

Comparison of treatment costs of laparoscopic and open surgery

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Abstract

Introduction: Laparoscopy has been a standard procedure in most medical centres providing surgical services for many years. Both the range and number of laparoscopic procedures performed are constantly increasing. Over the last decade, laparoscopic procedures have been successfully applied both in emergency and oncological surgery. However, treatment costs have become a more important factor in choosing between open or laparoscopic procedures.

Aim: To present the total real costs of open and laparoscopic cholecystectomy, appendectomy and sigmoidectomy.

Material and methods: Between 1 May 2010 and 30 March 2015 in the Department of Thoracic Surgery, General and Oncological Surgery, Medical University of Lodz, and in the Department of General Surgery of the Saint John of God Hospital, Lodz, doctors performed 1404 cholecystectomies, 392 appendectomies and 88 sigmoidectomies. A total of 97% of the cholecystectomy procedures were laparoscopic and 3% were open. Similarly, 22% of total appendectomies were laparoscopic and 78% were open, while 9% of sigmoidectomies were laparoscopic and 91% open.

Results: The requirement for single-use equipment in laparoscopic procedures increases the expense. However, after adding up all other costs, surprisingly, differences between the costs of laparoscopic and open procedures ranged from 451 PLN/€ 114 for laparoscopic operations to 611 PLN/€ 153 for open operations.

Conclusions: Laparoscopic cholecystectomy, considered the standard surgery for treating gallbladder diseases, is cheaper than open cholecystectomy. Laparoscopic appendectomy and sigmoidectomy are safe methods of minimally invasive surgery, slightly more expensive than open operations. Of all the analyzed procedures, one-day laparoscopic cholecystectomy is the most profitable. The costs of both laparoscopic and open sigmoidectomy are greatly underestimated in Poland.

Key words: laparoscopy, cholecystectomy, appendectomy, costs of treatment, open surgery, sigmoidectomy.

Introduction

Laparoscopy has been a standard procedure offered for many years by most medical centres providing surgical services in Poland. The number of laparoscopic procedures is steadily increasing, as is their range. For some time, laparoscopic procedures have been successfully applied in the treatment of acute cases, such as acute cholecystitis and acute appendicitis [1–3], and minimally invasive techniques, such as exploratory laparoscopy, are increasingly

used in diagnostics [4, 5]. The development of videoscopy also allows for the treatment of neoplastic diseases. While the surgical team always considers the clinical condition of the patient and concomitant disturbances, including their past surgical history, in choosing between the open or laparoscopic procedures [6], the cost of therapy is now also playing a more important role [7].

A laparoscopic procedure results in minimal interference in the condition and functioning of the patient, and the wound is as properly dressed as in an

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open procedure. A smaller post-operative wound reduces post-operative pain, which in turn contributes to a lower risk of infection and post-operative hernia [8]. Shorter hospitalization time and post-operative recovery might also reduce treatment costs [9].

Aim

The aim of the study is to present the total real costs of open and laparoscopic cholecystectomy, appendectomy and sigmoidectomy.

Material and methods

Between 1 May 2010 and 30 March 2014 in the Department of Thoracic Surgery, General and Oncological Surgery, Medical University of Lodz, and the Department of General Surgery of the Saint John of God Hospital, Lodz, 1404 cholecystectomies, 393 appendectomies and 88 sigmoidectomies were performed. In total, 97% of the cholecystectomy procedures were laparoscopic operations and 3% were open operations. Similarly, 18% of appendectomies were laparoscopic and 82% were open, and 9% of sigmoidectomies were laparoscopic and 91% were open. In patients who underwent cholecystectomy, a laparoscopic procedure was standard. In more than ten patients, doctors performed open surgery due to prior surgical history, confirmed complicated acute cholecystitis or suspected gallbladder cancer. Although an open procedure was commonly used for appendectomy until 2011, since then some surgeons have been taking a laparoscopic approach. Likewise, laparoscopic sigmoidectomy is a relatively new procedure in Poland [10, 11], with operations of this type only being performed since 2013, but only in selected patients. To simplify the following analysis, the following exchange rate was adopted: € 1 = 4 PLN.

