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Original Research Article

Cost effective analysis of open and laparoscopic inguinal mesh hernioplasty

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ABSTRACT

Background: Inguinal Hernia mesh repair surgery is one of the most commonly conducted surgical procedures. Between two approaches: open and laparoscopic, which is better for the patient in terms of cost and outcome in terms of quality of life and return to economic activity. To facilitate comparability across studies, cost effectiveness analysis requires measurement of both costs and quality adjusted life years (QALY).
Methods: Descriptive, observational study which entails classifying costs, identifying cost centres, tracing all costs related to the elective procedures for inguinal mesh hernioplasty by both open and laparoscopic methods followed by checking the Quality of life pre and post-surgery of these patients through the EQ-5D-3L by telephonic interview. A Cost Effective analysis was conducted by the end of the study. Based on available data, we took 35 cases of laparoscopic procedure and 45 cases of open surgery as a universal sample size.
Results: Traditional costing showed a difference of approximately INR 3245.93/- in the 2 procedures with laparoscopic surgery being costlier. Significant improvements were noted in patients post laparoscopic surgeries with less people complaining of post operative pain/discomfort and early resumption of daily activities and mobility within a month after the surgery. ICER is tilted in favour of laparoscopic surgeries by a value of Rs 1,08,197.66 per QALY.
Conclusions: The difference in cost is minimal but the difference in the QALY scores and ultimately the ICER determines that laparoscopic surgery has an edge over open surgery in terms of outcome and patient comfort.

Keywords: Cost effective analysis, QALY, ICER, Mesh hernioplasty

INTRODUCTION

Inguinal Hernial repair is one of the most common general surgical procedures that are currently taking place across the world. In India the estimated annual incidence of inguinal hernias is 19,57,850.[1] Currently there are 2 surgical techniques through which it is being addressed, open and laparoscopic. It is but the next assumption that a minimally invasive technique would certainly be more cost effective than the open one but we really have to provide the evidence for the same and not assume it on face value.[2]

Benefits to patients of minimal access interventions arise from reduced operative trauma and swift post-operative recovery. This is certainly advantageous to some groups of patients more than others such as those for whom a long period of absence from employment has a high personal opportunity cost, or individuals with dependent children or relatives. The total cost of healthcare services may also be affected by minimal access treatments.

Length of hospital stay is often reduced compared with open surgery, with a reduced requirement for hospital beds, however there is a possibility of more primary care support.[3]

Instances of primary inguinal hernia are routinely treated by open mesh or mesh plug repair with local or regional anaesthesia being the procedure of choice. Mesh has the advantage of providing a tension-free repair and is also necessary to eliminate the altered collagen metabolism that would occur with time.[4]

There are several sources for cost data: hospital, Medicare, and private sources. It is important to remember, especially if using hospital data, the difference between costs and charges. Costs are the actual expenditures incurred when providing a service and charges are list prices. As expected, charges are usually inflated and do not reflect the actual cost.[5]

The maximum possible reduction in a disease due to the use of an intervention is termed the "efficacy" of the intervention which can be measured with randomized controlled trials (RCTs). The benefit from an intervention that is applied in practice to a population larger than that taking part in the RCTs is called "effectiveness". The difference between efficacy and effectiveness can be large, and obtaining realistic measures of effectiveness is a challenge. CEA expresses the net direct and indirect costs and cost savings in terms of a predefined unit of health outcome (eg, lives saved or cases of illness avoided). The total net costs, sometimes called incremental costs, of an intervention are calculated and then divided by the number of health outcomes averted to yield the total net cost per unit of health outcome.[6]

Cost effectiveness is an important consideration when evidence for predominance of one surgical technique is lacking. In order to compare alternative treatments, we measure both costs and quality adjusted life years (QALY) for the multiple therapies under question. Costs can be measured from the perspective of society, the payer, or the patient, and the scope may include both health care and non-health care costs. A QALY measure combines life expectancy and quality of life.[7]

The QALY was originally developed as an academic standard for measuring health effects in cost-effectiveness analysis, to aid decision-makers responsible for allocating scarce resources to competing healthcare programs. In using QALYs, it is to be assumed that decision-makers aim to maximize health or health improvement across the population within the limitation of resource constraints. It is further assumed that health or health improvement can be measured or valued based on the amount of time spent in each health state associated with a particular disease. The conventional QALY is therefore a valuation of health benefit. [8]

