Prostatectomy outcomes for patients with benign prostatic hyperplasia and its associated factors in East and West Gojjam zones comprehensive specialized hospitals, Northwest Ethiopia

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Abstract

Background Benign prostatic hyperplasia (BPH) is non-cancerous growth of the prostate gland which surrounds the urethra. For men with BPH who are older than 50, a prostatectomy is a common surgical procedure. Open prostatectomy is still more prevalent in regions with limited access to advanced surgical procedures like transurethral resection of the prostate and robotic-assisted laparoscopic prostatectomy. Determining prostatectomy outcomes for BPH and associated factors is essential to optimize patient care and improve awareness of this condition. However, the outcomes of prostatectomy and associated factors are not studied in Ethiopia.

Objectives To assess prostatectomy outcomes for patients with benign prostatic hyperplasia and its associated factors in East and West Gojjam Zones, 2021.

Methods A facility-based cross-sectional study was employed among 412 patients with prostatectomy using systematic sampling. Five-year secondary data from 2016 to 2021 data was extracted from patients' medical records using a structured proforma. The outcomes of prostatectomy for BPH are categorized into good outcomes if significant symptom relief such as reduced urinary frequency, urgency, and nocturia and preserved sexual function using International Prostate Symptom Scores and Sexual Health Inventory for Men. A poor outcome involves minimal symptom improvement, recurrence of symptoms, severe complications like urinary incontinence or retention, and erectile dysfunction. Besides this, logistic regression models were computed to assess the relationship between variables.

Results Among 412 patients with prostatectomy, 68 (16.5%; 95% CI 12.9–20.1) had poor outcomes, and 344 (83.5%; 95% CI 79.9–87.1) had good outcomes. In addition, patients who took venous thromboembolism (VTE) prophylaxis were 80% less likely to develop good prostatectomy outcomes than those who did not take prophylaxis (AOR = 0.2; 95% CI 0.07–0.6). Good prostatectomy outcomes were 86% lower in those who did not obtain the proper wound care than in those who did (AOR = 0.14; 95% CI 0.03–0.6). Comparably, patients with hypertension comorbidity were 70% (AOR = 0.3; 95% CI 0.1–0.6) less likely to have good prostatectomy outcomes. On the other hand, patients who

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underwent transurethral resection of the prostate (TURP) had twice the odds of a good prostatectomy outcome compared to those who underwent transvesical prostatectomy (TVP) (AOR = 2; 95% CI 1.5–5.4). Moreover, patients who received preoperative oral medical therapy for benign prostatic hyperplasia (BPH) were twice as likely to experience poor prostatectomy outcomes compared to those who did not take preoperative medical therapy (AOR = 2; 95% CI 1.2–8.7). Similarly, patients with a prostate volume of 100–200 cm^3 were five times more likely to develop poor prostatectomy outcomes compared to those with a prostate volume of 30–60 cm^3 (AOR = 5; 95% CI 2.3–10).

Conclusions A total of 16.5% of the participants experienced poor outcomes following prostatectomy. The factors associated with these outcomes included venous thromboembolism prophylaxis intake, appropriate wound care, hypertension as a comorbidity, surgical modality, preoperative oral medication therapy for BPH, and prostate volume.

Keywords Prostatectomy outcomes, Benign prostatic hyperplasia, Associated factors, Ethiopia

Introduction

The prostate gland is part of a male reproductive system located at the base of the bladder and in front of the rectum by surrounding the urethra that carries urine from the bladder to the penis [1, 2]. Benign prostatic hyperplasia (BPH) is a histologic diagnosis characterized by the non-cancerous proliferation of epithelial and stromal components of the prostate gland, and its prevalence is increasing with age [3]. More than 75% of people over the age of 80 and 90% of people over the age of 85 experience BPH-related symptoms [4]. BPH causes compression of urethra that results lower urinary tract symptoms, gross hematuria, infections due to incomplete emptying, bladder caliculi and urinary retention. The retention of urine can cause gradual dilation of ureters (hydroureter) and kidneys (hydronephrosis) [5–8].

Benign prostatic hyperplasia causes lower urinary tract symptoms (LUTS) via direct bladder outlet obstruction (BOO) from enlarged prostate tissue and from increased muscle tone and resistance within the enlarged gland [9, 10]. The prevalence and the severity of LUTS in aging male can be progressive and is an important clue for diagnosis of BPH. LUTS are categorized into storage, voiding, and post-voiding symptoms [11]. Urgency, frequency, and nocturia are examples of urinary storage symptoms. Hesitancy, straining to void, dysuria, and urinary intermittency are examples of urinary voiding symptoms, whereas sensation of incomplete bladder emptying and post-void urinary dribbling are examples of post-voiding symptoms [8, 12–14].

BPH management depends individual patient factors such as the size of the enlarged prostate, the patient's age and overall health, the degree of urinary obstruction [15, 16]. About 20% of patients with BPH undergo prostatectomy [17]. Prostatectomy refers to the surgical removal of all or a portion of the prostate gland. Men with moderate to severe LUTS, refractory urinary retention, recurrent urinary tract infection, recurrent gross hematuria, recurrent bladder stones, and bilateral hydronephrosis with renal functional impairment is treated primarily with prostatectomy [6, 18].

The type and extent of the procedure performed, various perioperative parameters, comorbidities, and lifestyle characteristics determine the outcomes of a prostatectomy. Many studies show that aging, obesity, urinary tract infection, both current and former smoking, heavy alcohol consumption, chemical exposure, comorbidities (hypertension, diabetes [type 2], heart disease, urinary tract infections), sleeping hours, residence, physical activity, vitamin D deficiency, nature of operation (elective, emergency), approach to prostatectomy (transvesical vs. transurethral resection of the prostate(TURP), and incision type (lower midline vs. Pfannenstiel) are the factors that can affect the outcomes of prostatectomy [19–23]. Even though majority of patients who undergo prostatectomy has favorable outcomes, some may develop poor outcomes such as clot formation, bladder neck spasms, urethral stricture, wound infections, urinary incontinence, hemorrhage, retrograde ejaculation, and erectile dysfunction [24, 25].

