RESEARCH ARTICLE

Comparative analysis of the direct hospitalization cost of laparoscopic and open cholecystectomy at the Philippine General Hospital

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ABSTRACT

Objective: This study aimed to compare the cost of hospitalization for open and laparoscopic cholecystectomy (OC and LC) among adult patients with cholelithiasis in the Philippine General Hospital.

Methodology: The billing records of all patients admitted for elective cholecystectomy from February to July 2017, were reviewed. An item by item costing for room and board, laboratories, radiologic exams, surgical and anesthesia needs for each patient meeting the inclusion criteria was done.

Results: From February to July 2017, a total of 391 cholecystectomies were performed; 156 cases (78 OC and 78 LC) were included in the analysis. There is no significant difference between the mean total cost for the laparoscopic group which was 20,549 +/- 4,972 pesos and 18,465 +/- 7,908 pesos ($p < 0.05$) for the open group.

Conclusion: Total cost of LC is comparable to OC. However, when the total expenses were divided into categories, the OC group incurred significantly bigger charges than the LC group in room and board, laboratories, radiology, pharmacy, and surgery needs. On the other hand, the LC group had significantly higher mean charges for the surgery needs inclusive of the laparoscopic machine and disposable instruments.

Keywords: *laparoscopic, open, cholecystectomy, cost*

Introduction

Cholecystectomy is one of the most frequently performed surgical procedures worldwide [1]. In the Philippines, based on the Philhealth claims for 2011, it is the most common general surgery operation followed by appendectomy [2]. Laparoscopic cholecystectomy (LC) has replaced open cholecystectomy (OC) as the standard of treatment for uncomplicated cholecystitis globally. It accounted for 83.3% of cholecystectomies performed in England from 2000 to 2009 [3]. In the Philippine General Hospital (PGH), cholecystectomies done laparoscopically comprised 55% of all elective cholecystectomies in 2014. This figure is significantly lower compared to the percentage of LC in other countries. For a procedure deemed as the standard, local data shows that Filipino patients may not be receiving optimal care. Despite the integration of LC in residency training and availability of equipment, the low proportion of patients undergoing laparoscopic surgery may still be due to higher costs, perceived or actual.

Numerous studies compared OC and LC in terms of safety, efficacy, morbidity, mortality, and cost. Analysis of the available evidence showed that there is no difference in the aforementioned outcomes with the exemption of cost [4,5,6]. Several studies showed that patients who underwent LC had shorter length of hospital stay, lesser amount and period of analgesia, and shorter recovery time [4,7,8]. In a prospective study done by Medeiros *et al*. (2012), the total hospital cost for OC was R$ 868.95 compared to R$ 990.15 for LC. The difference in cost was not statistically significant [9]. Likewise, in a multicenter study by Nilsson *et al*. (2004), results showed no significant difference in total cost between LC and OC for elective cases using reusable trocars [10]. In contrast, a cohort study (n=43,433) by Zacks *et al.*(2002) concluded that OC generated higher charges compared to LC ($12,125 versus $9,139) [11]. The operative costs were higher for LC according to a study done by de Pouvourville *et al.* (1997) and in another study by Vanek *et al.* (1995)wherein the mean total charge was 8% higher for LC [12,13].

In the Philippines, in an unpublished study done by Perez at the UP-PGH in 2004, the factors affecting the length of stay

and the direct cost of patients admitted for elective OC were investigated. Fifty-seven percent of the total cost was allotted to ward cost, 27% to OR cost and the rest was divided among anesthesia, pharmacy, radiology, and laboratories expenses. The prolonged hospital stay attributed to the long waiting time to surgery resulted in higher costs for the room and board. Unfortunately, cost analysis of LC and OC are often inconsistent and divergent which can possibly be attributed to differences in the inclusion, exclusion criteria, methodology employed and perspective used. Practice patterns in the Philippines vary from those in advanced centers in developed countries and data on costs of laparoscopic surgery can not be extrapolated to the local setting.