The most common method for deriving aggregate measures is to rescale each individual's valuations so that full health is given a value of 1 and death a value of 0, and then take the average of these values as the basis for the 'social values' of all other health states. Cost-utility analysis (CUA) is a form of cost-effectiveness analysis that uses QALYs gained as the measure of effect. This has the advantage of allowing comparisons across all programs, as they are all measured in the same unit. The scope and limitations of various QALY measures can be seen in two contexts: when making decisions between different treatments for the same individual, and when allocating limited resources among different health care activities that serve different groups of people. [9]

There is a true quality-of-life value, Q, that cannot be measured directly, but that can be measured indirectly by asking a series of questions known as "items," each of which measures the same true concept or construct. These questions are then asked of the patient, and the answers are converted to numerical scores that are then combined to yield "scale scores," which may also be combined to yield domain scores or other statistically computed summary scores. If the items have been chosen properly, the resulting scale of measurement, Z, should differ from the corresponding true value, Q, only by random error of measurement and should possess several important properties.[10]

It is essential to understand the distinction between cost and charge. Costs are the actual expenses incurred when providing a service, while charges are the listed prices, which are usually higher than the actual cost. Hospitals tend to keep their cost structures confidential in order to maintain their competitive advantage and prevent insurance reimbursements from decreasing. Utilities are the preferences that individuals or society may have for a particular health state. To calculate the Quality-Adjusted Life Years (QALYs) for permanent health states, one must multiply the utility of the health state by the patient's expected number of remaining healthy life years. For temporary health states, when a time frame is specified, QALYs are calculated as:

Example of Calculating QALYs for Temporary Health States

Formula = [Utility of the health state × duration of the state] + [number of remaining healthy life years × utility of healthy years]

In a study of wrist arthrodesis with a superficial wound infection, QALYs were calculated as: [0.85(utility of infection)]×[0.038years(duration of infection)] + [30years (healthy life years) − 0.038] × [0.82(utility of healthy life years without complication)] = 24.6 QALYs.

The Incremental Cost Effectiveness Ratio (ICER) is a measure of the additional cost incurred for a given increase in effectiveness when comparing two interventions. It is calculated by subtracting the cost of one therapy from the cost of another, and then dividing this difference by the difference in effectiveness between the two therapies. This metric is becoming increasingly important in healthcare, as it allows for a direct comparison of the cost-effectiveness of different interventions.

A lower value indicates that the intervention is more cost-effective than others, meaning that it provides a better health benefit at a lower or same cost. It is expressed in monetary units per health outcome (currency value per quality adjusted life years). Figure 1 gives the outcomes of the economic analysis. The objectives of the study are to estimate costing of laparoscopic and open mesh hernioplasty, quantify QALY parameters of patients in both procedures and compare cost effectivity of the two procedures based on costing and QALY and give recommendations.

METHODS

Scope

Being a single worker study the scope of this study was restricted to ascertaining unit cost of operating on a patient of inguinal hernia or incisional hernia by both open and laparoscopic methods in Department of Surgery of Command Hospital (Southern Command). A telephonic interview was conducted to ascertain the Quality of Life of the patients, post-surgery by the EQ-5D-3L questionnaire.

Study design

This was a descriptive, observational study. This study entails classifying costs, identifying cost centres, tracing all costs related to the elective procedures for inguinal mesh hernioplasty by both open and laparoscopic methods followed by checking the Quality of life pre and post-surgery of these patients through the EQ-5D-3L. A cost Effective analysis was conducted by the end of the study to determine which procedure fairs better amongst the two economically.

Study period

The study was carried out from 15 June 2022 to 14 August 2022, a total period of eight weeks.

Sample size

For 95% CI, SD of 5.7 and d of 3.22, the ideal sample size came out to be 12. However, based on available data, we took 35 cases of laparoscopic procedure and 45 cases of open surgery as a universal sample size.

Inclusion criteria

Patients between the age of 20-60 yrs, who had inguinal hernia as established by coming to the Surgical OPD for consultation for the same and were electively operated between the years 2019-2022.

Exclusion criteria

Patients with co morbidities such as diabetes, hypertension, with multiple conditions such as inguinal hernia with hydrocele and those with any complications that may have occurred during surgery.

Data collection and tools of measurement

The data for the study was collected as follows.

Direct observation

The observations were made on, Physical facilities and layout of the centre, staffing pattern in various areas of the centre, and materials used/ expended during the process flow.

Study of documents/records

All the documents/records related to patients, procedures, staff, and centres were studied. The information gathered from the above records was analyzed to study the annual workload; policies and procedures of the centre; activities and cost centers for each procedure under study.

Interview of the staff

Staff dealing with the process of surgery and peri-operative care directly or indirectly were interviewed by using the open-ended questionnaire to ascertain their functioning, utilization of resources and bottlenecks if any.