Cost analysis:

- average price of threads = 8 PLN/€ 2 per piece;
- hospital stay in the University Teaching Hospital – Central Veterans' Hospital in Lodz = 320 PLN/€ 80;
- cost of a surgeon in the operating theatre per hour = 100 PLN/€ 25 gross;
- the cost of work in the operating theatre was calculated according to the following formula:
1 hour of work of the operating theatre = 1 month of work of the operating block (the total time of all procedures/number of operating theatres)/maintenance costs of the operating block (elec-

tricity + personnel + indirect costs) = 360 PLN/€ 90;

- average operation time was calculated from operative reports;
- the cost of a single use of a reusable trocar was calculated by dividing its price (800 PLN/€ 200) by the average number (around 300) of laparoscopic procedures performed with the trocar in a period of a year = 2.60 PLN/€ 0.65;
- the cost of a single use of a grasper or reusable scissors was calculated by dividing their price (1800 PLN/€ 450) by the average number (around 300) of laparoscopic procedures performed in a period of a year = 6 PLN/€ 1.50;
- the cost of a single use of a grasper was calculated by dividing its price (2000 PLN/€ 500) by the average number of procedures performed with the grasper in a period of two years = 3.30 PLN/€ 0.83;
- the cost of a single use of a laparoscopic tower was calculated by dividing its price (225,000 PLN/€ 56,250) by a 5-year depreciation period and the average number of performed procedures: 225,000/(5 years × 300 procedures) = 150 PLN/€ 37.5

Results

The need for single-use equipment in laparoscopic procedures adds to the cost of the procedures. However, after adding up all other costs, the final results were surprising, with the differences between the costs of laparoscopic and open procedures ranging from 451 PLN/€ 113 for laparoscopic operations to 611 PLN/€ 153 for open operations, with a wide range of differences for each type of procedure: for appendectomy, the open procedure is 7.8% less expensive than laparoscopy, but for cholecystectomy, the open procedure is 28.6% more expensive than laparoscopy. While the cost of laparoscopic and open sigmoidectomies appear to be comparable, the latter is 8.9% cheaper. All the performed calculations are presented in Tables I–IV.

Discussion

Most public health care centres face financial problems. The financial outcome of a centre is not often related to its personnel or work organization but potential financial problems result from underestimating the cost of surgical procedures funded by the NFZ (public health service). This study analysed the three most common surgical procedures

Table I. Costs of open and laparoscopic appendectomy

Parameter	No. open/lap	Open surgery [PLN/EURO]	Laparoscopy [PLN/EURO]	Notes
Hospital stay [days]	1.9/1.3	608/152	416/104	
Surgical team	2/2	140/35	182/46	
Operation time [min]	42/55	252/63	330/82.5	
Trocar 12 mm	0/2	0/0	5.20/1.30	
Trocar 5 mm	0/1	0/0	2.60/0.65	
Threads	4*(1-4)/2*(4-5)	32/8	16/4	*1. Peritoneal stitch *2. Fascial stitch *3. Subcutaneous stitch *4. Dermal stitch *5. Roeder loop
Grasper 5 mm	0/3	0/0	18/4.5	Scissors included
Laparoscopic tower	0/1	0/0	150/38	Optics included
Total		1,032/258	1,120/280	

Table II. Costs of open and laparoscopic cholecystectomy

Parameter	No. open/lap	Open surgery [PLN/EURO]	Laparoscopy [PLN/EURO]	Notes
Hospital stay [days]	2.4/1.4	768/192	448/112	
Surgical team	3*/2	348/87	160/40	*1 surgeon or automated retractor
Operation time	1 h 10 min/48 min	420/105	288/72	
Trocar 12 mm	2	0/0	5.20/1.30	
Trocar 5 mm	1	0/0	2.60/0.65	
Threads	5*(1-5)/3*(1+3+5)	40/10	16/4	*1. Peritoneal stitch *2. Muscular stitch *3. Fascial stitch *4. Subcutaneous stitch *5. Dermal stitch
Grasper 5 mm	3	0/0	18/4.5	Hook and scissors included
Laparoscopic tower	1	0/0	150/37.50	Optics included
Clip applicator	1	0/0	3.30/0.83	
Clips	1 pack – 6 pieces	0/0	36/9	
Total		1,578/394	1,127/282	

performed using open and laparoscopic methods: cholecystectomy, appendectomy and sigmoidectomy. Both the direct cost of surgery and all the indirect costs incurred by the centre in order to provide patients with suitable therapy were included. The analysis does not include costs which are the same

for the compared procedures, i.e.: 1) a set of reusable surgical instruments: clamps, pincers, scissors, peans, etc.; 2) sterilization of a set of surgical instruments; 3) preparing the patient and operative area; 4) anaesthetizing the patient; 5) draping the patient; 6) the cost of histopathological examination.

