Women's Health and Complications

RESEARCH ARTICLE

Estimate Cost Analysis for Uterine Rupture

Salem Alsuwaidan[1]*, Amsha Saud Aburasyin[2], Mohammed Alsuwaidan[3], Wesam Abdulwasea Saeed Almekhlafi[4], Hamad Altalasi[5]

[1]Salem Alsuwaidan, Head of Science and Technology, Research and Innovation Center, King Saud Medical City (KSMC), Riyadh, Saudi Arabia
[2]Amsha Saud Aburasyin, Obstetrics & Gynaecology, King Saud Medical City, Riyadh, Saudi Arabia
[3]Mohammed Alsuwaidan, General Director for Clinical Education Directorate, Primary Health Care Deputyship, MOH
[4]Wesam Abdulwasea Saeed Almekhlafi, Associate Consultant Obstetrics & Gynaecology, King Saud medical city, Riyadh, Saudi Arabia
[5]Hamad Altalasi, Director of Health Economics and Health Insurance, Riyadh, Saudi Arabia

Abstract

Introduction: The estimated cost for treatment is calculated in this study as the summation of utilized materials or medications, consultation(s), lab requests, hospitalization, costs of radiology services, and the average direct cost for any surgical or medical procedure.

Objectives and Aim: The direct cost estimation for KSMC is compared to the cost of patients with uterine rupture in another governmental hospital (under the umbrella of Ministry of Health (MOH)) and in private hospitals. A secondary aim for this project is to compare the estimated cost of medical complications and other variables that may affect the overall cost of the therapy for uterine rupture.

Methodology: The direct costs are the resources directly consumed, starting from the admission of the patient until discharge. These resources include materials or medications, consultation(s), laboratory work, hospitalization, surgical intervention, blood transfusion, etc.

Results: This retrospective study was conducted on the records of 25 patients with uterine rupture to calculate the best-cost. It was found that (84%) of the patients were of Saudi nationality. The average age for these patients was 29.08 years (SD ±6.05), average gestational age was 37.4 weeks (±4.2), average parity was 2.8 deliveries (±2.3), and average baby birth weight was 2.78 kg (±0.7). Also, the average duration between diagnosis of uterine rupture and surgery was 24 minutes (±28).

Conclusion: The estimated cost showed that the lowest cost of treatment was at KSMC, compared to those of both MOH and private hospitals. Medical complications are considered the main factor affecting cost estimation; direct medical costs increase with the progress of complications. There was no significant influence of mother's age on uterine rupture, while a survey of gestational ages indicated that a baby with a gestation period of 40–41 weeks will have significantly lower associated costs compared to those of babies born at 39 weeks or sooner.

Keywords: Estimate Cost, Uterine Rupture, Cost analysis

Introduction:

Maternal mortality is a public health challenge in Saudi Arabia and worldwide. One contributor to high maternal morbidity and mortality is uterine rupture [1]. This obstetrical emergency occurs when the muscular wall of the uterus tears during pregnancy or childbirth, causing complications for laboring mothers that often result in fatal maternal and neonatal outcomes. Causes of uterine rupture may be spontaneous, traumatic or caused by scar dehiscence [2]. Uterine rupture can be incomplete, where uterine serosa remains intact, or complete, where the full-thickness of the uterine wall, including the uterine serosa, is disrupted. Complete rupture often results in a direct connection between the peritoneal space and the uterine cavity with or without protrusion or expulsion of the fetus and/or placenta into the peritoneal cavity. Uterine rupture can occur during labor with regular contractions when a previous scar is pressured by the baby's movements, resulting in tears to the uterine wall. After a uterine tear, the contents of the uterus, including the baby, may spill into the mother's abdomen [3,4].

The main signs and symptoms of uterine rupture include excessive vaginal bleeding, sudden abnormal abdominal pain between contractions, and loss of uterine muscle tone at the site of a previous uterine scar, rapid heart rate, low blood pressure and shock in the mother, abnormal heart rate in the baby, and difficulty or failure to locate the baby's heartbeat. Uterine rupture is associated with previous cesarean section, mal-presentation, second-stage dystocia, induction of labor, big baby, post-term (≥42 weeks) births, maternal age, and short (≤164 cm) maternal stature [5,6].

