surgeries between group I & II.

| <i>Gastrointestinal surgeries</i> | Group-I N (%) | Group-II N (%) | P value* |
|------------------------------------------|--------------------------|---------------------------|-----------------|
| Stomach | 33 (7.8) | 19 (3.6) | 0.005 |
| GJ±TV | 28 | 12 | |
| Gastrectomy | 5 | 7 | |
| Hepatopancreaticobiliary | 151 (35.8) | 314 (60) | <0.001 |
| Open cholecystectomy | 24 (5.8) | 31 (6) | |
| Laparoscopic cholecystectomy | 98 (23.2) | 272 (52) | <0.001 |
| Whipple's pancreaticoduodenectomy | 4 | 2 | |
| Cystogastrostomy | 11 | 5 | |
| Distal pancreatectomy | 1 | 0 | |
| LPJ | 4 | 1 | |
| Open Liver hydatid cyst excision | 0 | 1 | |
| Laparoscopic Liver hydatid cyst excision | 6 | 1 | |
| CBD exploration | 3 | 1 | |
| Splenectomy | 3 (0.7) | 10 (2) | 0.115 |
| Bowel | 52 (12.3) | 85 (16.2) | 0.088 |
| Right hemicolectomy | 10 | 5 | |
| Left hemicolectomy | 5 | 2 | |
| Stoma | 6 | 7 | |
| Stoma reversal | 23 (5.45) | 62 (11.85) | |
| Feeding jejunostomy | 3 | 1 | |
| Resection anastomosis | 4 | 6 | |
| Enterocutaneous fistula excision | 0 | 1 | |
| Total colectomy | 1 | 0 | |
| Appendix | 122 (29) | 51 (9.7) | <0.001 |
| Open appendectomy | 11 (2.6) | 9 (1.7) | |
| Laparoscopic appendectomy | 111 (26.3) | 42 (8) | <0.001 |
| Rectum | 9 (2.1) | 12 (2.3) | 0.8668 |
| Diagnostic laparoscopy | 27 (6.4) | 17 (3.3) | 0.022 |
| Miscellaneous | 25 (5.9) | 15 (2.9) | 0.02 |
| Total | 422 (100) | 523 (100) | <0.001 |

Split skin grafting

1.15% (n=18) cases got split skin grafting (SSG) done in 2009. In 2018, 0.9% (n=18) patients underwent SSG. There was insignificant decrease in the proportion of SSG from 2009 to 2018.

Salivary glands

0.6% (n=9) cases got operated on the salivary gland (parotid gland) in 2009. In 2018, 0.94% (n=19) patients underwent surgery on salivary glands (parotid gland, n=17 & submandibular gland, n=2). There was a slight increase in the proportion of salivary gland surgeries from 2009 to 2018 but the change was insignificant (p=0.216).

Table 8: Comparing the procedures on the anal canal between group-I & II.

| Anal surgeries | 2009 N (%) | 2018 N (%) | P value |
|------------------------------------|-----------------------|-----------------------|----------------|
| Fistulectomy | 35 (2.2) | 71 (3.5) | |
| Hemorrhoidectomy | 43 (2.8) | 69 (3.4) | |
| Lateral anal sphincterotomy | 15 (1) | 20 (1) | |
| APR (Ca anal canal) | 0 | 1 (0.1) | |
| Total | 93 (6) | 16 (8) | 0.018 |

Table 9: Comparing the laparoscopic surgery rates between group I and II.