Table III. Costs of open and laparoscopic sigmoidectomy

Parameter	No. open/lap	Open surgery [PLN/EURO]	Laparoscopy [PLN/EURO]	Notes
Hospital stay [days]	4.4/3.8	1,408/352	1,216/304	
Surgical team	3/2	515/129	500/125	*1 surgeon or automated retractor
Operation time	1 h 45 min/2 h15 min	630/157.50	900/225	
Trocar 12 mm	2	0/0	5.20/1,30	
Trocar 5 mm	2	0/0	5.20/1,30	
Threads	7*(1 – 6)/3*(1 + 3 + 5)	56/14	24/6	*1. Peritoneal stitch *2. Muscular stitch *3. Fascial stitch *4. Subcutaneous stitch *5. Dermal stitch *6 Garter stitch
Grasper 5 mm	5	0/0	30/5	Hook and scissors included
LigaSure 5 mm	1	0/0	1,800/450	
LigaSure 10 mm	1	1,600/400	0/0	
Laparoscopic tower	1	0/0	150/37.50	Optics included
Reticular stapler	1	0/0	600/150	
Stapler TA 60	1	450/112.50	0/0	
Clip applicator	1	0/0	3.30/0.83	
Clips	6	0/0	36/9	
Stapler CEEA	1	1,620/405	1,620/405	Stitch fixing a stapler head
Total		6,279/1570	6,890/1722	

Table IV. Total cost of all procedures

Procedure	Price [PLN/EURO]	National Health Fund		Profit [PLN/EURO]
		Points	Cost [PLN/EURO]	
Open appendectomy	1,552/388	47	2,444/611	892/223
Laparoscopic appendectomy	1,640/410	47	2,444/611	804/201
Open cholecystectomy	2,098/524	63	3,276/819	1,178/295
Laparoscopic cholecystectomy	1,647/412	57	2,964/741	1,317/329
Open sigmoidectomy	6,799/1,700	110	5,720/1,430	-1,079/-270
Laparoscopic sigmoidectomy	7,410/1,852	110	5,720/1,430	-1,690/-423

The total cost of the above procedures is around 520 PLN/€ 130. Table IV presents the total cost of hospital treatment, including the procedures required for both open and laparoscopic methods.

When considering the costs of sigmoidectomy, it should be pointed out that the price of the most commonly used mechanical stapler, the CEEA 31 mm, substantially increases the total cost of surgery, by

1,600 PLN/€ 400. This equipment is used in both the open and laparoscopic methods.

All trocars used in the evaluated laparoscopic procedures are reusable, and their only replaceable part is a seal, which should be replaced after about 200 procedures. Undoubtedly, the application of single-use trocars would considerably increase the total cost of laparoscopic operations. Conversion is another factor contributing to an increase in the cost of surgery [12]. The costs of converted procedures will be subject to a separate analysis.

Open appendectomy was 88 PLN/€ 22 (7.8%) cheaper than laparoscopic appendectomy, although based on financial settlements with the NFZ (public health service), both methods were found to be profitable: 892 PLN/€ 223 and 804 PLN/€ 201 respectively. Similarly, open sigmoidectomy is 611 PLN/€ 153 cheaper (8.9%) than laparoscopic surgery, despite longer post-operative hospitalization. The period of hospitalization after a laparoscopic procedure was reduced due to less acute post-operative pain, the application of a “fast track” recovery programme and the fact that the patients can regain their mobility more quickly [13]. Unfortunately, both methods incur losses for the medical centre performing the procedures: 1,079 PLN/€ 270 for the open surgery and 1,690 PLN/€ 422 for the laparoscopy. In contrast, laparoscopic cholecystectomy is 451 PLN/€ 113 (28.6%) cheaper than open cholecystectomy, and both methods are profitable for the centre, earning 1317 PLN/€ 329 for the laparoscopy and 1178 PLN/€ 295 for the open procedure.

However, the techniques used in operations are constantly changing. “Single-incision” methods, which are now quite common, are more expensive than standard laparoscopy [14] and represent another challenge for surgeons. The question is whether the NFZ (public health service) will correctly estimate the cost of these innovative procedures.

Conclusions

Laparoscopic cholecystectomy, considered the standard surgical procedure in treating gallbladder diseases, is cheaper than open cholecystectomy. Laparoscopic appendectomy and sigmoidectomy are safe methods of minimally invasive surgery which are only slightly more expensive than open operations. Of all the analyzed procedures, one-day laparoscopic cholecystectomy is the most profitable

for the centre. The costs of both laparoscopic and open sigmoidectomy are greatly underestimated in Poland.

Conflict of interest

The authors declare no conflict of interest.

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