Acute and long-term complications of uterine rupture are

Correspondence to: Salem Alsuwaidan, Head of Science and Technology, Research and Innovation Center, King Saud Medical City (KSMC), Saudi Arabia, Email: Sa[DOT]alsuwaidan[AT]ksmc[DOT]med[DOT]sa

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associated with anemia, blood transfusion, bladder injury, wound infection, sepsis, and sometimes death. Complications like obstetric fistula, psychological trauma, and permanent loss of fertility are some of the long-term outcomes. Acute renal failure is also possible following massive hemorrhage. Among these risks, the most commonly encountered complication is hemorrhage, leading to anemia. Patients with fistulas often suffer from leaking urine or feces through the vagina, and thereafter with being unclean, smelling of urine and feces and dealing with recurrent infection. This can lead to the patient being outcast from their families and enduring worsening poverty, malnutrition, and almost unbearable suffering [7,8].

Risk factors of uterine rupture can be life threatening and can be heightened in a woman with an unscarred uterus [9]. The incidence of uterine rupture in Yemen is higher than in Saudi Arabia, indicating that Yemen must improve antenatal and intra-natal care to provide better health services [10]. The management of uterine rupture depends on the surgeon's skills, the nature of the rupture, and the condition of the patient. Surgical interventions are emergency laparotomy with caesarean delivery and repair of uterine tear, subtotal hysterectomy, or total abdominal hysterectomy [11]. Epidemiological studies show that maternal death as a consequence of uterine rupture occurs at a rate of 0–1% in modern developed nations, while the mortality rates in developing countries are 5–10% [12,13]. To our knowledge, there are no studies showing the rate or incidence of uterine rupture in Saudi Arabia. The biggest challenge in this study is lack of information, as no similar studies are available in Saudi Arabia or worldwide. Research on the economic impacts of management of uterine rupture is also limited.

Health economic studies provide information to decision makers for the efficient use of available resources while maximizing health benefits. Economic evaluation is one part of health economics and is a tool for comparing costs and consequences of different interventions. It includes cost-minimization, cost-effectiveness analysis, cost-utility analysis, and cost-benefit analysis. Many important forces shaping health and healthcare have more to do with economics and social policy than with any particular medical treatment or procedure [14,15].

Cost must include the price of all services and resources acquired or consumed during treatment. The costs of a service can be classified as:

- Direct costs: resources directly consumed in the service provision, such as drugs, staff, etc. Direct costs are those related to the direct provision and use of health services
- Indirect costs: resources used for providing services by support units (e.g. radiology, laboratory) that centrally supply other departments. Indirect costs also refer to the loss of productivity of patients and caretakers due to medical treatment
- Intangible costs: pain, suffering, social stigma, etc. Intangible costs cannot be valued in terms of money
- Overhead costs: resources used to support the organization overall, without providing direct care, such as management, security, etc.

Indirect, intangible, and overhead costs cannot be directly allocated due to the common use and wide distribution of the resources involved to serve different customers [16].

There are no universally accepted guidelines for evaluating an economic modeling approach [17]. The cost and outcomes of the main interventions in this study are compared and assessed using previous medical cases of uterine rupture. The cost estimate covers all items that affected the patient in one hand and the institution in the other, including setting and other financial conditions.

This is an exploratory study with a retrospective approach, using the medical records at King Saud Medical City (KSMC) to assess the costs related to patients with uterine rupture. This study uses an account analysis approach and various types of analysis to estimate the direct costs for patients with uterine rupture. The estimated cost is calculated as the summation of utilized materials or medications, consultation(s), lab requests, hospitalization, costs of radiology services, and the average direct cost for any surgical or medical procedure. This study demonstrates how health economics can enhance doctors' knowledge and the importance of integrating health economics into clinical practice for best practice.