Data analysis

The computation of the cost of procedure was done under three phases of patient care, namely, pre-op, surgery and post op. The total cost of both procedures includes the sum of all the above costs apportioned for each phase of activity separately.

Resource use data

There are 4 headings under which cost was calculated. Pre-operative investigations and admission with overnight stay 1 day prior to surgery. Peri-operative which includes gowns, gloves, intravenous transfusion equipment, sutures, laparoscope, instruments, anaesthetic agents, analgesics, cost of operative staff. Hospital stay taken as 48 h post-surgery and includes hospital stay along with the nursing care and doctor's rounds twice a

day. Post-operative includes antibiotics, anti-inflammatory medicines, general ward utility items.

Assumptions

Following assumptions were taken for the study. (a) Salary of the staff was taken as per the 7th central pay commission; (b) For calculating the cost, only the direct manpower has been considered; (c) Leave period of the staff was considered for the study as the staff takes leave as per their requirement and it would be difficult to calculate as this is a single worker study; (d) While calculating the electrical load, the load of security lights was considered; (e) The duration of open surgery was taken as 1hour and that for laparoscopic as 2 hours based on the average time taken for both procedures; (f) The policy for post op care in the hospital requires all patients to be kept under observation for 48 h under admission, hence post op was considered the same for both. However; a special mention will be made later for hospitals who detain the patient for 6 h post laparoscopic surgery and then send the patient home.

QALY estimation

The Euroqol EQ-5D-3L questionnaire was used to interview as many patients as possible whose records are available with the hospital and who fall within the inclusion criteria. The value for utility factor was determined through it.

Observations

Cost allocation

The cost was allocated as given in Table 1.

Table 1: Outcomes of economic analysis.

Incremental cost	Incremental effectiveness		
	More	**Same**	**Less**
More	Need ICER	Weakly reject	Reject
Same	Weakly accept	Neutral	Weakly reject
Less	Accept	Weakly accept	Need ICER

Table 2: Costing of manpower.

Nomenclature of staff	Monthly salary (INR)	Hours of working	Hourly salary (INR)	No. of hrs. involved		Total cost (INR)	
Primary Surgeon (Lt Col)	1,35,587.00	8 hrs on full days and 6 hrs on half days For 26 working days= 192 hrs	706	1hr	2hr	706	1412
Surgical Trainee (Maj)	1,17,657.00		612	1hr	2hr	612	1224
OT Matron (Maj)	1,17,657.00		612	1hr	2hr	612	1224
Anaesthesiologist (Lt Col)	1,35,587.00		706	1hr	2hr	706	1412
ORA (Hav) Anaesthetist	41,161.00	12hr shifts for 5 days and 06 hour shift for 1 day For 26 days, working time = 284 hrs	214	1hr	2hr	214	428
ORA (Hav) Surgery	41,161.00		214	1hr	2hr	214	428
Ward Nurse (Capt)	1,08,492.00		382	24hrs		18	
Nrsg Asst (Nk) – 1	41,161.00		144	24hrs		6.5	
Nrsg Asst (Nk) – 2	41,161.00		144	12hrs		3	
Housekeeper (Sep)	41,161.00		144	2hrs		0.5	
Total						3092	6156

Hospitals are complex organizations

A single costing method was found to be insufficient to allocate all the costs involved in patient care. Hence, three costing methodologies were used:

Hourly rate method

For the purpose of allocating time sensitive costs. This method was used for computing manpower cost as well as equipment and maintenance.

Per diem method

For the purpose of allocating cost on per day basis. This method was used for apportioning of building and maintenance as well as stationary and administrative charges.

Surcharge method

This method was used for item-sensitive costs wherein apportioning is done using unit cost. These included drugs and consumables, investigations, electricity, air conditioning, CSSD, linen and laundry, dietary services.

Cost center: direct labour cost

Manpower cost

The monthly salary of all the manpower involved in the surgical procedures for inguinal mesh hernioplasty was

taken as per the 7th pay commission. The apportioning of salaries to the time spent was done in the following manner.

Cost was apportioned to salary per hour considering 192 working hours in a month. This was considered for the following categories of staff and apportioning was done as shown in Table 2.

Table 3: Cost of consumables used in the surgery apportioned to their usage.

