

# Cost Analysis of Vaginal Hysterectomy as Compared to Laparoscopic Assisted Vaginal Hysterectomy for Non-prolapse Uterus in a Tertiary Institution in South Africa

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**Abstract:** *Background:* Many hysterectomies are now performed by laparoscopic assisted vaginal hysterectomy (LAVH) technique. To establish LAVH as a routine procedure remains controversial, partly because of concerns about the cost. We studied hospital charges and cost of LAVH as compared to vaginal hysterectomy (VH) for non-prolapse uterus in clinically similar groups of patients. *Study design:* This was a cross-sectional analytic study, covering a period of two years. This study was undertaken at the Department of Obstetrics and Gynaecology of the Charlotte Maxeke Johannesburg Academic Hospital (CMJAH), to determine the direct hospital costs between the two surgical techniques VH and LAVH respectively. Women admitted for hysterectomy for benign uterine conditions, were enrolled in the study. Criteria for inclusion were uterine size less than 12 weeks gestation, width  $\leq 9$  cm and length  $\leq 14$  cm on ultrasound examination. Clinical ovarian pathology and uterine prolapse were criteria for exclusion. Patients were recruited from the unit records and divided into two groups matched with respect to age, parity, and indications for hysterectomy. Vaginal hysterectomy was performed in 60 patients out of the 100 patients included in the study, and 40 patients underwent LAVH. *Results:* All cases were successfully performed with no need to convert to the abdominal route. The time required for LAVH was significantly longer as compared to VH: 64, 0 v 31,3 minutes respectively ( $p < 0.001$ ). The postoperative hospital stay days and opiate injections required were both not significantly different between the VH and LAVH groups. Longer operating time and, as well as the expenses of the equipment to perform LAVH, were the main sources of additional cost in LAVH. The average hospital charges were significantly higher in LAVH as compared to VH ( $p < 0.001$ ). *Conclusion:* Both techniques offer the same benefits of shorter hospital stay, less analgesia needed, rapid mobilisation, and early discharge. However, VH was found to be least costly, mainly due to significant less operative time. LAVH is significantly costlier, mainly due to expensive laparoscopic devices and afore-mentioned long operation time.

**Keywords:** Benign Gynaecological Pathology, Vaginal Hysterectomy, Laparoscopic Assisted Vaginal Hysterectomy, Non-prolapse Uterus, Hysterectomy Cost

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## 1. Introduction

Hysterectomy is currently one of the most common operative procedures for benign uterine diseases performed in the world [1, 2]. In a large scale surveys, 70- 80% of hysterectomies have been shown to be carried out via the abdominal approach, except when treating utero-vaginal

prolapse, for which the vaginal route is generally preferred [3-12]. This latter indication accounts for about 10% of all hysterectomies conducted worldwide [12, 13]. The advantages provided by vaginal hysterectomy (VH) or laparoscopic hysterectomy (LH), either total laparoscopic hysterectomy (TLH) or laparoscopic assisted vaginal hysterectomy (LAVH) over abdominal hysterectomy (AH)

include less postoperative pain, less need of analgesia, shorter hospital stay, more rapid recovery and return to daily activities, and reduced hospital charges [14-18]. Additionally, intra-operative and post-operative complications reported with VH as compared with AH or LH are much less [19-21]. Despite the benefits offered by VH, the advent of laparoscopic approaches had little effect in reducing the rate of AHs. Burkett D *et al.* – assessing current trends in resident hysterectomy training – concluded that with the initiation of endoscopic approaches (LH) and robotic hysterectomy (RH), the VHs are underutilised [22]. Two studies based on data from the US in the mid-90s analysed the costs and charges associated with VH and LAVH, and determined that VH appeared to be much cheaper than LAVH [23, 24]. This study intends to perform an evaluation of these costs and charges associated with VH and LAVH, in a tertiary institution in South Africa. This is in our understanding the first study of its kind to be performed in South Africa or even in the African Continent.

## 2. Materials and Methods

This is a cross-sectional analytic study that took place at Charlotte Maxeke Johannesburg Academic Hospital (CMJAH). The study was approved by the Ethics Committee of the University of Witwatersrand (ref. Nr: M150462). CMJAH is a tertiary-level academic hospital, and a referral centre for the eastern and western areas of greater Johannesburg. The department of obstetrics and gynaecology is attached to the University of the Witwatersrand. All patients admitted between January 2015 and December 2016 for hysterectomy due to benign conditions, meeting the guidelines criteria (vaginally accessible uterus, uterine size  $\leq 12$  weeks of gestation or  $\leq 280$  g on ultrasound examination, pathology confined to the uterus) were included. According to the guidelines set by the unit, nulliparous women, women without uterine descent, women with fibroid uterus, women with previous pelvic surgery or caesarean section, and women with cervical dysplasia or pre-malignant conditions were also included. Women with utero-vaginal prolapse and adnexal pathology who underwent VH were excluded from the study.