Prostatectomy, which remains the most common urologic surgery in older adults for symptomatic BPH, yields different outcomes. For instance, 17.3% of patients who underwent prostatectomy developed post-operative complications [25]. These complications include antibiotic treatment for symptoms of urinary tract infection (5–20%), the risk of re-operation after 8–10 years (15%), severe sepsis (6%), and severe hemorrhage requiring transfusion (7.5%) [25]. However, another study showed that 90% of men undergoing elective prostatectomy for severe symptoms and BOO had favorable outcomes [26]. Therefore, the objective of this study is to assess outcomes of prostatectomy for patients with benign prostatic hyperplasia and its associated factors in East and West Gojjam Zones Comprehensive Specialized Hospitals.

Conceptual frame work

This conceptual framework shows the possible relationship between the dependent and independent variables [19, 20, 23, 27–29] that was developed after reviewing different literatures (Fig. 1).

Methods

Study design, area and period

A cross-sectional study was conducted by reviewing the past 5-year secondary data on patients' medical records available in East and West Gojjam Zones Comprehensive Specialized Hospitals from March 1 to July 30, 2021.

The study was conducted at Debre Markos and Felege Hiwot Comprehensive Specialized Hospitals. Debre Markos Comprehensive Specialized hospital is located in Debre Markos town, Northwestern Ethiopia. Debre Markos, which is the capital of East Gojjam Zone, is located 300 km away from Addis Ababa and 269 km away from Bahir Dar. Felege Hiwot Comprehensive Specialized hospital is located in Bahir Dar, which is the capital of Amhara region. On average, a total of 100 and 120 patients with benign prostatic hyperplasia were admitted in Debre Markos and Felege Hiwot Specialized Hospitals, respectively, for prostatectomy per annum.

Eligibility criteria, sample size and sampling procedure

All patients who underwent prostatectomy for benign prostatic hyperplasia between September 1, 2016, and May 30, 2021, were included in the study, with participants selected using a systematic sampling technique. However, patients who were identified with incomplete or lost records for the major variables were excluded from the study.

The sample size was determined using the single population proportion formula, assuming a 95% confidence interval, a 5% margin of error, and a 50% proportion. After adding a 10% adjustment for potential missing patient charts, the final sample size was 423 patients.

A multi-stage sampling process was employed in the study. The first stage involved stratified sampling based on the hospital, while the second stage utilized systematic random sampling to select participants. After
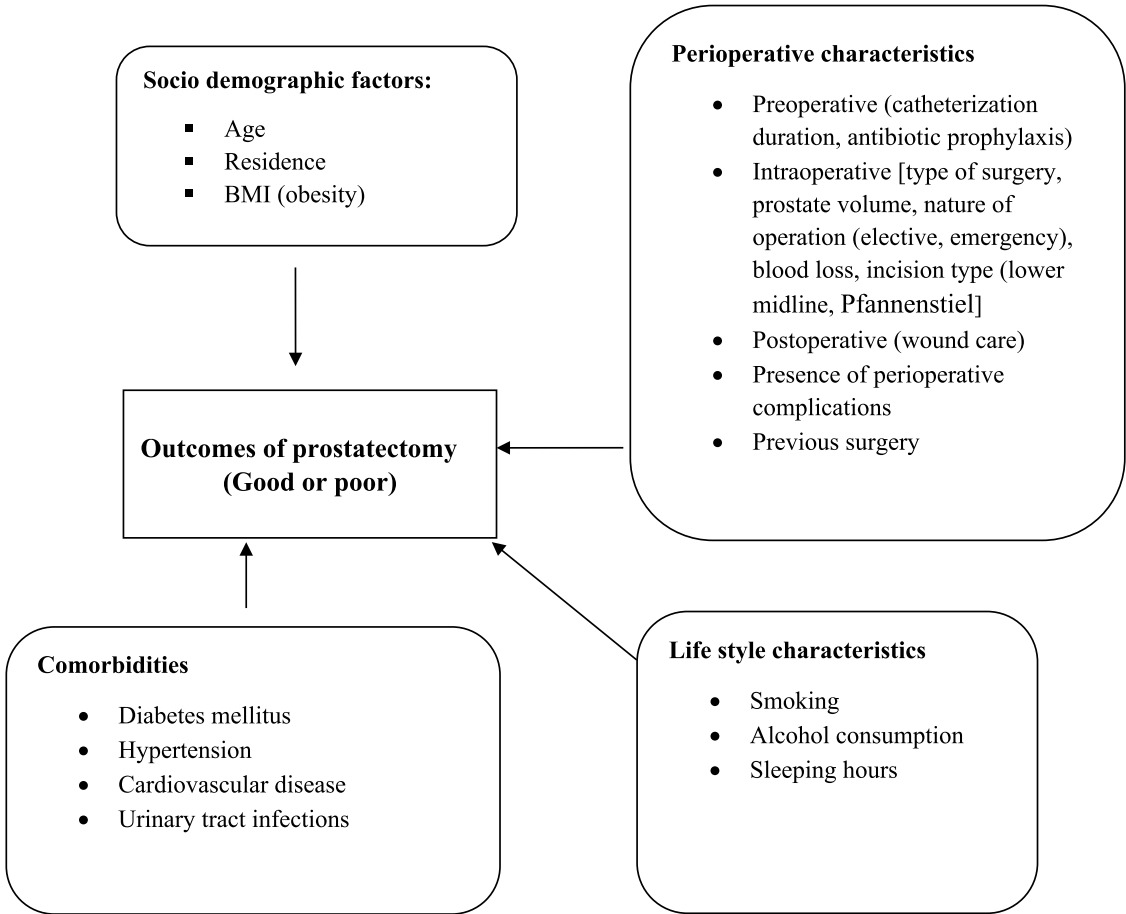
Fig. 1 Conceptual framework that shows the relationship of dependent and independent variables

patients were proportionally allocated to each hospital based on their population size, all patients who had undergone prostatectomy in the past 5 years at the East and West Gojjam Zones Comprehensive Specialized Hospitals were listed using their medical registration numbers (MRNs) as a sampling frame. The first patient was randomly selected as the starting point, and subsequent participants were chosen systematically, with every third patient selected until the desired sample size was achieved (Fig. 2). If any selected patient chart had missing or incomplete data for key variables, it was replaced with the next available chart from the sampling frame.