Nomenclature	Qty.	Unit cost (Rs)	Amount of usage	Total cost (INR)
CO2 gas cylinder	512L	336.00	35L	14.62
Sevoflurane	250ml	2760.00	10ml	110.40
Mesh (prolene 15x15)	1	885.00	1	885.00
Spinal anaesthesia (bupivicaine+ dextrose)	4ml	23.45	4ml	23.45
Sutures (vicryl 2,0)	12	147.001	1	11.00
Sutures (prolene 2,0)	12	127.00	1	10.00
Drapes	1	569.00	1 set	569.00
CBC				
Coulter LH series pak reagant kit	150	14897.00	1	99.30
Coulter lyse S lll diff lytic reagent	50	7003.00	1	140.06
Coulter LH series diluent	200	4686.00	1	23.24
Coulter series cleaner	80	6305.00	1	78.81
LFT with enzymes				
ALP Seimens dimension EXL 200	360	1566.00	1	4.35
AST Seimens dimension ECL 200	360	1074.00	1	2.98
ALT Seimens dimension ECL 200	240	1043	1	4.34
Protien Seimens dimension ECL 200	480	1043.00	1	2.17
Albumin Seimens dimension ECL 200	480	1045.00	1	2.17
Total bilirubin	480	1716.00	1	3.57
Direct bilirubin	320	1432.00	1	4.47
RFT with electrolytes				
Urea Seimens dimension ECL 200	480	1566	1	3.20
Creatinine Seimens dimension ECL 200	480	1491	1	3.10
PT	30ml	120.00	0.01ml	0.04
PTTK	12ml	2155.68	0.05ml	8.98
Blood sugar	1440	4061.00	2	5.60
X-ray film	50	2141.00	1	42.82
Blood group reagent				
Anti B	1ml	6.00	0.2ml	1.20
Anti AB	1ml	7.00	0.2ml	1.40
Anti D	1ml	16.50	0.2ml	3.30
HBsAg	1	8.85	1	8.85
Anti HCV	50	1115.00	1	22.30
HIV	1	23.00	1	23.00
Normal saline	1	13.26	3	39.78
Inj omnatax 1g IV	1	35.00	2	70.00
Tab combiflam	1	0.68	1	0.68
Foley's catheter	1	15.00	1	15.00
Urobag	1	71.73	1	71.73
Total				2,309.91

*Items marked in maroon are used exclusively in laparoscopic surgery and those marked in purple were used exclusively in open surgery. Rest of the items marked in black are common to both procedures

The ward hours have been apportioned to 1 bed by dividing the number of hours with a ward strength of 32 and a bed occupancy of 70%.

There is an additional cost of consultation of the surgeons to be factored in once the patients have been admitted until discharged when they check up on the patient's status during morning and evening rounds. This amounts

to 5 minutes each for pre op day post admission; post op in the evening; post op morning day after surg; post op evening day after surg; post op 2nd day morning after surg; post op 2nd day evening after surg. The additional cost of the expertise of the surgeons (primary and surgical trainee) will be added into the labour cost which amounts to Rs 353 + Rs 306 which on adding to the total cost makes it Rs 6815 for laparoscopic surgery and Rs 3,751 open surgery**.**

Cost center: direct material cost

Cost of equipment and consumables

The unit cost of all the drugs and consumables used for the pre-op pre anesthetic check, surgical procedures and post-op drugs as the Last Procurement Price (LPP) as obtained from the medical stores from the list the unit costs was shown in Table 4.

Table 4: Equipment cost with its cost apportioning.

Equipment	Cost in rupees	Cost (Rs) per hour	Utilisation time for each sample batch (in hour)	Unit cost	Cost apportioning
Laparoscopic surgical set	36,03,827.00	41.00	2	41.00	82.00
Anaesthesia gas station	1,21,000.00	1.38	2	1.38	2.76
Cautery machine	1,92,743.00	2.20	2	2.20	4.40
Blood coagulation machine (Stago)	3,00,000.00	3.42	0.03	114.33	0.10
Dimension EXL 200 (Seimens)	55,18,300.00	70.00	2	70.00	140.00
X-ray machine	9,63,200.00	11.00	0.08	137.50	0.88
ECG machine	75,873.21	0.86	0.08	1075.00	0.06
ELISA for HIV(Biogenex)	1,75,000.00	2.00	4	0.5	8.00
Fully automated haematology analyzer (Beckman Coulter LH -750)	15,83,750.00	18.07	0.08	225.87	1.44
Total					239.64

Table 5: Cost of stationary/administrative.