At present, there is still no published study on cost analysis of cholecystectomy in the Philippines. This study aimed to compare the cost of hospitalization for open and laparoscopic cholecystectomy among adult patients with cholelithiasis in PGH. Specifically, it aimed to determine and compare the patient's age, sex, ASA classification, itemized costing including room and board, laboratories, radiologic tests, surgical needs, anesthesia needs and pharmacy items for OC and LC, hospital length of stay, and to identify potential areas to decrease the cost of cholecystectomy. It will provide objective evidence on the current differences in the cost of LC and OC in PGH. The analysis of the direct cost of a very common surgical procedure will be of importance to administrators, health care providers and patients alike. This data will be extremely useful in formulating strategies to lower the costs of this procedure which will translate to more Filipino patients receiving the standard of care for cholelithiasis.

Methodology

Study Design

This is a retrospective descriptive study of the cost of hospitalization of all consecutive patients meeting the inclusion criteria admitted at PGH.

Study Setting

The study was conducted at PGH which is considered the biggest modern government tertiary hospital in the Philippines, servicing more than 600,000 patients annually. It remains the only national referral center for tertiary care, providing direct and quality patient services to thousands of indigent Filipinos all over the country. Despite the increasing number of cholecystectomies per year, the percentage done laparoscopically remains significantly lower compared to international statistics.

Study population, sampling and sample size

Total enumeration of patient records meeting the inclusion criteria admitted from February to July 2017 were included in the study. A minimum sample size of 156 (78 for each technique) was determined by setting an alpha level of 0.05 and power of 0.8. Mean estimates of the different services will be compared between open and laparoscopic technique. Sample size was computed using G*power version 3.1.9.2 for difference between two independent means. Previous studies have prospectively included consecutive patients with numbers ranging from 35 to 495 in a period from 6 months to 5 years.

Eligibility Criteria

Billing records of patients admitted at the PGH Surgery charity and pay wards for elective cholecystectomy with the following characteristics were included in the study: a male or female patient with cholelithiasis, aged 18 years or older at recruitment and in reasonable to good health (ASA I or II), who underwent laparoscopic or open cholecystectomy. Records of patients with the following characteristics were excluded from the study: those presenting with obstructive jaundice secondary to choledocholithiasis or pancreatitis; known pregnancy, known cirrhosis of the liver, history of abdominal malignancy, previous upper abdominal surgery (precluding a laparoscopic approach), acute cholecystitis and those with moderate to severe systemic disease (ASA III and higher). The ASA classification is described in the table below. Similarly, records of patients who underwent procedures other than simple cholecystectomy and those who underwent additional procedures like ERCP were excluded in the study.

Data Collection

The billing records of all patients admitted at PGH for elective cholecystectomy from February to July 2017 who met the inclusion were reviewed. An item by item costing was done for each patient for the following categories: room and board, laboratories, radiology, pharmacy, surgical needs and anesthesia needs. The surgery needs category was divided into surgery and surgery plus; the latter included cost for the laparoscopic machine and disposables like trocars, hand instruments and ligaclips in addition to the other basic surgical needs. Costs were calculated in Philippine pesos and prices used in the computation were based on the PGH rates. A standard value was used for both pay and charity patients. The information was obtained

Table 1. *ASA Classification*

ASA CLASSIFICATION	DESCRIPTION
I	A normal healthy patient.
II	A patient with a mild systemic disease. Example: Patient with no functional limitations and a well-controlled disease
III	A patient with a severe systemic disease that is not life-threatening. Example: Patient with some functional limitation as a result of disease

from the in-patient account record from the Informatics Systems Office. The ASA classification of each patient were reviewed from the computerized patient registry of the Department of Anesthesia. On the other hand, the clinical abstract available on the Integrated Surgical Information System (ISIS) was the source of the past medical and surgical history of each patient.

Data Analysis

The age, sex, and ASA classification of the patients whose records were included were compared. The mean age was calculated and compared using t-Test. The costs incurred during each admission was summed up per category. Similarly, the mean value for each category was computed and the two means per category was compared using a t-test.

