COST-EFFECTIVENESS ANALYSIS OF LAPAROSCOPIC SURGERY VERSUS OPEN SURGERY IN RENAL CELL CARCINOMA AT INNER MONGOLIA MEDICAL UNIVERSITY SUBSIDIARY HOSPITAL IN INNER MONGOLIA, CHINA

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Abstract

The purposes of this study are to calculate the treatment cost on the perspective of provider, to assess short outcome (complications avoided) as well as the cost - effectiveness of the surgical treatments for renal cell carcinoma. This study aims to compare the 30 patients of laparoscopic surgery with 30 patients of open surgery in Inner Mongolia Medical University Subsidiary Hospital in Inner Mongolia in China during 2010-2011， The data source is from the medical records and hospital cost accounting bills.

The results showed that the cost of laparoscopic surgery is $ 1326.2 / person, the number of complications avoided patients are 24 out of 30 patients. Therefore, the average cost of each complications avoided is $55.25. Moreover, the cost of open surgery is $920.6 / person, the number of complications avoided patients are 26 out of 30 patients and the average cost of each complications avoided is $35.4.

In conclusion, from the provider perspective's point of view and based on the limited available database, the effectiveness of open surgery seems to be better than the effectiveness of laparoscopic surgery. However, the interpretation of the study results should be with caution regarding the implementation of a surgical procedure to treat this disease further since this study employed only one hospital data base and a short period of time. Over which the other members in the society dare not to doubt nor dispute.

Keywords: Cost-Effectiveness, Renal Cell Carcinoma, Laparoscopic Surgery, Open Surgery

Introduction

Problems and Significance

With the improving of modern medical technology all over the world, the application of the machine also gradually applied in clinical surgery. The minimally invasive treatment of laparoscope is one of the cases. This new technology and traditional open operation apply in lots of clinical surgery fields, for example: Aspects of department of genecology of breast cancer treatment，general surgery treatment of cholecystitis as well as the urology field kidney cancer treatment.

Kidney cancer is a kind of typical urinary system disease. It is also one type of the tumour which threatens human health in recent years. There are quite different incidence and death number around the worldwide in different countries. In United States, malignant tumours' of the urinary system comprise slightly more than 2% of new cancer cases and deaths with an estimated 31,200 new cases causing approximately 11,900 deaths in 2000. Annual mortality-to-incidence show a significantly higher ratio of associated with renal cell

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carcinoma compared with other common urological malignancies. (Pantuck, Zisman and Belldeqran, 2011: 1611-1623)

Renal cell carcinoma as main component of the kidney cancer，Incidence rates and mortality have been increasing steadily year by year，especially in Europe and the United States. (Lipworth, Tarone and McLaughlin, 2006: 2353-2358) There are also different incidence and death number around the worldwide. It is the 12th most common site in male and 17th in female. In less developed countries, rankings for the incidence is 16th, About women it ranks 12th and 17th in developed and developing countries respectively, The highest rates in both men and women were observed in the Czech with 20 and 10 annual new cases per 100,000 population. (Eble, 2004: 675)

In China，According to the National Cancer Prevention and Control Research Office, and the Ministry of Health Center for Health Statistics publish the data of our pilot cities and counties which are information of morbidity and mortality shows that there is an upward trend in renal cell carcinoma incidence. 1988-1992, 1992-1988, 1998-2002, the incidence of kidney and other urinary system cancers are 4.26, 5.4 and 6 per thousand populations respectively. According to incidence，the numbers of the infected are 28447，36594 and 49007 respectively. The number of women is half of the number of male patients. Urban areas higher than rural areas. And there are big differences in incidence among different areas.

The investigation of renal cell carcinoma is controversial，in the western developed countries, laparoscopic is widely used in many years，but in China，this technology treatment introduced in hospital just few years， and the first time, this treatment just take account into the department of obstetrics and genecology disease surgery. Moreover, compared with laparoscope，open operation remains the advantages of cheap.