Equipment	Qty	Cost rate (INR)	Total cost (INR)	Hours of life of eqpt (WH per day x 365 days x 5 yrs)	Cost per hour (INR)	Hours of utilization per day	Total cost per day (INR)
Stationary	1	46.94	46.94				187.76
Fire alarm speakers	1	3,308.00	3,308.00	43800	0.08	0.25	0.005
Fire sprinklers	1	609.00	609.00	43800	0.01	0.25	0.003
Fire sensor	1	850.00	850.00	43800	0.02	0.25	0.005
Television	1	25,000.00	25,000.00	43800	0.57	8	4.57
Almirah	1	17,700.00	17,700.00	43800	0.40	24	9.70
Wall clock	1	826.00	826.00	43800	0.02	24	0.45
Microwave	1	14,987.00	14,987.00	43800	0.34	24	8.21
Refrigerator	1	3,995.00	3,995.00	43800	0.09	24	2.19
Water dispenser	1	7,590.00	7,590.00	43800	0.17	24	4.16
Desktop computer with printer & UPS	1	59,870.00	59,870.00	43800	1.37	9	12.30
Hand dryer	1	9,738.00	9,738.00	43800	0.22	20	4.45
Storage cabinet	1	10,000.00	10,000.00	43800	0.23	24	5.48
Table	1	7,500.00	7,500.00	43800	0.17	24	4.11
Chair	3	5,976.00	17,388.00	43800	0.40	24	9.53
Notice board	1	2,200.00	2,200.00	43800	0.05	24	1.21
BMW dustbins	3	1,000.00	3,000.00	43800	0.07	24	1.64
Total							255.77
Total cost for duration of stay (i.e total x 04 days)							1,023.08

Table 6: Cost of equipment.

Equipment	Cost (INR)	Hours of life (WH per day x 365 days x 7yrs)	Cost per hour (INR)	Maintenance cost @ 3% per annum (INR)	Maintenance cost per day	Total cost per day (assuming 24 hrs utilization) (INR)
Hi-Lo beds with mattress-manual	61,027.00	61320	0.99	1830.81	5.02	28.78
Patient attendant couch	23,949.00	61320	0.39	717.47	1.97	11.33
Patient bedside locker	8,260.00	61320	0.13	247.80	0.68	3.80
SS top patient stool	1,500.00	61320	0.02	45.00	0.12	0.6
Crash cart trolley	16,910.00	61320	0.27	507.30	1.39	9.00
Overbed cardiac table	8,183.00	61320	0.13	245.49	0.67	3.79
Multipara monitor	35,000.00	61320	0.01	1026.45	2.81	3.05
MGPS terminal unit (Oxygen, Vac, MA)	777.00	61320	0.01	23.31	0.06	0.30
Ceiling mounted IV stand	1,251.00	61320	0.02	37.53	0.10	0.58
Cublicle tracks with curtai	2,880.00	61320	0.04	86.40	0.24	1.20
Nurse call system	43,173.00	61320	0.70	1295.19	3.55	20.35
Air purifier	10,000.00	61320	0.16	300.00	0.82	4.66
Total cost						87.44
Total cost for duration of stay per patient (04 days)						349.76

Table 7: Miscellaneous costs.

Service used	Consumption	Rate (INR)	Total cost for 4 days (INR)
Water consumption per patient per day	500 L	10.00 (per 500l)	40.00
Electricity consumption per patient per day	1KWH	7.20	28.80
Type of Diet consumed	'O' diet	159.28	637.12
Cost of Linen and Laundry	Per day per patient	20.25	81.00
Cost of sterilization	Per cubic feet load per drum	40.00	160.00
Cost of building [area (3586.27sqm) x construction cost per sqm (20,000.00) = 7,17,25,400.00]	Per year assuming 50yrs life span and straight line depreciation = 14,34,508.00	3.60 (per bed for 1 day)	14.52
Building maintenance (for OT and Surg Ward = 3586.27sqm)	E&M -118.70 B&R-243.50 (per sqm)	3.28 (per bed per day)	13.15
Running cost of air conditioning	1KW	7.20	28.80

Cost of medical equipment

The cost of sophisticated, electro-medical and non-electromedical equipment obtained from the blood transfusion stores and medical stores. It was apportioned for per hour of use assuming the life of the equipment to be 10 yrs and daily availability for utilisation for 1 h. The list is as shown in Table 4.

The costing per hour was carried out by dividing the cost of equipment by 365 × 24 × 10 to signify the life cycle of 10 yrs.

Cost of stationary/administrative

The cost of stationary which was being utilized by the dept. of surgery for the mesh hernioplasty for inguinal hernia surgery is mentioned in Table 5.

Cost of building

Building housing the OT and surgical ward is involved in patient care. Costs were calculated with an average life of building as 50 years and considering the straight line method of depreciation. As per income tax, 1961 depreciation rate of hospital building is 10% per annum. The per diem method of costing has been used for the surgical department as the bed occupancy for one full day and the cost had been apportioned accordingly.