Ethical Considerations

The study was conducted in accordance with the guidelines of the Helsinki Declaration, and was approved by the University of the Philippines Manila Research Ethics Board (UPMREB) Review Panel. The identities of the individual patients whose records were reviewed and included in the study were not revealed in any way. There was no conflict of interest between the investigators. All expenses incurred during the study were shouldered by the principal investigator.

Results

From February to July 2017, a total of 391 cholecystectomies were performed. Seventy-three percent of the cases were done laparoscopically. Ten of the 288 cases (3.47%) were converted to open. Of the 103 patients who underwent the open technique, only 78 patients met the inclusion criteria. Reasons for exclusion included presentation as obstructive jaundice from choledocholithiasis, cardiac conditions requiring a previous coronary artery bypass grafting and pacemaker insertion, and acute cholecystitis. A total of 156 cases were included in the analysis: 78 cases for open and 78 cases for laparoscopic cholecystectomy.

Clinical characteristics of participants

The mean age in the open group was 42 +/- 14 years, while mean age in the laparoscopic group was 44 +/- 15 years. There is no significant difference found in the mean age between the two groups. Females outnumbered males in both groups: 69% females vs 31% males in the open group and 60% females vs 40% males in the laparoscopic group.

Table 2. *Prevalence of Age, Sex, and ASA classification*

		Open n= 78	Laparoscopic n= 78	p-value
AGE	mean +/- SD (min, max)	42 +/- 14 (19, 85)	44 +/- 15 (19, 86)	0.477
SEX	Male	24 (30.8%)	31 (39.7%)	0.241
	Female	54 (69.2%)	47 (60.3%)	
ASA CLASSIFICATION	1	67 (85.9%)	61 (78.2%)	0.211
	2	11 (14.1%)	17 (21.8%)	
SERVICE	Charity	28 (35.9%)	25 (32.1%)	0.612
	Pay	50 (64.1%)	53 (67.9%)	

Table 3. *Length of hospital stay and post operative days*

		Open n= 78	Laparoscopic n= 78	p-value
LENGTH OF HOSPITAL STAY	mean +/- SD (min, max)	6 +/- 4 (2, 19)	3 +/- 2 (2, 10)	0.000
POST OPERATIVE DAYS	mean +/- SD (min, max)	2 +/- 1 (1, 9)	1 +/- 1 (1, 3)	0.000

For both groups, more patients had ASA 1 classification, 86% in the open group and 78% for the laparoscopic group. Most patients who had ASA 2 classification had hypertension and diabetes mellitus; one had hyperthyroidism and two had bronchial asthma.

Length of Hospital Stay

Significant difference between the two groups was noted in terms of total length of hospital stay and post operative days. Mean total hospital stay of the open group was 6 +/- 4 days while it was 3 +/- 2 days for the laparoscopic group. Similarly, the mean post-op days of the open group was longer at 2 +/- 1 days than that of the laparoscopic group at 1 +/- 1 day.

Cost of hospitalization

The cost of open cholecystectomy was noted to be significantly higher for room and board, laboratories, radiology, and surgical needs. The mean cost for the room and board for the open group was 3,365 pesos which was twice that of the mean of 1,705 pesos for the laparoscopic group. Similarly, the mean laboratory expense was 1,462 pesos in the open group but only 946 pesos in the laparoscopic group. The mean radiology cost for the OC group was 466 pesos compared to 112 pesos in the laparoscopic group. The average pharmacy cost was 2,671 pesos which was significantly higher for the OC group than the LC group (1,101 pesos). No significant difference was found between the two groups in terms of anesthesia