In China, the traditional open operation has been widely used. In recently years, with minimally invasive surgery which use laparoscope gradually promotion the usage, the two treatments gradually become the most widely treatment to cure the renal cell carcinoma. But the two treatments have different cost and effectiveness. And according to a lot of related literature, there are a lot of research pay attention on the clinical effectiveness comparison with undergo the two treatments, in views about length of the stays in hospital, length of the operation time, and so on, there are less research analysis the two treatments from the economics and economic evaluation. This study want to analysis this two different methods use the cost effectiveness analysis to find which treatment is more reasonable. For patients, this study can provide the decision evidence for patients choose which treatments are more reasonable. For hospital, in order to use reasonable treatment in clinical and provide evidence to develop scientific treatment, and make more reasonable policy suggestions.

Objective of the Research

This study compared the laparoscopic surgery and open surgery in treatment about renal cell carcinoma by economic evaluation method which is cost-effectiveness analysis. This study used retro perspective, by means of medical records and the hospital cost accounting bills (January 2010-December 2011).

In order to complete the patients' different status after treatments, this study choose postoperative complications and intraoperative complications avoided rate as short term effectiveness.

Methodology

Data sources

This study chooses data were the history patient's records and the medical care bills from the department of urology of one public hospital in Inner Mongolia, China. The data is patient level data. This study extracts patient documents during January 2010 - December 2011 in one public hospital in Inner Mongolia, uropoiesis surgical department. The patients did the radical nephrectomy using two treatments respectively, age are among 20—84 years old.

Basic patient information investigation: Including name, age, and the number of inpatient，contact information, discharge time, history of previous abdominal surgery, and the MRT check situation (tumor stages and size).

Clinical patient information investigation：Including hospital stays, recovery time, complications, the cure rate.

Inclusion criteria

1.Without concomitant disease patients with renal cell carcinoma；

2. According to the TNM Classification of Renal Cell Carcinoma by WHO, based on different stages, patients have different influence in terms of cost and effectiveness. So this study limited the stages are T1N0M0 and T2N0M0. TIN0M0 means tumor 7cm or less in greatest dimension, limited to the kidney. No regional lymph node metastasis and no distant metastasis. T2N0M0 means tumor more than 7cm in greatest dimension, limited to the kidney.

3. Doctors not have clinical recommendations about the treatment, surgical procedure for patients based on their own choices.

Exclusion criteria

1. Patients with obvious concomitant disease.
2. Patients not include in TIN0M0 and T2N0M0.
3. Patients were advised to choose the treatment by doctors.

Samples information

There were 98 target populations of renal cell carcinoma patients which do the radical nephrectomy using two treatments respectively in 2 years. According to the eligible criteria, the laparoscopic patients are 30， the open surgery patients are 30.

Table 1 Patients basic information of the LAP group and OPE group

Characteristic	Average. (SD) Of recipient		p value
	Laparoscope (n=30)	open surgery (n=30)	
1. Sex			
Male	19	20	0.787
Female	11	10	
2. Age	55.1 (11)	54.7 (12.2)	0.886
3. Hospital says	14.8 (7.2)	15.4 (4.2)	0.696
4. Recovery time	6.3 (5.9)	8.7 (2)	0.039
5. Tumor diameter	4.9 (1.5)	5.8 (0.8)	0.016
6. Tumour size			
Left	27	24	0.585
Right	14	16	

This study analysis the statistics data by IBM SPSS Statistics 21, by means of the basic information about sample patients from target population. The contents include age, gender, tumor diameter，hospital stays, kidney disease, and therapeutic effect. More details in continued tables. And the null hypothesis is two groups of data difference not have the statistic significant，alternative hypothesis is two groups of data difference have the statistic significant.

1. Patients' age: Patients' age means the patients age when they check in the hospital and accept the treatments. Based on the patients' medical records the first page recorded, compare the 2 groups' age statistic difference by independent sample t test. Significance level is 95%. The difference between two groups of age not has the statistic significant.

2. Patients gender：Based on the patients' medical records the first page recorded, compare the 2 groups gender statistic difference by Chi-square test. Significance level is 95%. The difference between two groups of age not has the statistic significant.