Aim and Objectives

Reinforcement of cost-conscious medical practice is being urged by medical professionals. Cost-awareness must have a place in clinical research education and in medical treatment guidelines. This project will give direct cost economic impact estimates for the therapy for uterine rupture at KSMC. Direct cost is the summation of utilized materials or medications, consultation(s), lab requests, hospitalization, costs of radiology services, and the average cost for any surgical or medical procedure. The direct cost estimation for KSMC will be compared with the cost of patients with uterine rupture in another governmental hospital (under the umbrella of Ministry of Health (MOH)) and in private hospitals. A secondary aim for this project is to consider the costs of medical complications and other variables that may affect the cost estimation.

Methodology:

Study design

This exploratory study models how to make cost estimation for the therapy of uterine rapture. This study calculated the average direct costs for all services and resources acquired or consumed. The individual direct cost is the resources directly consumed starting from the admission of the patient until discharge. These resources include materials or medications, consultation(s), laboratory work, hospitalization, surgical intervention, blood transfusion, etc.

Procedure

Twenty-five medical records for women admitted to KSMC with a diagnosis of ruptured uterus were reviewed. The records were dated within the last ten years, during 2010−2020. The following variables were collected in the review: diagnosis of ruptured uterus, maternal age, gestational age at delivery, parity, baby birth weight, duration of hospitalization, and surgical intervention. Additionally, the assessment of maternal outcome, including acute and long-term complications (anemia, blood transfusion, ICU admission, bladder injury, hysterectomy, wound infection, sepsis and mortality), were noted.

Statistical consideration

The study population was made up of 25 patients who had uterine rupture and recovered. The data were collected in an Excel sheet, and then the collected data was cleaned and verified. The data was then transferred to SPSS 24 for the descriptive analysis, frequency and student's t-test of the main variables, or when appropriate.

The cost was estimated for every patient individually, and then the average cost estimate was calculated for the 25 patients. Alternatively, the estimated range for the direct cost was calculated as a collective cost for an average of the variables.

Setting

The location of this study was the Department of Obstetrics & Gynecology at the KSMC. All medical files were obtained from the hospital's medical records. This research was granted approval by the KSMC IRB committee with reference number: H1RI-18-Mar20-02.

Results

In the past ten years, 25 women with uterine rupture were admitted to the KMSC and were successfully treated.

This is a retrospective study conducted on the 25 medical records of patients with uterine rupture to calculate the best estimate cost for patients with uterine rupture in KSMC−Riyadh. It was found that 84% of the patients were of Saudi nationality, and 16% for other nationality. Of the 25 patients, 18 (72%) attended the antenatal care unit as walk-in and only 7 patients (28%) were booked. The average age for these patients was 29.08 years (SD ± 6.05); the average gestational age was 37.4 weeks (± 4.2); average parity was 2.8 deliveries (± 2.3); and average baby birth weight was 2.78 kg (± 0.7). Also, the average duration from diagnosis of uterine rupture to surgery was 24 minutes (± 28) ranging from 0 to 120 minutes, while the average hospitalization was 5.32 days (± 2.15). The average cervical dilation (from 0–10, where 0 = closed) was 2.84 cm (± 3.2). See Table 1 for more information.

The difference in costs between KSMC, MOH and private hospitals is demonstrated in Figure 1. The lowest cost is seen at KSMC (10,086 SR; SD ± 4,347) compared with MOH cost (12,114 SR; SD ± 6145), and private hospital costs (15,192 SR; SD ± 8,889), with a significant difference ($p<0.001$). Although KSMC is a tertiary care hospital and considered the largest hospital in Saudi Arabia, it has the least cost of service amongst all other hospitals in Saudi Arabia.