Table 4. *Mean values of expenses*

	Open n= 78	Laparoscopic n= 78	p-value
	mean +/- SD (min, max)	mean +/- SD (min, max)	
TOTAL BILL	18,465 +/- 7,908 (7,846, 56,111)	20,549 +/- 4,972 (12,677, 46,856)	0.051
SUBTOTAL	18,465 +/- 7,908 (7,846, 56,111)	12,491 +/- 3,553 (7,145, 28,269)	0.000
ROOM	3,365 +/- 4,697 (1,000, 40,000)	1,705 +/- 816 (1,000, 5,000)	0.003
LABS	1,462 +/- 1,649 (0, 9,600)	946 +/- 851 (0, 3,570)	0.016
RADIO	466 +/- 627 (0, 3,100)	112 +/- 335 (0, 2,113)	0.000
PHARMA	2,671 +/- 2,117 (472, 12,025)	1,101 +/- 717 (70, 3,540)	0.000
ANES	3,606 +/- 1,633 (230, 8,192)	3,324 +/- 2,213 (853, 17,934)	0.366
SURGERY	5,415 +/- 1,519 (633, 8,848)	3,803 +/- 1,883 (439, 7,849)	0.000
SURGERY PLUS	3,803 +/- 1,883 (439, 7,849)	11,861 +/- 3,567 (6,014, 28,739)	0.000

expenses. The mean anesthesia cost was 3,324 pesos in the laparoscopic group and 3,606 pesos in the open group. All patients who underwent laparoscopic cholecystectomy were under general anesthesia while for the open group, 54% were given general anesthesia, 18% epidural anesthesia and 28% received spinal anesthesia.

The mean cost of surgical needs was 5,415 pesos in the open group but only 3,803 pesos in the laparoscopic group. For the surgery plus category, there was a considerable difference between OC and LC group. The mean cost for surgery plus was at 11,861 pesos for the laparoscopic group which was thrice that of the open group which was only 3,803 pesos.

When the fee for the laparoscopic tower and the disposables were not included in the computation of the subtotal cost, the mean value for the OC group (18,465 pesos) was significantly higher compared to 12,491 pesos in the laparoscopic group. There is no significant difference between the mean total cost for the laparoscopic group which was 20,549 +/- 4,972 pesos and 18,465 +/- 7,908 pesos for the open group.

Discussion

Laparoscopic cholecystectomy is the standard of treatment for cholelithiasis. Its advantages over open cholecystectomy are well established and have been demonstrated in numerous studies [4,5,7,14]. These benefits include shorter recovery period, earlier resumption of feeding, less post operative pain, better aesthetic outcome and fewer off days from work. However, the result of previous studies comparing the cost between the two techniques are inconsistent. The cost analysis would be different from the point of view of the patient, the hospital and the national health system. The inclusion of indirect costs will also give varied outcomes compared to direct costs alone. Also, inclusion of patients with more comorbidities and previous surgeries will have a substantial impact on the cost of hospitalization [7,9,10,14,15]. This study showed an objective comparison of the direct cost of hospitalization between the two techniques.

Similar to other studies on cost analysis, ensuring that the two groups were equal in terms of age, sex and ASA classification was important to avoid the effect of confounders and based on the results of this study, the two groups were comparable with respect to these characteristics. There are still no studies directly investigating the effect of age and sex on the cost differences between LC and OC. Studies available looked into the effect of age on outcome of cholecystectomy. A study by Masqood *et al*. in 2017 included patients with ASA classifications of 3 and 4 and results revealed that older patients had significantly higher rates of comorbidities and intraoperatively, they had more blood loss, longer operative times, and more open operations. Postoperatively, these patients had more complications, hence a longer hospital stay [16]. One study evaluated the effect of the male gender on the outcome of laparoscopic cholecystectomy and found that there was no significant difference with regards to conversion rate to open and complications. A significantly longer hospital stay was noted in males [17].

Analysis of data showed that the OC group had significantly longer total and postoperative length of hospital stay compared to the LC group. In addition, they incurred significantly bigger charges than the LC group for room and board, laboratories, radiology, pharmacy, and surgery. On the other hand, the LC group had significantly higher mean charges for the surgery plus category. There was no significant difference in the anesthesia expenses and total cost.