| Procedure | 2009 N (%) | 2018 N (%) | P value* | Change % |
|----------------------------|---------------------|---------------------|----------|-------------|
| Lap cholecystectomy | 98 (35.9) | 272 (78) | <0.001 | ↑ 42.1 |
| Lap appendectomy | 111 (40.6) | 42 (12) | <0.001 | ↓ 28.66 |
| Diagnostic lap | 27 (9.9) | 17 (4.84) | 0.015 | ↓ 4.84 |
| Lap inguinal hernia | 20 (7.3) | 11 (3.15) | 0.017 | ↓ 4.15 |
| Lap varicocele | 5 (1.84) | 2 (0.57) | 0.14 | ↓ 1.27 |
| Lap hydatid- cyst excision | 6 (2.2) | 1 (0.3) | 0.025 | ↓ 1.9 |
| Lap ovarian cystectomy | 1 (0.36) | 2 (0.57) | 0.711 | ↑ 0.21 |
| Others | 5 (1.84) | 2 (0.57) | 0.14 | ↓ 1.27 |
| | 273 (100) | 349 (100) | 0.91 | |
| | 273/1567 =17.42% | 349/2020 =17.27% | | |

Table 10: Comparing the top 10 elective surgeries in group-I & II.

| Top 10 | 2009 (Group-I) | N (%) | Top 10 | 2018 (Group-II) | N (%) |
|--------|------------------------|------------|--------|------------------------|-------------|
| 1 | Open inguinal hernia | 308(19.65) | 1 | Open Inguinal hernia | 395(19.55) |
| 2 | Hydrocelectomy | 122(7.78) | 2 | Lap Cholecystectomy | 272(13.46) |
| 3 | Lap appendectomy | 111 (7) | 3 | Ventral Hernia repair | 230 (11.38) |
| 4 | Swelling excision | 101 (6.44) | 4 | Hydrocelectomy | 130 (6.43) |
| 5 | Lap cholecystectomy | 98(6.25) | 5 | Varicose veins surgery | 129 (6.38) |
| 6 | Breast lump excision | 87 (5.55) | 6 | Breast Lump excision | 96 (4.75) |
| 7 | Ventral hernia repair | 86 (5.48) | 7 | Swelling Excision | 86 (4.25) |
| 8 | Mastectomy | 65 (4.14) | 8 | Fistulectomy | 71 (3.5) |
| 9 | Thyroid surgeries | 64 (4) | 9 | Hemorrhoidectomy | 69 (3.41) |
| 10 | Varicose veins surgery | 58 (3.7) | 10 | Stoma Closure | 62 (3) |

Pilonidal sinus

0.4% (n=7) cases got operated for pilonidal sinus in 2009. In 2018, 0.9% (n=18) patients underwent pilonidal sinus surgery. The surgeries include excision, z plasty, and rhomboid flap. There was a slight increase in the proportion of pilonidal sinus surgeries from 2009 to 2018 but the change was insignificant (p=0.112).

Others

Other procedures in 2009 constituted 3.8% which include secondary suturing (n=24), amputations (n=13), incision & drainage (n=9), trucut biopsy, marjolin's ulcer excision, wound exploration, drain removal, lymph node biopsy (n=2 each), and sinus tract excision, lymphangioma excision, escharotomy, suture removal (n=1 each). Other procedures in 2018 also constitute 3.8% which include secondary suturing (n=41), Amputations (n=4), Incision & Drainage (n=10), trucut biopsy (n=1), wound exploration (n=6), and sinus tract excision (n=15). There was no significant change in other procedures from 2009 to 2018 (p=0.978).

Laparoscopic surgeries

In 2009 (group-I), 17.42% (n=273) cases underwent laparoscopic surgery. In 2018 (group-II), 17.27% (n=349)

cases underwent laparoscopic surgery. The most frequent lap surgery in 2009 was lap appendectomy (40.66%, n=111), followed by lap cholecystectomy (35.9%, n=98), whereas in 2018, the most frequent lap surgery was lap cholecystectomy (78%, n=272), followed by lap appendectomy (12%, n=42). The rest of the surgeries along with their p values are given in (Table 9). There was a significant increase in the Lap cholecystectomy rate from 2009 to 2018 (p<0.001). Lap appendectomy rate has significantly decreased from 2009 to 2018 (p<0.001). Other lap surgeries (1.84%, n=5) in 2019 include lap right hemicolectomy and lap rectopexy (n=2 each) and lap retroperitoneal tumor excision (n=1). In 2018 other surgeries include lap celiac plexus block and lap gastrojejunostomy (n=1 each).