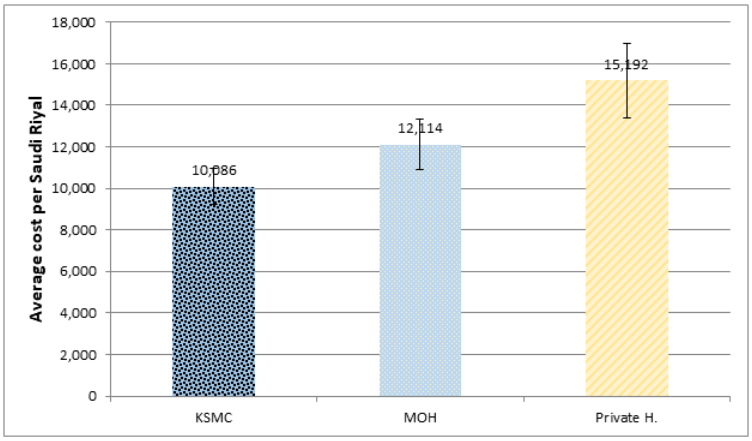
Medical complications are considered one of the main factors affecting cost. For the uterine rupture specifically, the main complications for the 25 patients were anemia (14 cases), blood transfusion (8 cases), intensive care admission (8 cases), and bladder injury (3 cases) with some patients having more than one complication. The least cost was seen with the nine patients without complications, with 7,015 SR (SD ± 870), which is a significantly lower cost ($p<0.05$) than the group average of 10,086 SR (SD ± 4,347).

In order to calculate the average direct cost for any surgical or medical procedure, there should be a summation of the average cost of utilized medications, consultation(s), lab requests, hospitalizations, and average costs of radiology services. The estimated cost for a uterine rupture was calculated to be about SR 10,000, as estimated by the KSMC. Alternatively, to get a better estimation, the direct cost can be calculated by summing

Table 1: Results demonstrated the average cost in Saudi Riyals for 25 patients admitted to the KSMC, showing the average of other parameters that could affect the cost. This table also demonstrated a comparison between two age groups and comparison between three "gestational age" groups.

Mean variable/ Standard Deviation	ALL Data	Group of Age (per year)		Gestational Age (per week)		
		28 and lo	29 and hi	37 & lo	38 -39	40 and hi
	(n=25)	(n=13)	(n=12)	(n=8)	(n=12)	(n=5)
Age /year	29.08	24.38	34.17	28.13	29.50	29.60
	6.05	2.96	4	5.99	6.84	5.03
Gestational Age/week	37.40	36.77	38.08	33.88	38.42	40.60
	4.16	5.215	2.68	5.96	0.52	0.55
Parity	2.80	1.77	3.9	3.88	2.67	1.40
	2.29	1.166	2.71	2.95	2.02	0.55
Baby Birth Weight	2.78	2.71	2.86	2.41	2.96	2.96
	0.70	0.86	0.51	1.09	0.38	0.25
Duration from Dx to surgery	24.00	26.15	21.67	39.13	17.42	15.60
	28.09	24.50	32.48	43.15	15.44	11.97
Hospitalization/ day	5.32	5.92	4.67	6.50	4.83	4.60
	2.16	2.87	0.49	3.16	1.47	0.55
Cost/ Saudi Riyal	10,086	11,540	8,510	12,853	9,449	* 7,186
	4,347	4,966	3,020	4,725	4,105	957

*significant ($p<0.05$)



KSMC= King Saud Medical City; MOH= Ministry of Health hospitals; Private H = Private Hospitals

Figure 1: The average cost of 25 patients (± Stand Err) having uterine rupture at KSMC compared with MOH and private hospital cost (considering direct cost for the same patients with their complications, medications, laboratory works etc.).

the direct costs per patient and then using the number of cases to calculate the average, including standard deviation.

The patients were categorized into two age groups for cost comparison. Those who were 28 years old or younger had an average cost of 11,540 SR (SD ± 4,966). This cost was higher than patients aged 29 years old and older who had an average cost of 8,510 SR (SD ± 3,020). However, this difference was not significant ($p = 0.081$). It can be seen in Table 1 that none of the other parameters were found to be significantly different between the two age groups.