Most cost analysis studies with higher charges for OC than LC have attributed the difference in cost to longer hospital stay in the OC group. In a study by McIntyre in 1992, the average length of stay for laparoscopic group was 1.6 days as opposed to the 4.8 days in the open group [7]. This finding is consistent with the results in all the studies comparing the length of stay between the two approaches, the values ranging from 1-16 days for LC and 4-22 days for OC. The shorter length of stay can possibly be attributed to the less postoperative pain after LC as mentioned in the study by de Pouvourville *et al*. (1997) and and Hardy *et al*. (1994) [4,12]. Some studies claim that there are more complications after OC but others claim that there was no significant difference in the complication rate between OC and LC [4,6]. The presence of postoperative complications like wound and respiratory infections are also probable causes of longer hospital stays. Bosch *et al*. (2002) concluded that the cost of LC was 18% cheaper than OC because of shorter hospital stay [15]. For this study, lack of OR slot for some of the charity patients especially those in the open group has caused delay in the surgery translating to more days in the hospital. In relation to the prolonged length of stay, the mean cost for the room and board for the open group was higher than that of the mean for the laparoscopic group. Again, these findings were consistent with the results from the previous studies mentioned above. Another category with higher cost for OC which may be correlated with a longer hospital stay is the pharmacy expenses. The average pharmacy cost for the OC group was 2,671 pesos which was significantly higher than the

LC group (1,101 pesos). As mentioned, the difference can possibly be explained by the longer length of stay in the OC group, but it may also be due to less pain medication requirement for the LC group. Unlike most studies where non operating room related expenses were clumped into a total hospital charges, a study by Vanek *et al*. (1997) included pharmacy costs as one of the categories. They found no significant difference in the pharmacy charges for the OC and LC groups [13]. Comparison of results with other studies is difficult for certain categories because the definition for each category varies among studies. For example, one study may include intraoperative and post operative pain medications under anesthesia while others will have separate categories for these items.

In this study, the mean laboratory cost was higher for the open group than the laparoscopic group. One study which utilized similar categories for cost analysis showed no significant difference in the laboratory costs but it was higher for LC in a study done by Bosch *et al*. in 2002. However, the cause of the higher laboratory cost for LC was not discussed [13,15] Possible factors that may contribute to increase in laboratory fees would be the laboratory tests for preoperative clearance. In addition, patients with more comorbidities may need more preoperative and postoperative tests. Further investigation for the probable causes of the discrepancy in laboratory costs is recommended. For this study, the mean radiology cost was also greater for OC compared to LC. The difference can be explained by the greater number of patients undergoing intraoperative cholangiography (IOC) in the OC group (22 in OC and 1 in LC). General surgery residents in PGH are often required to do routine intraoperative cholangiography for open cholecystectomies to check for possible common bile duct stones and anatomic abnormalities. This trend was also observed in one study where the performance of cholangiography increased the total charges by 18% for LC and by 11% for OC [13]. Similarly, studies by Bass *et al.* (1992), McIntyre *et al.* (1992) and Zacks *et al.* (2002) have identified use of IOC has led to significant increase in cost for OC [7,11,18].

No significant difference was found between the two groups in terms of perioperative anesthesia expenses. In a study by Bosch *et al*. (2002), cost of perioperative medications were higher for the LC group while the cost of postoperative medications was higher for the OC group due to less postoperative pain. Another study investigated the need for analgesics upon discharge, and observed that pain medications were needed for a shorter period for the LC group [4,15].