3. Tumor diameter：according to the B-ultrasonic examination，get the tumor diameter. Based on the patients' medical records the first page recorded, compare the 2 groups' tumor diameter statistic difference by independent sample t test. Significance level is 95. The difference between two groups of age has the statistic significant.

4. Hospital stays: means the time patients check into the hospital accept treatment until they check out of the hospital. Based on the patients' medical records the first page recorded, the situation about post-operation complication, record the sum of twice the hospital days. Significance level is 95%. The difference between two groups of age not has the statistic significant.

5. Kidney site: means the right kidney and the left kidney. Based on the patients' medical records the first page recorded, compare the 2 groups' kidney disease statistic difference by Chi-square test. Significance level is 95%.The difference between two groups of age not have the statistic significant.

6. Recovery time：means after doing the operation, the patients check out of the hospital time. Some researches got the laparoscopic surgery recovery time is faster than open operation, because the open operation patients need more time to exhaust. Based on the patients' medical records the first page recorded, compare the 2 groups' recovery time statistic difference by independent sample t test. Significance level is 95%. The difference between two groups of age has the statistic significant.

Database diagram and effectiveness

Database diagram is designed to estimate the cost of treatment and follow up for different outcome after treatment. The diagram algorithm is built on account of the available data and the actual effect of treatment. After doing the screen according to the eligible criteria from the target population, according to the samples build the database diagram.

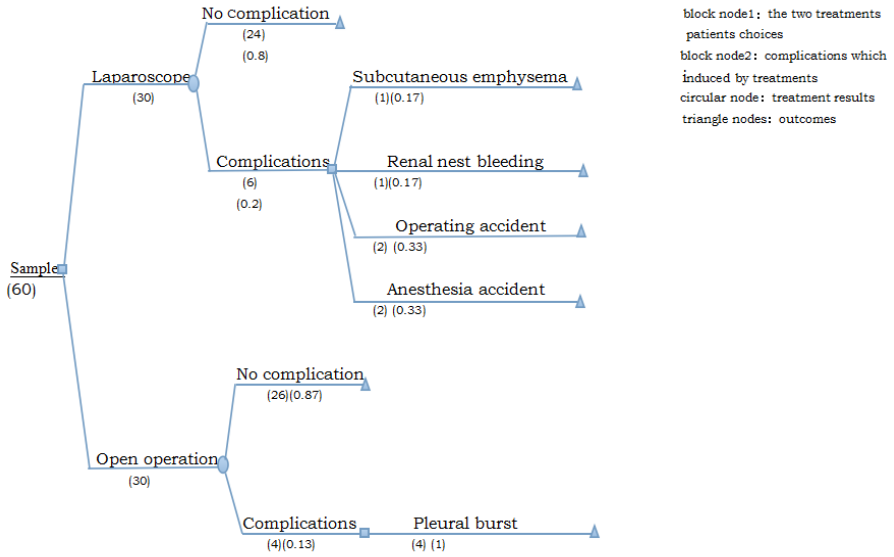

Figure 1 database diagram

Based on the available medical records, after did the treatments, they have been come out some complications, and two treatments has different complications, the complications can be divided into 2 types, Inoperative complications and postoperative complication. Inoperative complication means the process of the operation, generate the complications, postoperative complications means the complications which occurred after the operation.

This study will use the numbers of patients of complications avoided undergo the two treatments as the short-term effectiveness, according to the database diagram, the effectiveness patients of laparoscope are 24. So rate of complications are 24/30 = 80% and the effectiveness patients of open surgery are 26/30 = 86%.

To analysis the overall cost-effectiveness of laparoscope treatment relative to open operation of renal cell carcinoma，this study estimated the probabilities of different health states after did the operation，this study did retro perspective find the number of different states after operation, for example:

Probabilities of complication avoided after laparoscope = the number of complication avoided after laparoscope/total patient undergo laparoscope

Costing

This study divided two types of the cost centers, which have the directly relationship to the two treatment. Operation room and ward room. So this study will be the provider perspective, and the data type is patient-level data. Which including the disposable materials cost, pharmacy cost in terms of patients in ward and in operation room. As well as the building and equipment cost in operation and in ward of a hospital, otherwise, the labor cost is also included. Because this study calculate the cost include capital cost and recurrent cost which are take advantage over years, so the cost in 2010 will be convert into 2011 by inflation-adjusted method.