Top 10 surgeries

The 3 most common surgical procedures in 2009 were open inguinal hernia surgery (19.65%, n=308), followed by hydrocele surgery (7.78%, n=122) and laparoscopic appendectomy (7%, n=111). In 2018, the top 3 surgeries performed were open inguinal hernia surgery (19.55%, n=395), laparoscopic cholecystectomy (13.46%, n=272) and ventral hernia surgery (11.38%, n=230). The rest of the top 10 surgeries are given in (Table 10).

DISCUSSION

In the literature, except for very few foreign studies in the past, there were no recent studies that compared the general surgery workload between two time periods in our country.^{1,3-5} To our knowledge, our study is the first of its kind in recent times. Our study differs from all the reference studies in that we have compared the spectrum of elective surgeries between 2009 & 2018 in a teaching institute rather than a population. We couldn't find a study of sole elective general surgeries in the literature. A population-based epidemiological study of major surgical procedures was done by Bhasin S.K et al in India in 2008.⁷ There was also a surgical audit done in Ethiopia on elective and emergency cases published in 2019.⁸ But, these studies were not comparative.

Age and gender

In our study, there was a 28.9% rise in the total number of elective surgeries between 2009 & 2018. This increase in the surgical volume of elective general surgeries denotes that though there was a fragmentation of general surgery into multiple sub-specialties, the workload on general surgeons hasn't decreased. Despite the increase in surgical volume, there was no change in gender distribution in age groups and M:F ratio from group-I to Group-II, which is almost 1.7:1 in both the groups. The minimum age limit has increased from 8 years to 12 years, but the maximum age limit has decreased from 88 years to 83 years which doesn't appear significant in our study. With time, there was a shift in the mean age of presentation of surgical patients towards the older age group in our study, this is supported by the fact that the most common age group in 2018 was 30-49 years compared to 20-39 years in 2009 and also the mean and median age of our cohorts has increased from 2009 to 2018 significantly.

Spectrum of surgeries

In the '80s and '90s, general surgeons used to perform most of the major surgeries excluding some cases of neurosurgery and cardiothoracic surgery. As time progressed, due to the division into multiple sub-specialties, the varieties of major surgeries performed by a general surgeon have decreased.^{1,3-5} This statement holds good for our study because the number of major abdominal surgeries has decreased from group-I to group-II (27% vs. 25.9%). This decrease in abdominal surgeries may appear insignificant but from Table-7 we can observe that the significant decrease in gastrointestinal surgeries has been masked by a significant increase in the number of lap cholecystectomies. Shoemaker CP and Rutkow IM have compared the surgical burden in the '80s and '90s in America during the beginning of newer surgical subspecialties, whereas the present study compared between 2009 and 2018 in India when the subspecialties have already been established.^{1,3-5} Still, the change is

similar irrespective of the timing of the study because in the past the decrease in major surgical workload for general surgeons can be attributed to the development of newer subspecialties whereas in the present it can be attributed to the decreasing capability of general surgeons to perform a wide variety of surgeries due to under training and due to diversion of major general surgical cases to subspecialties.

Hernia surgeries have increased in a good number since 2009 in our study. It outnumbers many other surgical procedures. It was, is, and will be the most common surgical procedure performed by a general surgeon. In our study, the raise in hernia surgeries from 2009 to 2018 is 5.15% which was similar to the findings in a Turkish study.⁹ Among hernias, inguinal hernia surgeries are the ones which were frequently performed in our study, a finding consistent with many other studies.^{3-5,7,9,10} Though inguinal hernia surgeries were the commonest procedures, their rate has decreased by 15.4% from 2009 to 2018 in our study which is consistent with Serker et al and Dabbas et al findings, where they have observed a decrease in 7.9% over 5 years from 2005 to 2010 and 11.6% over 10 years from 1998 to 2008 respectively.^{9,10} In the current era, the rate of incisional hernia surgeries is on a significant rise. Due to an increase in the number of laparotomies, the rate of incisional hernia surgeries has increased over time.^{9,10} In our study, we included incisional hernias in ventral hernias which showed a significant increase.