Variables of the study
The dependent variable of the study is outcomes of prostatectomy (good vs. poor), while the independent variables are sociodemographic characteristics(age, address, marital status, and occupation); life style characteristics(cigarette smoking, alcohol drinking, functional status, chemical exposure, sleeping time, and effect of illness on sexual activity); clinical symptom characteristics(incomplete emptying, frequency, intermittency, urgency, weak stream, straining, and nocturia); perioperative characteristics (preoperative characteristics: medical management, urinalysis result, complete blood count result, kidney function test result, antibiotics prophylaxis, venous thromboembolism prophylaxis, catheterization, catheter duration; intraoperative characteristics: nature of surgery, type of surgical procedure, incision type, estimated blood loss; postoperative characteristics: wound care); and comorbidities(hypertension, diabetes and urinary tract infection).

Operational definitions
According to this study the terms below are defined as:

The clinical symptoms related to BPH are categorized in to irritative and obstructive symptoms.

Irritative symptoms

- Frequency: how often patients urinate again in less than 2 h after finishing urinating
- Urgency: how often the patient finds it difficult to postpone urination.
- Nocturnal: how many times the patient most typically gets up to urinate at night until the time when he wakes up in the morning
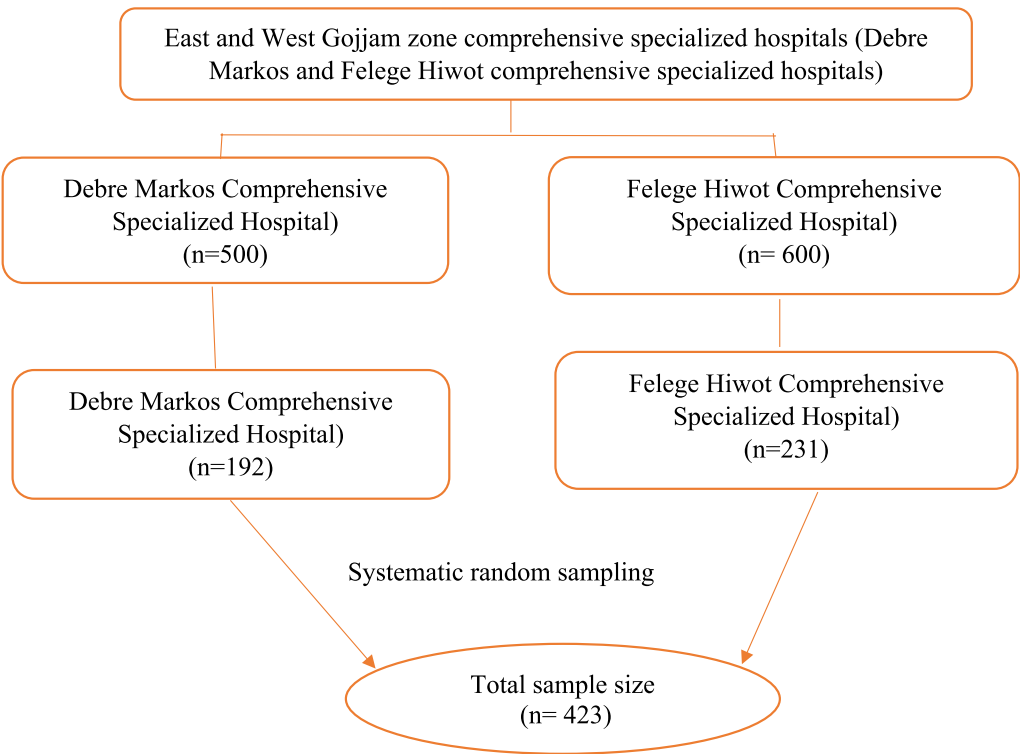

Fig. 2 Schematic presentation of sampling procedure to select study participants in East and West Gojjam Zone Comprehensive Specialized Hospitals, Northwest, Ethiopia, 2021

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Obstructive symptoms

- Incomplete emptying: sensation of not emptying the bladder completely after finishing urinating.
- Intermittency: how often the patient stops and starts several times to urinate.
- Weak Stream: how often the patient has a weak urinary stream.
- Straining: how often the patient has to push or strain to begin urination.

The outcomes of prostatectomy for BPH are categorized in to good outcome of prostatectomy and poor outcome of prostatectomy based on functional outcome and sexual function. Good outcome of BPH surgery is characterized by significant symptom relief, including reduced urinary frequency, urgency, and nocturia, as measured by improved International Prostate Symptom Scores and minimal to no impact on sexual function, as assessed by the sexual health inventory for men (SHIM). On the other hand, poor outcomes of BPH surgery refer to minimal symptom improvement or recurrence of symptoms post-surgery, persistent or severe complications such as urinary incontinence or retention, and significant erectile dysfunction.

Poor outcomes of prostatectomy: If the patient has one or more of the above postoperative complications following prostatectomy, persistent lower urinary tract symptoms and has retreatment (reoperation).

Lower urinary tract symptoms (LUTS): The severity of LUTS is made based on International prostate symptom score (IPSS) which contains 7 questions related to BPH symptoms. Each question has responses that range 0–5. The total score, therefore, ranges from 0 to 35. A score of 0–7 indicates mild symptoms, 8–19 indicates moderate symptoms and 20–35 indicates severe symptoms.

Sexual function is assessed using the Sexual Health Inventory for Men (SHIM), which consists of five questions, each scored from 1 to 5. The interpretation of the total score is as follows: a score ranging from 22 to 25 indicates preserved sexual function with no significant erectile dysfunction. Scores between 17 and 21 suggest mild erectile dysfunction. A score of 12 to 16 reflects mild-to-moderate erectile dysfunction, while a score from 8 to 11 indicates moderate erectile dysfunction. Scores between 5 and 7 are indicative of severe erectile dysfunction.