Disposable materials cost and pharmacy cost calculation，this part of cost calculation will use the price charge ratio according to the patients' records. The labor cost in ward was divided into two categories which were nurse work in ward and physician. And according to the different professional qualifications, every rank of the medical staff can support services to patients, so this study will take the total salary every year in nurses and physician. And

about the trainee, hospital not sends the salary to this part of workers, so this study not considers the trainee cost.

About this hospital's human resources allocation, the ward nurses are managed by the ward, and the nurse provide the medical service to the inpatient patients in the ward. And the physicians not just work for ward, they also work for the outpatient and the operation room. So about the nurse salary, they just related to the ward room or operation room, which are two independent department. But the physicians' salary included in inpatients, outpatients and operation.

When calculate the salary cost for the nurse and physician in inpatients in ward, there is an assumption，about the inpatient service，the nurse and the doctors provide the same service to every patients，no matter renal cell carcinoma patients or other urological diseases patients. In another word，salary in every patients are the same，the difference are the hospital stays. The ward has 15 nurses and 7 doctors, the work days are 20 days, and the average inpatients are 42 per day in this ward. After calculate the salary inputs per patient per day, according to the hospital stays, these salary inputs allocated in every patients. About doctors salary，According to the management of the physician service of this hospital，the doctors provide inpatient service for 12 days per mouth，outpatient for 6 days，operation for 12 days. So this study will use the direct allocation to allocate the salary of the physician by the allocation index about the working times.

Thirdly, Equipment and building cost. About the equipment and building cost in ward, there are several methods of calculating the capital cost in the research of economic evaluation, the best way is to use annuity of the initial equipment and building over the useful life. This method has many advantages which have been reported before. Because about the capital cost, the important index are opportunity cost and depreciation, so this method take into account both of them. (Drummond, 2005)

According to the database，the equipment and building was bought in 2005，so this study use present value formula to convert the cost which from 2005 to 2010 and 2011. The discount rate was used by the annual interest rate which formulate by Central Bank of China. (3.6%) After conversion from the original value (2005) to the year of patients used (2010-2011), this study used the expected years of useful life of the equipment and building based on estimate useful lives. According to the hospital assets book, the useful life for equipment is 5 years, building is 20 years. Because this study use the annuity to calculate the depreciation. After calculate the total capital cost of the ward from the 2005 to 2011 and 2010, which are total 5 and 6 years, next step is to allocate the cost to the patients in ward, like the assumption which salary cost calculation part wrote, this part this study also has an assumption, which is the depreciation cost of each patient daily consumption is the same, no matter renal cell carcinoma patients or other patients, so this study will use the total capital cost to calculate the average capital cost per patient per day, and times the hospital days, get the capital cost consumption for every patients.

Same with the ward cost, in operation room, disposable materials cost calculation，this part of cost calculation will use the price charge ratio according to the patients' records. Salary cost in operation room is divided into 3 types of medical staff, operation room nurse, doctors and anaesthetists. When calculate the salary cost for the nurses, physicians and anesthetists in operation room, same like the ward salary calculation there are an assumption，about the operation service，nurses, physicians and anesthetists input the same value of labor to every patients，no matter renal cell carcinoma patients or other diseases patients. In another word，salary in every patients are the same，the difference are the operation hours. And according to the renal cell carcinoma operation procedure which formulate by Ministry of Health in China to calculate the operation salary cost.