From (Table 5), we can see that there was a significant decrease in breast and thyroid surgeries. This is due to the diversion of breast cases (mastectomies) to surgical oncologists and thyroid cases to ENT surgeons in our institute.

Rampant lap cholecystectomies and lap appendectomies

Elective laparoscopic cholecystectomies and laparoscopic appendectomies have flabbergasting results in our study. Each constituted 29% of total GI surgeries in 2009. But, the proportion of cholecystectomies has doubled from 29% to 58% and the proportion of elective appendectomies has fallen to 1/3rd (29% vs. 9.7%) from 2009 to 2018. Nenner RP et al from 1990-1993 in New York had observed the increase in the total cholecystectomies by 28.12% in the initial years after the introduction of laparoscopy.¹¹ During the same period, Lam CM et al in Scotland has observed an increase in the total cholecystectomy rate by 18.7%.^{11,12} Nenner RP et al attributed the rise to procrastinating mildly symptomatic patients whereas Lam CM et al have attributed this rise to increased referrals by general practitioners and gastroenterologists resulting from the enhanced perceived benefits of lap cholecystectomy.¹² Pulvirenti E et al in their study has observed that 21.18% of cholecystectomies performed were without any indication.¹³ These studies have concluded that there will be a dramatic rise in rates of laparoscopic

cholecystectomies if performed on asymptomatic patients. In our study, we have not analyzed the indications of cholecystectomies but a rise of 177% in the number of laparoscopic cholecystectomies from 2009 to 2018 cannot be justified.¹¹⁻¹³ Increased enthusiasm of surgeons for laparoscopic training could be a reason for such a dramatic increase, but in 2018, 78% of the Lap surgeries were lap cholecystectomies compared to 35.9% in 2009 which shows predilection of surgeons towards mere lap cholecystectomies without any up-gradation in advanced laparoscopy.

The elective total appendectomy rate has decreased significantly from 29% to 9.7% of all GI surgeries in our study. The elective Lap appendectomy rate has a dramatic fall from 26.3% to 8%. Despite an increase in the incidence of appendicitis, our study showed a reduction in the incidence of appendectomies.¹⁴ This was because there were rampant Lap appendectomies performed in 2009. There was no significant change in the rate of open appendectomies though. This can be attributed to the increased enthusiasm of general surgeons to learn lap appendectomies in 2009 due to unknown reasons. The negative appendectomy rate was 9% to 20% in different studies.¹⁵⁻¹⁷ Alhamdani YF et al and Seetahal SA et al studies show that the negative appendectomy rate has decreased over time.^{15,16} Though we haven't calculated the negative appendectomy rate in our study, our finding of decreased appendectomies was consistent with these studies.

Present scenario of general surgeons in government institutions

Based on the results of our study, we can observe that the increase in surgical load is attributed to the rise in specific surgeries like hernia repairs and cholecystectomies which together have increased from 1/3rd to half of the total elective surgeries past 10 years in our institute. There were minimal advances in surgical procedures over this decade in our study. Except for common laparoscopic surgeries, there were no advanced laparoscopic surgeries performed in our institute. Though the surgical load has increased, there was a lack of training in advanced procedures in general surgery.

Limitations

The data we have collected from the registers were manually entered hence some degree of human error was beyond doubt. But, this bias was neutralized by comparison. Our study was an institutional-based study and not population-based, hence we cannot generalize our conclusions to the entire population. The results and conclusions obtained in our study hold good for general surgeons working in public sectors like government teaching institutions but not for the private sector.

CONCLUSION

From our study, we would like to conclude that there is an increase in the volume of surgeries for general surgeons' overtime with narrowing of the surgical spectrum to mere hernias and cholecystectomies. Despite the establishment of many surgical subspecialties in the current era, general surgeons should be trained and encouraged to practice surgeries of other subspecialties in institutions to improve the standards of surgical training.

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