Data collection tool and procedure

Data were collected using a structured, validated and pretested checklist(tool) which was developed after reviewing prior similar literatures that assess severity of BPH such as the American Urological Association symptom index (AUA-SI)/International Prostate Symptom Score (IPSS) and different studies on outcomes of prostatectomy that can address the objectives of the study [30, 31]. The checklist was used to extract all relevant data from the patients' charts about the outcome and independent variables. Data were collected from patient medical records, and registration charts available in the hospital by 4 trained surgical nurses. First medical record number (MRN) of patients in the study period was identified from registration books (logbooks). Then, systematically selected MRN was used to retrieve cards from the card office. Besides this, the data were supervised by 2 public health professionals having previous experience. Continuous follow-up and supervision were also made by principal investigator throughout the data collection period. Before data collection, the tool/checklist was arranged based on content validity index (CVI) format and sent to two surgeons via email to give their evaluation on clarity and relevance. Based on their responses, item content validity index (I-CVI) scores were calculated by dividing the expert agreement by the number of experts, and finally, the average of I-CVI scores across all items were computed. Based on this procedure, the overall score content validity index (S-CVI) of the items was 0.84, which indicates the tool is acceptable. Moreover, the reliability of the tool was assessed by Cronbach alpha, with overall alpha coefficients of 0.82.

Data quality assurance and analysis

Prior to the actual data collection period, data collectors and supervisors received training on the study's objective, use, and the ways of collecting data to maintain the quality of the data. In addition to collecting and cross-matching patient cards and surgery registrations, the data was extracted from patients' medical records using a structured proforma. Moreover, the tool was checked for clarity, comprehensiveness and content validity by an expert and pretested on 5% of the sample at Finote-Selam General Hospital. The principal investigator then, reviewed the data each day and verified its consistency, accuracy and completeness.

The completeness and consistency of the questionnaire were checked after the data were collected. Similarly, missing values were checked before analysis. Then, both the questionnaire and the variables were coded, categorized, and entered into the Epi Data Manager software (version 4.6) and exported to SPSS (version 25) for further analysis. Bivariable and multivariable logistic regression models were used. Crude odds ratios (COR) with 95% confidence intervals were estimated in the bivariable logistic regression analysis to assess the association between each independent variable and the dependent

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variable. Variables with a *p* value of less than 0.25 in bivariable logistic regression were fitted into the multivariable logistic regression analysis. After that variable with a *p* value of less than 0.05 were regarded as statistically significant factors, and adjusted odds ratios (AOR) with their 95% confidence intervals (CI) were estimated to assess the strength of association. The Multicollinearity between each independent variable was checked and there was no correlation between the independent variables with the variance inflation factor (VIF) with a maximum value of 3.2 and the tolerance test with a minimum value of 0.5. Model fitness was assessed by Hosmer and Lemeshow's goodness of fit test to check model adequacy using *p* value and is greater than 0.65.

Results

Sociodemographic characteristics of the respondents

A total of 412 out of 423 participant charts were included in the study, resulting in a 97% completed data rate. The participants' ages ranged from 51 to 80 years, with a mean age of 66.7 ± 6.5 years. Moreover, among the participants involved in the study, 327 (79.4%) were rural dwellers, and 79.4% were farmers (Table 1).

Life style characteristics of the participants

In this study, several lifestyle characteristics of the participants were analyzed. Among the 412 participants, a significant majority, 279 individuals (67.7%), reported consuming alcohol. In terms of functional status, most participants, 355 (86.2%), were able to perform their daily activities independently. The study also noted that

smoking was relatively rare, with only 8 participants (1.9%) identifying as smokers, while a vast majority, 404 individuals (98.1%), did not smoke. Besides this, the distribution of participants' sleeping patterns was as follows: 109 individuals (26.5%) reported sleeping between 3 and 5 h per day. A larger group, comprising 273 participants (66.3%), slept between 6 and 8 h per day. Meanwhile, 30 participants (7.3%) had a sleep duration of 9–10 h per day.

Clinical symptoms related to BPH

All participants had a history of lower urinary tract symptoms (LUTS) before undergoing prostatectomy for an enlarged prostate gland. The symptoms were categorized into irritative types (frequency, urgency, and nocturia) and obstructive types (incomplete emptying, intermittency, weak stream, and straining). The severity of LUTS was assessed using the International Prostate Symptom Score (IPSS). Based on the IPSS score, 23 (5.6%) participants had mild symptoms, 96 (23.3%) had moderate symptoms, and 293 (71.1%) had severe symptoms.

Preoperative and postoperative LUTS using IPSS

LUTS preoperative symptoms

Before undergoing prostatectomy, participants experienced a range of lower urinary tract symptoms (LUTS), classified into irritative and obstructive types (Table 2). Irritative symptoms included frequency (mean score: 4 ± 1.5), urgency (mean score: 4 ± 1.5), and nocturia (mean score: 4 ± 1.5). Obstructive symptoms included

Table 1 Sociodemographic characteristics of the respondents in Debre Markos and Felege Hiwot Comprehensive Specialized Hospitals, 2021

Variables	Frequency (%)
Age	
51–60 years	89(21.6)
61–70 years	201(48.8)
71–80 years	122(29.6)
Address	
Urban	85(20.6)
Rural	327(79.4)
Marital status	
Married	317(76.9)
Single	13(3.2)
Divorced	82(19.9)
Occupation	
Farmer	327(79.4)
Merchant	63(15.3)
Government employee	22(5.3)

Table 2 Individual Symptom Scores at Preoperative and Postoperative (Mean ± SD) phases in Debre Markos and Felege Hiwot Comprehensive Specialized Hospitals, 2021