Firstly is operation nurses salary. The operation room has 15 nurses, the work days are 30 days, according to the operation procedure of the two kind of operation, two treatments both use 2 nurses can finish one operation, so this study calculate the average salary of the nurse, and times 2, get the operation nurses salary input of two treatments. The work days are 8 hours. Secondly is doctors salary, this study has been finish the doctor's salary allocation in above according to the doctors work time, which are inpatients, outpatients and operation, this part use the allocated salary in operation time, which are 14906 RMB, same like the nurses, the doctors salary also need to calculate the average salary by numbers of doctors, and according to the operation procedure, laparoscopic surgery need 3 doctors, open surgery need 4 doctors, and the average operation hours are 4 hours. Thirdly is anesthetists cost, the cost is also calculate based on the operation procedure, The anesthesia department has 30 anesthetists, the work days are 30 days, according to the operation procedure of the two kind of operation, two treatments both need 1 anesthetist can finish one operation, so this study calculate the average salary of the anesthetist, get the operation anesthetist salary input of two treatments. The work days are 8 hours.

Thirdly, equipment and building cost in operation room. As the calculation of capital cost in ward, this study used the annuity formula get the depreciation. The difference is because in this hospital, there are 24 operation rooms, one operation just use one room, and one room has one set of equipment, and the equipment was bought in the same year, which is 2005. So this study assume that the every patients in one hour consume the same depreciation, so this study take one set of the equipment in one operation room, calculate the depreciation per patients by operation hours.

Results and Discussion

Costing

As the study analysis before，according to the decision tree and cost，this study get the expected cost for each treatment, this study calculate the excepted cost by patients unit, because the medical resource consumed by the complication were included in the every patients medical records, so this study use the patients unit to calculate the estimated cost.

Estimated cost of laparoscopic surgery in renal cell carcinoma = cost of subcutaneous emphysema patients*0.17 + cost of renal nest bleeding patients*0.17 + cost of operating operation patients*0.33 + cost of anesthesia accident patients*0.33 + no complication patients*0.8 = 256964.8RMB = $39,785.2

Estimated cost of open surgery in renal cell carcinoma = cost of pleural burst patients*0.13+no complications patients cost * 0.87 = 178379.6 RMB = $27,618

1 dollar = 6.4588 RMB (2011)

Effectiveness

This study used the numbers of patients not have the complications undergo the two treatments as the short-term effectiveness, according to the decision tree, the effectiveness patients of laparoscope are 24. So rate of not have complications are 24/30 = 80% and the effectiveness patients of open surgery are 26/30 = 86%.

Cost-Effectiveness analysis

On the basis of this study definition of cost-effectiveness analysis, this evaluation is aim at to calculate the average cost of each complications avoided, and average cost of each 2-year disease free survival. This study gets the results:

Unit cost of LAP = 39,785.2/30 = $1326.2

Unit cost of OPE = 27,618/30 = $920.6

Short-term CEA

CEA = cost/effectiveness

CEA_{lap} = 1326.2/24 = $55.25

CEA_{ope} = 27,618/30 = $35.4

Therefore, in laparoscopic surgery, the average cost of each complications avoided is $55.25. In open surgery, the average cost of each complications avoided is $35.4.

So according to the less ratio, the more cost effectiveness treatment, so this study get the results which are the open surgery is the more cost effectiveness than laparoscopic surgery.

Conclusion and Recommendation

Conclusion

Compared the two cost-effectiveness results which are short-term (complication avoided), this study got the conclusion, which is the open surgery is the more cost-effectiveness treatment for cure renal cell carcinoma, but based on the limited database, this study just analysis the short-term, not have long-term outcome (5-year disease free survival, 10-year disease free survival). And the cost just included the direct cost, therefore, this study has limitation, maybe the results have bias.

Recommendation

This study may has some possible benefits: firstly, it can provide more effective, safe, economic treatment which from the cost perspective and effectiveness perspective; this study got the open surgery for hospital no doubt is the more cost effectiveness treatment to cure the renal cell carcinoma. Secondly, for hospital, it can make policy recommendations, the two treatments do some reform or improvement, provide reasons and evidence on establish disease charge criteria and achieve rational allocation of health resources, improve the utilization.

In conclusion，cost-effectiveness of a treatment takes account into not only the contributed benefit expended from the clinical effectiveness which from short term to medium term, but also think of the monetary perspective. Thus, this study is good for both patients and hospitals. So we can suggest the hospital and patients to choose the better treatment, which is open surgery.

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