Cost of building maintenance

Was calculated using the E&M and B&R rates given per square meter. The cost calculated per patient per day is shown in Table 7.

Cost of air conditioning

Air conditioning requirements of the operation theatre and surgical ward is handled by centralized air conditioning with a dedicated air handling unit of 5500 CFM, 2.2 kW fan motor having 450 mm diameter fan with separate fan coil unit (FCU) in surgical ward and operation theatre complex. The equipment cost was apportioned against the duration of the stay per patient and was added with running cost for the duration of the stay.

Total cost of air conditioning = 266.28 + 28.80 = 295.08

Cost of water consumption

Water consumption per patient per day taken as 500 l/day/patient.

Cost of electricity consumption

Electricity consumption per patient per day was taken as 1 KW.

Cost of dietary services

The authorized ration per patient for the 'O' diet was taken and the same was prices to calculate per day cost.

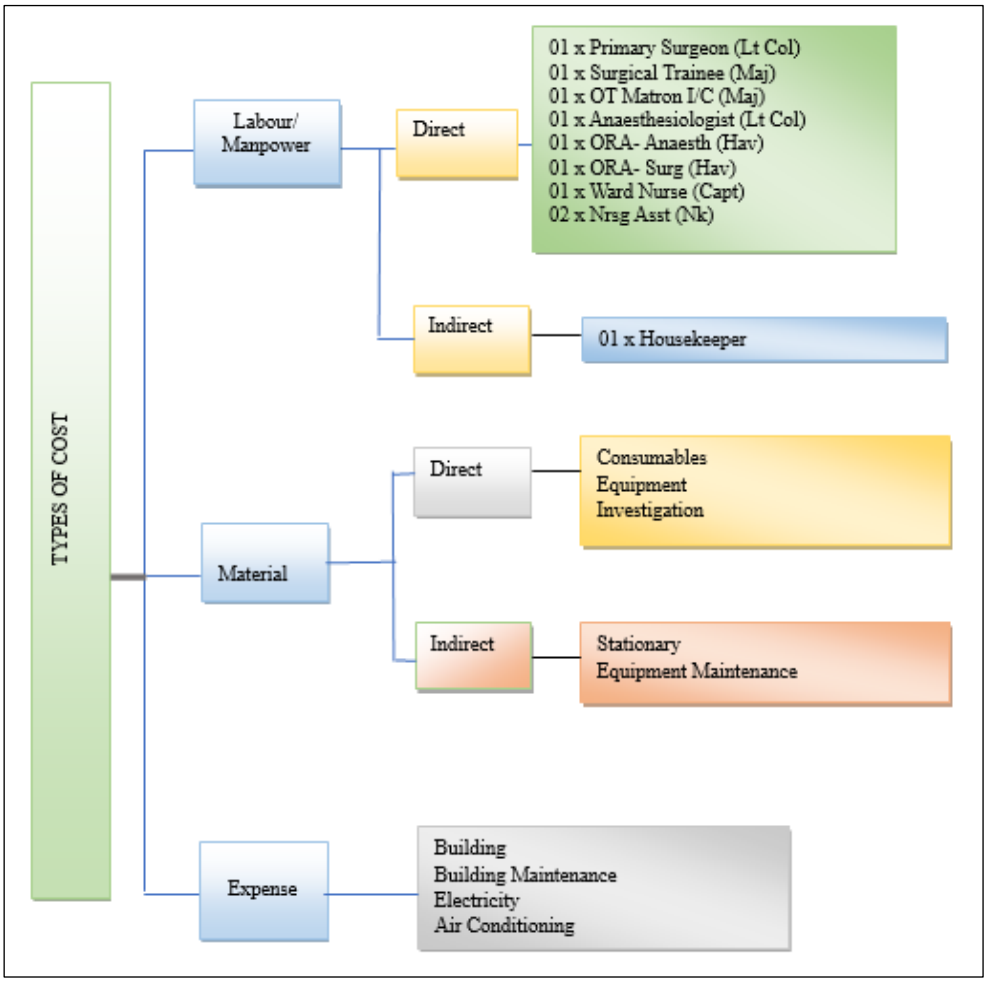

Figure 1: Cost allocation.

Table 8: Cost of air conditioner.

Details	Qty	Cost rate (INR)	Total cost (INR)	No of days being used	Hours of life of equipment (WH per day x 365 days x 5 yrs)	Cost per hour	Hours of utilization per day	Total cost per day	Total cost for duration of stay (INR)
AHU Eqpt cost	1	1,21,487.00	1,12,487.00	4	43800	2.77	24	66.57	266.28

Table 9: Total unit cost for conducting open and laparoscopic surgery in Command Hospital (SC).