Clinical baseline data that were evaluated included the patient's age, parity, the type of the procedure, the length of hospital stay, uterine weight, and the incidence of intra- and immediate post-operative complications. The costing was done from the provider's perspective (the hospital), and focussed on direct costs. Indirect costs included costs for laboratory investigations, medications not related to the procedure, drugs used after the operation for either analgesia or pain control and management of complications if any. These indirect costs or "ward charges" were not included in the costing. Only variable direct costs were included because fixed direct costs (e.g. capital costs, overheads) were assumed constant regardless of the type of procedure. The direct costs were defined as charges for operating time per minute on a subset of patients who had VH and LAVH and

consumables used for the procedures, LAVH and VH only. The operative time was measure for each procedure, calculated as the time that elapse from the first cut to the closure of the abdominal incisions in cases of LAVH or to the closure of the vaginal vault in cases of VH.

The medical aid scheme rate corroborated with the private sector was used to determine the cost of operation time per minute. In this setting it was calculated as (R187.00 + R200.00  $\div$  2) hence giving a rand value of R193.50 or 15, 3 USD. The price of disposable instruments used for the procedures were obtained from three different companies ((Johnson & Johnson Medical SA, Covidien-Medtronic SA and LigaSure TM) which supplied the hospital during the study period. However, the costs that were discussed were estimates rather than exact figure and include only the differences in theatre time amongst the two procedures and the consumables used.

Professional fees, which included the amount paid to the surgeon, the assistant, the anaesthetist and the theatre staff during the procedure, were not included in the analysis, as this is a state-run facility with salaried employees. The hospital charges for VH and LAVH performed during the study period which include ward fees - from admission to discharge were not included in the analysis as there was not a significant differences in hospital stay and analgesia needed between the two procedures. The direct cost of the procedures VH and LAVH, which included operation time and consumables, will be shown in South Africa rand (ZAR) and US dollars (USD), based on the mean exchange rates during the study period, which was 1USD=11,6 ZAR in January 2015 and 13,6 ZAR in December 2016, by the end of the study. The mean exchange rates used to calculate the cost of disposables and extra operating time for LAVH was 1USD=12, 6 ZAR. Consumables used to perform the two procedures namely, LAVH and VH will be discussed in the results. The vessel sealing device, Liga-Sure<sup>TM</sup> was used for all the LAVH. All the patients received prophylactic antibiotics.

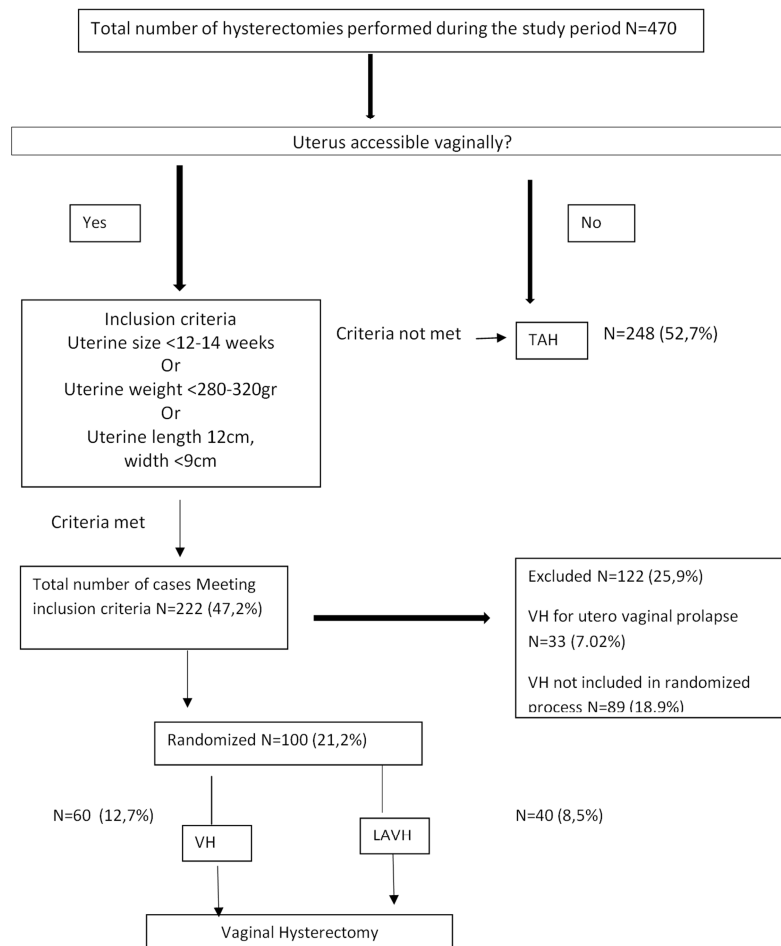
Statistical analysis. Data were analysed with STATA V 14.1. Mean and standard deviation, median and IQR, and proportions were used to describe the socio-demographic characteristics and outcomes of the study participants. Continuous data, if normally distributed, were compared between LAVH and VH groups using the student t-test, otherwise a Mann-Whitney test was applied. For categorical data a Chi-square test was used to compare categorical variables between LAVH and VH groups. The results were considered to be statistical significant for a p-value<0.05.