This study segregated the gestational ages (per week) into three groups: those born at 37 weeks or sooner, those born at 38–39 weeks, and born at 40–41 weeks. The results showed that the cost of those patients who carried their babies to 40-41 weeks were the least costly with 7,186 SR (SD ± 957), which was found to be significantly different ($p > 0.05$ for each) from the costs of the other two groups, 9,449 SR (SD ± 4,105) and 12,853 SR (SD ± 4,725) for 38-39 weeks and 37 weeks or sooner, respectively. It has been noticed that the duration (in minutes) from diagnosis until surgery was relatively similar, as shown in Table 1.

Parity, the number of pregnancies reaching viable gestational age (including live births and stillbirths), was also segregated to three groups: one baby, two babies, and three or more babies. ANOVA analysis showed no significant difference in cost between the three groups. It has been noted from the results that an increasing duration (in minutes) from diagnosis to surgery is associated to increasing cost estimates. The birth weight of the babies was considered as it had the potential to influence the cost of uterine rupture. This study considered three groups: 2.7 kg and lower, 2.71–3 kg and 3.01 kg and higher. It was found that although the cost for 3.01 kg and higher had the least cost, the difference to the others was insignificant, as illustrated in Table 2. In contrast, the duration (in minutes) from the diagnosis to surgery was not correlated positively with the cost estimation.

Table 2: Results demonstrated the average cost in Saudi Riyals for 25 patients admitted to the KSMC, showing the average of other parameters that could affect the cost. This table also demonstrated three "parity" groups, and three groups "baby birth weight". This table also showed the cost of those patients who had no complication, which is significantly ($p<0.05$) compared with the whole group.

Mean variable/ Standard Deviation	ALL Data	Parity			Baby Birth weight (per Kg)			No Complication
		1	2	3 and hi	2.7 and lo	2.71 - 3	3.1 and hi	
	(n=25)	(n=9)	(n=8)	(n=8)	(n=9)	(n=7)	(n=9)	(n=9)
Age /year	29.08	26.44	27.88	33.25	28.56	27.29	31.00	29.67
	6.05	5.39	5.69	5.42	4.59	7.23	6.50	5.43
Gestational Age/week	37.40	36.67	38.75	36.88	35.22	39.00	38.33	39.22
	4.16	6.44	1.49	2.59	6.32	1.16	1.58	1.39
Parity	2.80	1.00	2.00	5.63	2.67	2.43	3.22	1.44
	2.29	0.00	0.00	2.00	2.06	2.51	2.54	0.53
Baby Birth Weight	2.78	2.57	2.86	2.95	2.16	2.88	3.32	3.01
	0.70	0.98	0.34	0.61	0.80	0.06	0.24	0.36
Duration from Dx to surgery	24.00	22.33	11.50	38.38	33.67	15.14	21.22	16.56
	28.09	15.64	12.91	42.90	43.96	9.67	13.47	14.85
Hospitalization/ day	5.32	5.67	5.75	4.50	6.00	5.14	4.78	4.67
	2.16	3.24	1.58	0.54	3.08	1.86	0.97	1.00
Cost/ Saudi Riyal	10,086	10,384	9,060	10,776	11,876	9,727	8,574	* 7,015
	4,347	5,338	4,613	3,016	5,287	4,737	2,372	870

*significant ($p<0.05$)

Discussion:

King Saud Medical City is the most popular hospital in the Riyadh area, with about 1500 beds. This study was conducted to estimate the economic cost of uterine rupture, assuming that there is no inflation. Assessing direct cost is straightforward, as it is a technique to reach the nearest estimation for the cost and needs only to have the summation of patient cost elements. This study used an account analysis approach to estimate the direct cost for a patient with uterine rupture. It was conducted using the medical records of 25 uterine rupture patients. The average age of the patients was 29 years. The purpose of this study is to calculate the best cost estimate for patients with uterine rupture at KSMC-Riyadh. The estimated cost was calculated as the summation of utilized materials or medications, consultation(s), lab requests, hospitalization, costs of radiology services, and the average direct cost for any surgical or medical procedure. Alternatively, the calculation of estimated direct cost can be done via collection of the direct cost per patient, then averaging the costs for the number of patients to get a better estimation, including standard deviation.