Cost centre	Cost head	Cost (INR)	
		Open	Laparoscope
Direct labour	Labour cost	3751.00	6815.00
Direct material	Cost of consumables and expendables	2264.16	2162.59
	Cost of ward equipment	349.76	349.76
	Medical Equipment cost	154.88	235.24
Indirect Material	Cost of dietary, linen and laundry, CSSD	878.12	878.12
	Cost of stationary/administrative services	1023.08	1023.08
Expense	Cost of building	14.52	14.52
	Cost of building maintenance	13.15	13.15
	Cost of electricity and water	68.80	68.80
	Cost of running AC	295.08	295.08
Total		8710.98	11,956.91

Cost of linen and laundry services

Cost calculated in an unpublished study done by Dr Saurabh Singh from Dept. of Hospital Administration, AFMC, Pune titled, "To analyze and ascertain the cost per unit package of cardiac interventional procedure at a super speciality hospital" in 2017 was used after adjustment for inflation.

Cost of CSSD services (sterilization)

The cost is calculated in an unpublished study done by Dr Saurabh Singh from Dept. of Hospital Administration, AFMC, Pune titled, "To Analyze and ascertain the cost per unit package of cardiac interventional procedure at a super speciality hospital" in 2017 was used after adjustment for inflation.

To apportion the cost for calculating the unit cost of an inguinal hernia Surgery, the following steps were followed.

Direct labour cost

Manpower cost was calculated using the average time spent by each category of manpower involved and apportioning the cost accordingly based on the hourly rate as calculated in Tables 2. The cost of indirect manpower has not been considered.

Direct material cost

Cost of medicines and consumables: List of medicines and consumables used during each phase of patient care, i.e. pre-operative care, procedure, and post-operative care including reagents was prepared and the cost was apportioned to the consumption based on the costs and the time taken to run a single batch of tests as shown in Table 3.

Cost of medical equipment: Various equipment involved in management during different phases of patient care including pre-op investigations and their maintenance were listed and appropriated to the time of usage based on the cost as shown in Table 4.

Cost of stationary/administrative items: The cost of administrative items has been calculated as per the amount charged for their purchase and apportioned for the duration of their use in Table 5.

Indirect material costs

Cost of fitted equipment: The list of various equipment used in patient care during each phase was prepared and maintenance cost was calculated based on Table 6. The various costs under the head of expenses such as electricity and water consumption, air conditioning, dietary services, linen and laundry, sterilization through CSSD, building and building maintenance were apportioned to each patient based on the calculations as shown in Table 7 and 8. The total unit cost for conducting open and laparoscopic mesh hernioplasty conducted in Command Hospital, Pune is given in Table 9.

RESULTS

The findings of the entire costing study are given in Tables 2-8.

The costs for open and laparoscopic surgeries are summarized as Rs 8710.98 and Rs 11956.91 respectively as given in Table 8. The difference in cost between the two surgeries came to be Rs 3245.93 with laparoscopic procedure being costlier. However, it is pertinent to consider that the hospital studied had a policy of keeping patients of both open and laparoscopic surgeries for 48hrs. In other hospitals we may find that post laparoscopic procedures are taken as day care surgeries. So, the post op charges of room, manpower and ancillary

charges may not apply and change the cost difference between the two procedures.

For cost-effective analysis, 81 patients were interviewed based on the EQ-5D-3L questionnaire from Euroqol. 35 patients had undergone Laparoscopic procedures and 46 had undergone open mesh repair. The Quality of life as adjudged from indexing the values received from the 5 dimensions of mobility, self-care, usual activities, pain/discomfort and anxiety/depression is calculated to be 0.79 for Open Surgery and 0.82 for Laparoscopic Surgery. The QALY based on Quality of life parameters averaged earlier from the EQ-5D-3L questionnaire is calculated to be 0.30 for open and 0.32 for laparoscopic surgery.

$$\text{Now ICER} = \frac{\Delta C}{\Delta Q}$$

$$= \frac{11956.91 - 8710.98}{0.32 - 0.30}$$

$$= \frac{3245.93}{0.02}$$

= 1,62,296.50 per QALY.

The ICER value for the 2 procedures is Rs 1,62,296.50 per QALY gained in favour of laparoscopic inguinal mesh hernioplasty.