## 3. Results

During the study period, four hundred seventy hysterectomies were performed in our department. Out of these 222 (47, 2%) underwent VH. 43 (9, 1%) of the VH have been accomplished with the aid of LAVH (Figure 1). Out of these, 100 patients meeting the inclusion criteria set by the unit and matching in respect to the age, indication, parity and

uterine weight as reported by the department of histopathology were selected and analysed. It was imperative that the patients selected possessed sufficiently similar characteristics, in order to allow for sensible and reliable comparisons to be made. There were no significant differences in age, uterus weight and parity between VH and LAVH patients. However, the

indications were significantly associated with the type of hysterectomy performed (Table 1). All cases included in the study were successfully performed (no intra- or immediate post-operative complications) and there was no need for conversion to open AH.



**Figure 1.** Enrolment of the patients and their allocations to hysterectomy groups.

**Table 1.** Patient characteristics, indications for hysterectomy and the weight of the uteri measured after the operation. Values are means (SD).

	VH	LAVH	P-value
N	60	40	
Age, Median (IQR)	42.5 (37-46.5)	43 (36-46)	0.7480*
Uterus Weight {g}, Median (IQR)	65 (52-74)	57.5 (45.5-70)	0.2067*
Parity {n}, Mean (SD)	2.1 (0.9)	1.9 (1.1)	0.3541 <sup>#</sup>
Indications, n (%)			
Adenomyosis	1 (2.5)	1 (1.7)	
HGSIL	27 (45)	15 (37.5)	
HGSIL/PPP	0 (0)	4 (10)	
HGSIL/MEN	2 (3.3)	0 (0)	
HGSIL/MFU	9 (15)	2 (5)	
HGSIL/MFU/PMB	0 (0)	1 (2.5)	
MEN	1 (1.7)	0 (0)	
MEN/MFU	3 (5)	7 (17.5)	
MFU	17 (28.3)	10 (25)	0.022 <sup>+</sup>

VH=Vaginal Hysterectomy

LAVH=Laparoscopic hysterectomy

\*Mann-Whitney U Test; <sup>#</sup>Independent-T Test; <sup>+</sup>Fishers' Exact Test

Average number of hospital stay days and opiate injections required were both not significantly different between the VH and LAVH groups. However, there was a significant difference between VH and LAVH operation time (minutes) with those who underwent LAVH hysterectomy needing more time 64 min v 31.3 minutes for VH,  $p$ -value<0.001 (Table 2).

**Table 2.** Comparison of operation time, not including anaesthetic time between VH and LAVH post-operative course.

	VH	LAVH	P-Value
N	60	40	
Operation time {min}, Mean (SD)	31.3 (4.6)	64 (10.1)	<0.001
Hospital Stay {days}, Mean (SD)	2.1 (0.32)	2.2 (0.46)	0.2925
Opiate injections required {n}, Mean (SD)	2.9 (0.28)	3 (0.64)	0.3752

A summary of the key measures of resources used in the study can be found in Table 3. The mean cost of operation time was equivalent to 193, 50 ZAR or 15,3 USD per minute. The LAVH in our study took 32,7 minutes longer than VH; the total cost of extra theatre time needed to perform LAVH as compared to VH was estimated to be 6327.45 ZAR. The mean

cost of consumables regularly used by the unit was estimated to be 12 046.09 ZAR. Considering the extra theatre time and the consumables used during LAVH, an amount of 18373.54 ZAR or 1458.28 USD more was needed to perform LAVH as opposed to VH for the same indication and uterine weigh.