Symptom type	Preoperative score (Mean ± SD)	Postoperative score (Mean ± SD)
Irritative symptoms		
Frequency	4 ± 1.5	1 ± 0.5
Urgency	4 ± 1.5	1 ± 0.5
Nocturia	4 ± 1.5	1 ± 0.5
Obstructive symptoms		
Incomplete emptying	4 ± 1.5	1 ± 0.5
Intermittency	3 ± 1.5	0 ± 0.2
Weak stream	5 ± 1.5	1 ± 0.5
Straining	3 ± 1.5	0 ± 0.2
IPSS subscale		
Voiding(obstructive) IPSS	15 ± 5.3	2 ± 1.2
Storage(irritative) IPSS	12 ± 4.5	3 ± 1.5
Total IPSS	27 ± 7.5	5 ± 2.5
Bother score	High	Low

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incomplete emptying (mean score: 4 ± 1.5), intermittency (mean score: 3 ± 1.5), weak stream (mean score: 5 ± 1.5), and straining (mean score: 3 ± 1.5).

LUTS postoperative symptoms

Post-prostatectomy, participants showed improvements in their LUTS. The mean scores for irritative symptoms, such as frequency (1 ± 0.5), urgency (1 ± 0.5), and nocturia (1 ± 0.5), were lower than preoperative scores. Similarly, obstructive symptoms, including incomplete emptying (1 ± 0.5), intermittency (0 ± 0.2), weak stream (1 ± 0.5), and straining (0 ± 0.2), also showed reductions after surgery. The overall IPSS score decreased from a preoperative mean of 27 ± 7.5 to a postoperative mean of 5 ± 2.5, with significant improvement noted in both the voiding and storage subscales (Table 2).

Outcomes of prostatectomy

Benign prostatic hyperplasia (BPH) surgery outcomes can be classified based on functional outcome criteria and sexual function. Good outcome of BPH surgery is characterized by significant symptom relief, including reduced urinary frequency, urgency, and nocturia, as measured by improved International Prostate Symptom Scores and minimal to no impact on sexual function, as assessed by the sexual health inventory for men (SHIM). On the other hand, poor outcomes of BPH surgery refer to minimal symptom improvement or recurrence of symptoms post-surgery, persistent or severe complications such as urinary incontinence or retention, and significant erectile dysfunction. Based on the above category, among the participants, 344 (83.5%; 95% CI 79.9–87.1) had good outcomes from prostatectomy with symptom relief and minimal to no impact on sexual function, whereas 68 (16.5%; 95% CI 12.9–20.1) had poor outcomes from prostatectomy with minimal symptom improvement or recurrence of symptoms post-surgery and persistent or severe complications.

Sexual health, and functional outcomes

Sexual health outcomes

Postoperatively, sexual health outcomes were assessed using the Sexual Health Inventory for Men (SHIM). Based on operational definitions, sexual function was notably preserved, with 295 participants (71.6%) having preserved sexual function, whereas 117(28.4%) experiencing erectile dysfunction related to BPH (Table 3).

Postoperative functional and sexual outcomes

In the analysis of postoperative outcomes, participants were categorized into two groups: those with good outcomes and those with poor outcomes. Patients with good outcomes [$n=344(83.5\%)$] showed significant symptom relief, with a reduction in the total IPSS score from 11.3 ± 5.0 to 3.2 ± 2.3. They also reported minimal impact on sexual health (SHIM score: 20.3 ± 5.4) and minimal to mild urinary incontinence (score: 1.5 ± 0.9). On the other hand, patients with poor outcomes [$n=68(16.5\%)$] showed minimal or no improvement in LUTS, with a slight reduction in IPSS from 12.1 ± 5.4 to 10.8 ± 5.1. These patients also reported a significant impact on sexual health (SHIM score: 10.2 ± 4.7) and higher levels of urinary incontinence (score: 4.2 ± 1.3). In addition, poor outcome patients experienced recurrence of LUTS (mean score: 10.8 ± 5.1), compared to no recurrence in the good outcome group (mean score: 3.2 ± 2.3) (Table 4).

Perioperative characteristics of the participants

Preoperative characteristics

Of those participants, 141 (34.2%) had received treatment for a urinary tract infection (UTI) before surgery. Moreover, 321 (77.9%) had a negative urinalysis laboratory result, while the remaining had leukocytosis (WBC), albumin, or protein in their urine. Similarly, all of them had an enlarged prostate gland by abdominal and prostatic ultrasound. The patient's prostate gland measurement was ≥ 30 cubic centimeters using ellipsoid formula [volume = $\pi/6 \times$ (Length × width × height)]. Furthermore, 346 (84%) of the participants had received preoperative

Table 3 Sexual health outcomes (SHIM scores) post-prostatectomy (mean ± SD) among participants with preserved sexual function and erectile dysfunction, 2021

Domain	Mean ± SD
Confidence in maintaining an erection	4.5 ± 0.7 (Preserved)/2.5 ± 1.0 (ED)
Frequency of erections sufficient for penetration	4.2 ± 0.8 (Preserved)/2.8 ± 1.0 (ED)
Ability to maintain an erection during intercourse	4.3 ± 0.7 (Preserved)/2.9 ± 1.0 (ED)
Difficulty maintaining an erection to completion	2.5 ± 1.0 (Preserved)/4.0 ± 1.2 (ED)
Overall Satisfaction	4.0 ± 0.9 (Preserved)/2.5 ± 1.1 (ED)
Total SHIM Score	23.2 ± 1.3 (Preserved)/12.5 ± 3.2 (ED)

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Table 4 Summary of good vs. poor outcomes in post-prostatectomy patients

Outcome category	Good outcome [n = 344(83.5%)]	Poor outcome [n = 68(16.5%)]
Symptom relief	Significant reduction in IPSS (Mean: 11.3 ± 5.0 to 3.2 ± 2.3)	Minimal or no improvement in IPSS (Mean: 12.1 ± 5.4 to 10.8 ± 5.1)
Sexual function Impact	Minimal to no impact on SHIM (Mean: 20.3 ± 5.4)	Significant impact on SHIM (Mean: 10.2 ± 4.7)
Urinary Incontinence	No or mild incontinence (Score: 1.5 ± 0.9)	Severe incontinence or retention (Score: 4.2 ± 1.3)
Recurrence of Symptoms	No recurrence of LUTS (Mean: 3.2 ± 2.3)	Recurrence of LUTS (Mean: 10.8 ± 5.1)

catheterizations. Of whom, 8 (2.3%) had a suprapubic catheter, and 338 (97.7%) had a transurethral catheter of 4–45 day duration. Besides this, 5.8% of the participants had a serum creatinine level > 1.3 mg/dL, and all the participants had severe LUTS during the preoperative period (Table 5).