DISCUSSION

The subject matter of health economics includes factors that determine price patterns for health services, ways in which the materials, goods, health manpower, and facilities are brought together at the right time and place and in the right proportions to provide health services, and ways in which the different health goods and services are coordinated. An increasing life expectancy and decreasing death rate require among other things, an analysis of the optimum use of resources for maintaining and improving the people's health and the quality of the population.[11]

Conducting an economic analysis is important for assessing the health outcomes and resource costs of health interventions. It provides a way to compare the relative value of different interventions for improving health, taking into account all those affected by the intervention and all associated health effects and costs. The study should include mean or standard values for probabilities, utilities, costs, and discount rates for the reference case, which can be varied in a sensitivity analysis to obtain best and worst case scenarios.

Traditional costing techniques were employed because they treat overheads in a single pool of indirect costs which was beneficial for this study as the overhead cost per patient was relatively minimal. Amongst the QoL dimensions, the pain/discomfort dimension was found to be the strongest dimension where there was a difference of 21% between the 2 procedures with it being lower for laparoscopic hernioplasty. 7.5% reported coming back to usual activities faster and 6.6% respondents reported less incidents of anxiety/depression in laparoscopic procedures while the percentage for mobility and self-care were not numerically relevant to be quoted. These factors relate to early return to economic and leisure activities.

In a majority of low-and middle-income countries, the approach of determining the cost-effectiveness threshold is based on the per capita GDP.

The World Health Organization's CHOICE (Choosing Interventions that are Cost Effective) program uses this method as suggested by the Commission on Macroeconomics and Health wherein interventions costing less than three times the national annual GDP per capita for each disability-adjusted life year (DALY) averted are a good value for money, while those costing less than the national annual GDP per capita are considered highly cost effective. In India, this cost-effectiveness threshold could range from US $1582 (Rs. 90,688) to US $4746 (Rs. 2,72,064) per DALY based on 2014 GDP per capita estimates.[12]

The threshold represents the opportunity cost of the implementation, i.e. the health gain forgone by other patients. While the threshold is critical to the determination of the most efficient (i.e. health maximizing) use of resources. To recommend an intervention when the ICER is above the threshold is to pay more for the innovation than it is worth (in terms of the population's health). Promoting population health is consistent only with recommending treatments with ICERs that are below the threshold.[13]

The analytical unit of the CEA is the Incremental Cost Effectiveness Ratio (ICER), calculated as the difference in costs between two health care programs divided by the difference in outcomes. The types of outcomes that can be used in an ICER include mortality, clinical events, or Quality Adjusted Life Years (QALYs). The decision to adopt or not to adopt a program or intervention may be determined by the program's ICER, and as the ICER increases the likelihood of rejection on grounds of cost-effectiveness rises.[14]

Our calculated value is toward the lower end of the threshold range which allows for laparoscopic procedure to be considered as a standard practice or 1st line intervention, however further research with a higher sample size should be applied to offer that as an opinion derived from rigorous economic analysis. As per the CGHS list for Pune in 2020, the rates for open inguinal mesh hernioplasty is Rs 16,000.00 in non NABH accredited institutes and Rs 18,975.00 in NABH accredited institutes while for laparoscopic procedures it is Rs 18,000.00 in non NABH accredited institutes and Rs 20,700.00 in NABH accredited institutes. Ayushman

Bharat scheme rates mention Rs 10,000.00 for open and Rs 18,000.00 for laparoscopic procedure.

The costing as has turned out for the hospital under study is even less than the CGHS rates and Ayushman Bharat rates. This is probably due to the fact that the cost of land has not been factored into our study which would raise the cost significantly in private settings for whom these rates have been designed. Also, the centralized capital procurement and rate contracts by the governing body for all service hospitals ensures economy of scale which has contributed to reduction of cost.

As per the RCT conducted by Benedetto et al, the estimated ICER for patients was €3696.10s per QALY gained, in favor of TAPP, that is, at the willingness to pay threshold of €20,000s and €30,000s per QALY gained, was 95.38% and 97.96%, respectively.[15]

Studies have shown that the costs of laparoscopic hernia repair are higher than those for open hernia repair, however there are significant short-term quality of life benefits associated with laparoscopic procedures, as reflected by additional Quality Adjusted Life Years (QALY) gains, however these benefits were no longer relevant after 3 months.[16] This study has few limitations. QALY isn't calculated in India as utility factor isn't available. Due to a single principal worker only a limited sample size could be interviewed. Therefore, more weightage to the utility factor will come with a larger sample size. For this study we will restrict ourselves up till the point of calculation of ICER and not get into discounting and sensitivity analysis for the purpose of further economic evaluation.

CONCLUSION

In this study evidence points in the same direction that the laparoscopic surgery was more expensive but showed better post operative short-term quality of life benefits to the patients allowing them to return to their occupation and recreational activities sooner than open procedures however these benefits seemed to be limited to the first month post-surgery only.

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