**Table 3.** Estimated variable direct cost per LAVH vs. VH. Consumables price in ZAR.

Resource items	Estimated cost per procedure (ZAR)		
	LAVH	VH	Cost difference
Surgical cost per mean operating time	12384,00 ZAR	6056,55 ZAR	6327,45 ZAR
Consumables used during procedures	12046.09 ZAR	No consumables	12046,09 ZAR
Suture material used <sup>x</sup>	258.10 ZAR	260.55 ZAR	2.45 ZAR
Pharmaceuticals used during surgery, during post-operative period and discharge *	N/A	N/A	
Ward charges*	N/A	N/A	
Scrap sister and theatre staff +	N/A	N/A	
Specialist Surgeon, assistant Surgeon, anaesthetist +	N/A	N/A	
Total			18373,54 ZAR

<sup>x</sup> Cost of suture materials used during the two procedures, LAVH and VH not included in the cost calculation as there were no significant differences

\*Disposables used during the procedure are not included in the cost calculation

+ Professional fees were not included in the analysis, as this is a state-run facility with salaried employees.

## 4. Discussion

The results of this study are in agreement with those of other studies [14-18] which, clearly demonstrate that VH is less costly, and provides the same advantages as LAVH, namely less postoperative pain, less need of analgesia, shorter hospital stay, and a more rapid recovery and return to daily activities. Key measures used in this study to assess cost difference amongst the two procedures were related to operating time in theatre per minute, and the use of consumables during LAVH. Dorsey *et al.*, comparing costs and charges with three alternative techniques of hysterectomy --LAVH, AH and VH -- found that the mean total charges (facility charges plus professional fees) for the hospitalisation were much higher for LAVH as compared to VH ( $p$ <0.001) with the same clinical outcome [23]. Nehtat *et al.* -- comparing also the costs and charges of LAVH, AH, and VH --found that the mean cost of performing LAVH as compared to VH was significantly higher ( $p$ <0.05) [24]. A cost effectiveness analysis undertaken with the eVALuate study revealed that the vaginal approach was more cost-effective compared to the laparoscopic route, primarily due to the use of disposable instruments in laparoscopy [15]. Furthermore, Sculpher *et al.* found that LH cost an average of \$708 more

than VH, per patient. With more than 500000 hysterectomies performed annually in the United States, and more than 100000 in the United Kingdom, the vaginal approach seems even more relevant in this time of economic strain [25]. Kovac *et al.* found that by using guidelines to assist clinical decision-making for hysterectomy, VH found to be feasible in 98.9% of the cases, with potential savings of 1.2 million USD could be obtained for every 1000 hysterectomies performed vaginally, as well as a reduction of 20% in complications associated with the procedure [26].

Our results are in agreement with the above mentioned studies demonstrating that VH is the less costly route for hysterectomy [4, 23-26]. The main sources of the cost difference between LAVH and VH in our study were related to the differences in operation time and the cost of consumables used during LAVH compared to VH which requires no additional specific materials. In our study, LAVH took 32,7 minutes longer than VH ( $p$ <0.001). Considering the extra theatre time and the consumables used during LAVH, an estimated amount of 18373.54 ZAR or 1458.22 USD more was needed to perform LAVH as opposed to VH for the same indication and uterine weigh (excluding the aforementioned professional fees).

We estimated that by opting to perform VH instead of LAVH in patients presenting with the same indications and

uterine weight, as much as 18.4 million ZAR or 1.45 million USD, could be saved for every 1000 hysterectomies performed vaginally in South Africa. Choosing VH over LAVH has not been reported to affect hospital stay (ward fees) or drugs used during the immediate postoperative period and drugs given on discharge. When cost analysis was undertaken for this study, VH found to be much cheaper than LAVH. Longer operating time, as well as the expenses of the equipment to perform LAVH, were the main sources of additional cost in LAVH.

## 5. Conclusion

The results of this study demonstrated that VH for the non-prolapsed uterus should be the treatment of choice for benign gynaecologic disease. LAVH is unlikely to be considered cost effective when compared to VH for women undergoing hysterectomy for the same indication and uterine weight. All efforts should be directed to increase the numbers of VH among appropriately selected women, who today are operated in the main by the abdominal or laparoscopic approach despite VH serving as a viable alternative.

## Conflict of Interest

The authors declare that they have no competing interests.

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