Intraoperative characteristics of the participants

All participants underwent elective surgery for an enlarged prostate gland. The majority of the surgical procedures were transvesical prostatectomies (TVP), accounting for 341 (82.8%) of cases, while transurethral resection of the prostate (TURP) comprised 71 (17.2%) of the surgeries. All participants had enlarged prostate gland during intraoperative findings. Regarding the type of incision used, the midline incision was most common, utilized in 379(91.9%) of surgeries. Other incision types included retropubic 15 (3.7%), transverse 14 (3.4%), and Pfannenstiel 4(1%). Estimated blood loss was predominantly low, with 390(94.6%) of patients experiencing blood loss of less than 200 mL, whereas 22(5.4%) had an estimated blood loss of 200–500 mL. Blood transfusion was rare, with only 4(1%) of patients receiving a transfusion, while the remaining 408(99%) did not require transfusion.

Postoperative characteristics of the respondents

Among the participants, 272 (66%) of the respondents stayed less than 7 days in the hospital after an operation, while 140 (34% of the participants) stayed in the hospital for 7–14 days. Similarly, 315 (76.5%) of patients got wound care for open surgery, and 256 (62.1%) of patients had continued catheterization less than 14 days postoperatively. Although PSA testing and biopsy to rule out prostate cancer are not common after prostatectomy for benign prostatic hyperplasia (BPH), 80 specimens (19.4%) were sent for histopathology (biopsy), and 91 PSA tests (22.1%) were also sent. However, the results of the biopsy showed that all specimens were prostate cancer-free, and the PSA values were within the normal range (< 4 ng/ml) for all these patients, indicating no evidence of malignancy.

Comorbidity-related characteristics

A total of 22 (5.3%) and 67 (16.3%) of the participants had diabetes and hypertension as comorbidities, respectively. Moreover, 134 (32.5%) had associated urinary tract infections (Table 6).

Factors affecting prostatectomy outcomes

Using bivariable logistic regression analysis, we found that several factors were associated with prostatectomy outcomes in patients with benign prostatic hyperplasia (BPH), with a *p* value of less than 0.05 at a 95% confidence interval. These factors included age, address, occupation, venous thromboembolism (VTE) prophylaxis intake, wound care, hypertension, urinary tract infection (UTI) comorbidity, surgical modality, preoperative medical therapy, prostate volume, intraoperative blood loss, proper patient evaluation, and catheterization during the preoperative phase, preoperative catheterization duration, and UTI treatment at the preoperative phase. In contrast, after adjusting for confounding factors, multivariable logistic regression analysis revealed that only the following variables remained significantly associated with prostatectomy outcomes: VTE prophylaxis intake, wound care, hypertension, surgical modality, preoperative medical therapy, and prostate volume (Table 7).

The odds of having a good prostatectomy outcome were 80% lower among participants who took venous thromboembolism (VTE) prophylaxis compared to those who did not (AOR = 0.2; 95% CI 0.07–0.6). Similarly, the odds of a good outcome were 86% lower among patients who did not receive proper wound care for open surgery, compared to those who received proper wound care (AOR = 0.14; 95% CI 0.03–0.6).

The odds of a good prostatectomy outcome were 70% lower among patients with hypertension as a comorbidity compared to those without hypertension (AOR = 0.3; 95% CI 0.1–0.6). On the other hand, patients who underwent transurethral resection of the prostate (TURP) had twice the odds of a good prostatectomy outcome compared to those who underwent transvesical prostatectomy (TVP) (AOR = 2; 95% CI 1.5–5.4).

Moreover, patients who received preoperative oral medical therapy for benign prostatic hyperplasia (BPH)

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Table 5 Preoperative characteristics of the respondents in Debre Markos and Felege Hiwot Comprehensive Specialized Hospitals, 2021

Preoperative variables	Frequency (%)
Patient evaluation [history, physical exam (Digital rectal exam)]	
Done	358(86.9)
Not done	54(13.1)
Treatment for urinary tract infection	
Yes	141(34.2)
No	271(65.8)
Medical management for BPH	
Yes	10(2.4)
No	402(97.6)
Laboratory investigations and imaging (Last prior to surgery)	
Urinalysis	
Negative	321(77.9)
Albumin + 1 to + 3	39(9.4)
White blood cells (Leukocytosis)	48(11.7)
Protein	4(1)
Hemoglobin level	
< 13 g/dL	121(29.4)
13–18 g/dL	269(65.3)
> 18 g/dL	22(5.3)
Serum creatinine	
< 0.6 mg/dL	17(4.1)
0.6–1.3 mg/dL	371(90)
> 1.3 mg//dL	24(5.8)
Abdominal and prostatic ultrasound	
Enlarged prostate	412(100)
Volume/size of prostate gland in cm^3 with ultrasound using ellipsoid formula [volume = $\pi/6 \times$ (Length × width × height)]	
30–60 cm^3	66(16)
60–100 cm^3	142(34.5)
100–200 cm^3	204(49.5)
Antibiotic prophylaxis	
Given	404(98.1)
Not given	8(1.9)
Venous thromboembolism prophylaxis	
Yes	23(5.6)
No	389(94.4)
Catheterized at preoperative stage	
Yes	346(84)
No	66(16)
Type of urinary catheter, for catheterized	
Suprapubic catheter	8(2.3)
Transurethral catheter	338(97.7)
For catheterized, catheterization duration before surgery	
< 14 days	195(56.3)
15–28 days	112(32.3)