The mean cost of surgical needs exclusive of the fee for laparoscopic machine use and disposable instruments was higher in the open group. The higher cost can be attributed to the water soluble contrast used in cholangiography and greater number of sutures needed for an open cholecystectomy. However, with the addition of the laparoscopic machine fee and cost of disposable trocars, hand instruments and ligaclip in the computation for the total cost of surgical needs, an enormous difference in the operating room cost is noted for the minimally invasive approach. A higher OR cost was also seen in the study by Vanek *et al*. (1995) wherein the cost in the LC group was twice that of the OC group. The reason for this was the cost of the disposables as well as the longer operative time for LC [13]. Conversely, there is no significant difference between the mean total cost for the laparoscopic group which was 20,549 +/- 4,972 pesos and 18,465 +/- 7,908 pesos for the open group. The higher cost of the special laparoscopic equipment and instruments was offset by the considerably higher costs incurred for room and board, laboratories, radiology, pharmacy, and surgery in the OC group. Some studies have shown that the total hospital chargers were higher for OC, others claim that LC was more expensive while others reported the total cost was comparable in the two techniques. It was noted that the mean total cost for LC differed from 27% lower to 53% higher than the charges for OC [9,10,11,13,14].

With the data obtained from this study, the researchers were able to identify potential areas for reducing hospital cost for cholecystectomy. As mentioned previously, the shorter length of hospital stay has resulted in a lower cost for patients undergoing laparoscopic cholecystectomy [4,7,19]. This shorter hospital stay associated with faster recovery is the most appealing advantage of the laparoscopic technique both from the patient's and hospital's viewpoint. The improved efficiency associated with laparoscopic cholecystectomy allows the hospital to treat more patients resulting in an increase in the total resource used while the cost per patient is reduced [19]. In the PGH setting, there is a need to formulate strategies to reduce the preoperative length of stay especially for charity patients.

Aside from reducing the length of hospital stay, studies have emphasized the importance of finding ways to reduce the high charges for laparoscopic tools to decrease the overall cost for LC. In a study by Demoulin *et al.* (1996), it was computed that the cost per procedure of a full disposable set is 7.4-27.7 times higher than the cost per procedure with reusables [20]. Several studies have shown cost savings in the use of reusables or semi-reusables to decrease hospital charges [20,21]. Shifting to reusable from disposable instruments in the institution will result in cost savings in the long run. Aside from the shift to reusable instruments, other

recommendations to decrease expenses on laparoscopic tools include immediate financial settlement to the suppliers, substantial cost index reference and improved assessment and cost estimation of the resources within and between institutions [14].

Another way to cut down cost of operation is to employ selective rather than routine cholangiography [13]. In line with this, the Department of Surgery must come up with evidence based guidelines for the use of selective intraoperative cholangiography.

At present some centers in the country are already performing cholecystectomy on an ambulatory setting. This set up gives the patients the convenience of avoiding hospitalization hence decreasing the cost of undergoing cholecystectomy. However, there should be adherence to an appropriate selection criteria and discharge criteria in order to avoid complications and readmissions [22,23,24].

Limitations of the study

A longer study period and a bigger sample size may give us additional information, but due to time constraint, the study was limited to six months. Moreover, the indirect cost of cholecystectomy as well as the professional fees of the surgeons, anesthesiologists, radiologists were not included in the cost analysis for this study. Owing to the retrospective character of the study, the operative time and out of pocket expenses of the patients for items not available in the hospital were not accounted for. Given the aforementioned limitations, conclusions may not be generalizable to other institutions.

Conclusion

At the Philippine General Hospital, the total direct cost of LC is comparable to OC. But when one looks into the distribution of the expenses, the OC group incurred significantly higher charges than the laparoscopic group in room and board, laboratories, radiology, pharmacy, and surgery needs. On the other hand, the LC group had significantly higher mean charges for the surgery needs inclusive of the laparoscopic machine and disposable instruments.

Strategies to lower costs should focus on the need to lower charges for equipment use and the use of reusable instruments. With appropriate selection criteria, the initiation of ambulatory LC in PGH is another way to lower cost for both patients and the hospital. Further investigation on the causes of a longer hospital stay for OC in a tertiary government hospital setting is also needed because it contributes to higher charges. It is equally important to conduct studies on indirect costs of cholecystectomy. Evaluation of these parameters for the two techniques will enable the determination of their cost effectiveness and economic impact in the institution. The data obtained from this study will be used as baseline for better designed prospective cost analysis studies in the future.

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