The estimated cost for a uterine rupture was calculated to be about SR 10,000 as the estimated direct cost at the KSMC. Although the KSMC is a tertiary care hospital and is considered the largest hospital in Saudi Arabia, it provides the least cost amongst all other hospitals in Saudi Arabia. This study also demonstrated (as in Figure 1) the differences in estimated direct costs between KSMC, MOH and private hospitals; it showed that the least estimated cost was at KSMC, compared with both MOH cost (120% higher), and private hospitals cost (150% higher) with a significant difference ($p<0.001$). It has been noted that private costs reflect the private choices and decisions of the owners of that specific facility [18]. It is understood that patients may choose a private hospital for a private room, for a preferred doctor or with a feeling that the services will be better. However, KSMC is the most popular hospital and has the least expensive cost estimate in the KSA.

Medical complications are considered the main factor influencing cost estimates. The direct medical costs will increase with the progression of complications [19]. The main complications for patients with uterine rupture were anemia, blood transfusion, admission to intensive care unit, and bladder injury; some patients had more than one complication. Nine patients had no complications, and their average cost was the least with 7015 SR (SD ± 870), which is considered a significantly ($p < 0.05$) lower cost. Severe anemia developed in 68.3% in a previous study [20], compared to this study, where 56% developed anemia. Medical complications are usually associated with increased hospital stays and ultimately increase the cost estimate of any disease.

The only influence of age on uterine rupture in this study was that patients aged 29 years and older with uterine rupture had fewer complications and were therefore less costly than those aged 28 years or younger. This is in contrast with a previous study that mentioned that women aged 30 years or older have greater risk of uterine ruptures, higher incidences of complications, longer durations of stay in the hospital and thus more cost than younger women [21]. On the other hand, analysis of the gestational ages (with a total average of 37.4 weeks) indicates that a baby in gestation until week 40–41 will have significantly less cost than those born at 39 weeks or sooner.

This study found no significant difference in cost between the different parity groups; however, another study showed that those patients with a parity of three or more had the greatest risk after complete uterine rupture [22]. Sequential labor induction with the utilization of prostaglandins or oxytocin is considered the strongest risk factor to induce uterine rupture compared to spontaneous labor [23].

How uterine rupture is associated with low birth weight of the baby [24] was also considered, as it may influence the cost of uterine rupture. This study considered three groups: 2.7 kg and lower, 2.71–3 kg, and 3.01 kg or higher, finding that although the cost for 3.01 kg or higher was the least costly, the difference from the others was not significant, as illustrated in Table 2. In contrast to the parity, the duration (in minutes) from the diagnosis to surgery (in related to weight of the baby) was not correlated positively with the cost estimation. Therefore, monitoring the progress of labor and early detection of uterine rupture could improve maternal and neonatal outcomes [25,26].

The cost of quality of life cannot be estimated; this study aims to guide decision makers to be fair in the calculation of direct costs for patients but to ensure the hospital's continuity by avoiding economic loss; this action will maximize the benefit and minimize cost.

Conclusion:

The estimated cost was calculated as the summation of the direct cost of all utilized materials and medical procedures. The estimated cost analysis showed that the least cost was at KSMC, compared with both MOH and private hospitals.

Medical complications are considered the main factor influencing cost estimates; direct medical costs will increase with the progression of complications. The main complications for patients with uterine rupture were anemia, blood transfusion, admission to the intensive care unit, and bladder injury. Medical complications are usually associated with prolonged hospital stays and ultimately increase the cost estimate for any disease.

There was no significant influence of age on uterine rupture, yet those patients with uterine rupture age of 29 years and older had fewer complications and were therefore less costly than those aged 28 years and younger.

A cost comparison of gestational ages indicated that a baby born after week 40-41 will have significantly less cost compared with babies born at 39 weeks or sooner. This study also indicated that there were no significant differences from a cost point of view between the different parity groups. The cost estimate of uterine rupture on any other disease is associated with the expect complication(s), longer duration of stay in the hospital as the main factors will lead to higher cost.

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