Table 5 (continued)

Preoperative variables	Frequency (%)
29–45 days	39(11.4)
Indication for prostatectomy	
Mild–sever lower urinary tract symptoms (LUTS)	412(100)

Table 6 Associated comorbidities of the respondents in Debre Markos and Felege Hiwot Comprehensive Specialized Hospitals, 2021

Comorbidities	Frequency (%)
Diabetes mellitus	
Yes	22(5.3)
No	390(94.7)
Hypertension	
Yes	67(16.3)
No	345(83.7)
Other cardiovascular diseases	
Yes	4(1)
No	408(99)
Urinary tract infection (UTI)	
Yes	134(32.5)
No	278(67.5)

were twice as likely to experience poor prostatectomy outcomes compared to those who did not take preoperative medical therapy (AOR = 2; 95% CI 1.2–8.7). Similarly, patients with a prostate volume of 100–200 cm^3 were five times more likely to develop poor prostatectomy outcomes compared to those with a prostate volume of 30–60 cm^3 (AOR = 5; 95% CI 2.3–10).

Moreover, patients who took pre-operation medical therapy for BPH were 2 times more likely to develop poor prostatectomy outcomes as compared to those who did not take pre-operation medical therapy (AOR = 2; 95% CI 1.2–8.7). Similarly, patients who had prostate volume of 100–200 cm^3 were 5 times more likely to develop poor prostatectomy outcomes as compared with those patients who had prostate volume of 30–60 cm^3(AOR = 5; 95% CI 2.3–10).

Discussion

In most developing countries like Ethiopia, open prostatectomy is a common procedure for men with benign prostatic hyperplasia. Knowing the outcomes and the factors contributing to open prostatectomy enables improvement of surgical techniques, enhances patient care and satisfaction, informs clinical decision-making, and supports the development of evidence-based practice guidelines. Therefore, this study aimed to assess the

Table 7 Factors associated with prostatectomy outcomes in Debre Markos and Felege Hiwot Comprehensive Specialized Hospitals, 2021

Variable	Response	Outcomes of prostatectomy		COR (95% CI)	AOR (95% CI)	*p* value
		Poor	Good			
Age	51–60 years	7(10.3%)	82(23.8%)	1	1	0.43
	61–70 years	31(45.6%)	170(49.4%)	3.8(1.5–9.1)	1.5(0.5–5)	0.46
	71–80 years	30(44.1%)	92(26.7%)	1.7(1.1–3.1)	0.7(0.3–1.6)	
Address	Urban	24(35.3%)	61(17.7%)	0.4(0.2–0.6)	1.4(0.3–5.3)	0.5
	Rural	44(64.7%)	283(82.3%)	1	1	
Occupation	Farmer	39(57.4%)	288(83.7%)	3.4(1.3–8.9)	6(1.2–13)	0.05
	Merchant	22(32.4%)	41(11.9%)	0.8(0.3–2.4)	1.7(0.5–6.6)	0.4
	G. employee	7(10.3%)	15(4.4%)	1	1	
VTE prophylaxis	Yes	9(13.2%)	14(4.1%)	0.3(0.1–0.6)	0.2(0.07–0.6)	**0.008**
	No	59(86.8%)	330(95.9%)	1	1	
Wound care	Yes	63(92.6%)	252(73.3%)	1	1	**0.01**
	No	5(7.4%)	92(26.7%)	0.2(0.08–0.5)	0.14(0.03–0.6)	
Hypertension	Yes	26(38.2%)	41(11.9%)	0.2(0.1–0.3)	0.3(0.1–0.6)	**0.002**
	No	42(61.8%)	303(88.1%)	1	1	
Surgical modality	TVP	61(89.7%)	280(81.4%)	1	1	**0.03**
	TURP	7(10.3%)	64(18.6%)	1.9(1.1–4.5)	2(1.5–5.4)	
Pre-operation medica therapy	Yes	3(4.2%)	7(2.1%)	2.1(1.7–9.6)	2(1.2–8.7)	**0.02**
	No	68(95.8%)	334(97.9%)	1	1	
Prostate volume	30–60 cm^3	4(5.9%)	62(18%)	1	1	0.06
	60–100 cm^3	2(2.9%)	140(40.7%)	6.7(2.3–19.4)	1.5(1.2–7.5)	**0.04**
	100–200 cm^3	62(91.2%)	142(41.3%)	30.5(15–40)	5(2.3–10)	
Intraoperation blood loss	<200 mL	64(94.1%)	326(94.8%)	1	1	0.07
	200–500 mL	4(5.9%)	18(5.2%)	1.2(1.1–5.6)	1.1(0.9–3.5)	
Patient evaluation	Done	65(95.6%)	293(85.2%)	0.2(0.08–0.8)	1.6(0.9–5)	0.9
	Not done	3(4.4%)	51(14.8%)	1	1	
Catheterization at preoperative	Yes	65(95.6%)	281(81.7%)	0.2(0.06–0.6)	0.3(0.01–1.2)	0.5
	No	3(4.4%)	63(18.3%)	1	1	
Preoperation catheter duration	<14 days	37(56.9%)	158(56.2%)	2(1.1–4.5)	0.8(0.4–3)	0.7
	15–28 days	15(23.1%)	97(34.5%)	3.2(1.3–7.6)	0.9(0.1–5)	0.4
	29–45 days	13(20%)	26(9.3%)	1	1	
UTI	Yes	39(57.4%)	95(27.6%)	0.3(0.1–0.5)	0.07(0.04–0.4)	0.08
	No	29(42.6%)	249(72.4%)	1	1	
Treat for UTI at preoperative	Yes	35(51.5%)	106(30.8%)	0.4(0.2–0.7)	1.5(1.1–9)	0.06
	No	33(48.5%)	238(69.2%)	1	1	

COR, crude odds ratio; AOR, adjusted odds ratio; CI, confidence interval; VTE, venous thromboembolism and G. employee, government employee

outcomes of prostatectomy and the factors associated with it.

In this study, men over 50 years of age experience benign prostatic hyperplasia. Numerous studies in different countries are also consistent with this conclusion [32, 33]. This might be due to hormonal changes (decline in testosterone levels and an increase in levels of dihydrotestosterone), age-related metabolic changes such as insulin resistance and obesity, lifestyle habits, cellular alterations, and inflammation. This clearly indicates that as the age of men increases, the risk of benign prostatic hyperplasia also increases.

This study showed a significant number of patients with moderate to large prostate volumes: 34.5% in the 60–100 cm^3 range, 16% in the 30–60 cm^3 range, and 49.5% in the 100–200 cm^3 range. This volume-based distribution is used for the individualized administration of medical therapy, decision on transurethral resection of the prostate (TURP) vs. Holmium Laser Enucleation of the Prostate (HoLEP), and use of open surgery. Clinically,

alpha-blockers and 5-alpha-reductase inhibitors are typically used for 30–60 cm^3 prostates, with TURP or HoLEP for refractory cases [34]. For 60–100 cm^3 prostates, HoLEP is favored due to its lower complication rates [35]. In 100–200 cm^3 cases, HoLEP remains effective, while open prostatectomy may be required for complicated cases[36]. For giant prostates (>200 cm^3), HoLEP offers a minimally invasive alternative to open prostatectomy with reduced morbidity [37].

In this study, 83.5% with a 95% CI (79.9, 87.1) had good outcomes from prostatectomy with significant symptom relief (reduced urinary frequency, urgency, and nocturia) and preserved sexual function, whereas 16.5% with a 95% CI (12.9, 20.1) had poor outcomes from prostatectomy with minimal symptom improvement, recurrence of symptoms, severe complications (such as urinary incontinence or retention), and erectile dysfunction. This is in line with a studies done at Liaquat University in Pakistan [38], Newcastle, Britain [39] and Ghana [40], where 81.4%, 79%, and 78.6% of patients who underwent prostatectomy had good outcomes, respectively. This might be due to outcomes of prostatectomy for benign prostatic hyperplasia depend on a combination of patient factors, surgical technique, postoperative care, and long-term management. Therefore, considering these factors and individualizing treatment approaches, healthcare providers can strive to achieve the best possible outcomes for patients with BPH undergoing prostatectomy.

In the study, patients who underwent transurethral resection of the prostate (TURP) had twice the odds of a good prostatectomy outcome compared to those who underwent transvesical prostatectomy (TVP) (AOR = 2; 95% CI 1.5–5.4). This finding may reflect the inherent differences between the two procedures, particularly in terms of invasiveness and recovery. TURP, a minimally invasive procedure, offers faster recovery and fewer complications, making it more effective for moderate-sized prostates, which may explain its higher success rate in this study. In contrast, TVP, a more invasive approach, is typically used for larger or more complex prostates but carries a higher risk of complications, such as bleeding and prolonged recovery.

Moreover, patients who received preoperative oral medical therapy for benign prostatic hyperplasia (BPH) were twice as likely to experience poor prostatectomy outcomes compared to those who did not take preoperative medical therapy (AOR = 2; 95% CI 1.2–8.7). Preoperative medications, such as anti-androgen therapies (e.g., Finasteride and Dutasteride), commonly used to treat BPH, can influence surgical outcomes. While these medications reduce prostate size, potentially simplifying surgeries like TURP, they may also increase the risk of bleeding by altering prostate tissue consistency and blood flow. These changes can complicate surgery and delay postoperative recovery due to impaired tissue healing and other pharmacodynamic effects.

Moreover, patients who took venous thromboembolism (VTE) prophylaxis for thromboembolic diseases were 80% less likely to experience good outcomes following prostatectomy compared to those who did not take VTE prophylaxis (AOR = 0.2; 95% CI 0.07–0.6). A Swedish study [41], which found that patients undergoing prostatectomy who had a history of thromboembolic diseases were at a higher risk of complications, supports this finding. This might be because anticoagulant agents, together with prostatectomy given for thromboembolic diseases, may enhance major bleeding and heparin-induced thrombocytopenia. Therefore, risk stratification and optimal management of risk is crucial for better outcomes of prostate surgery.

Similarly, patients who did not receive proper wound care following open prostatectomy were 86% less likely to experience good surgical outcomes compared to those who received proper wound care (AOR = 0.14; 95% CI 0.03, 0.6). This finding is congruent with study done in Brazil [42]. This is due to the fact that inadequate wound care can lead to increased risk of complications such as infection, delayed wound healing, and prolonged recovery, all of which can adversely affect the overall success of the procedure. Therefore, ensuring appropriate wound care practices post-prostatectomy is essential for promoting patient recovery and improving surgical outcomes.

In addition, patients with hypertension as a comorbidity were 70% less likely to experience good surgical outcomes following prostatectomy compared to patients without hypertension (AOR = 0.3; 95% CI 0.1–0.6). This is supported by the American Urologic Association [43]. This is because hypertension can affect various aspects of surgical recovery, such as wound healing, cardiovascular function, and overall physiological response to surgery, potentially leading to poorer outcomes. Therefore, effective management of hypertension and consideration of its impact on surgical outcomes are important aspects of perioperative care for patients undergoing prostatectomy.

In addition, the majority of the patients had a transvesical prostatectomy (TVP) by type of surgical procedure in this study. This finding is in contrast with findings in developed nations, where transurethral resection of the prostate (TURP) is the most common treatment procedure for benign prostatic hyperplasia [44, 45]. This might be due to the access limitations of advanced prostate surgeries like TRUP and robotic-assisted prostatectomy technologies within the facilities in Ethiopia. This context clearly indicates the importance of improving access to advanced medical technologies in developing regions to

align surgical practices with global standards and potentially improve patient outcomes.

Limitation of the study

Since the data were collected using chart review, the study missed important variables like behavioral characteristics such as smoking and alcohol intake history. Besides this, the study addressed mainly the short-term complications and outcomes of prostatectomy. It is better to study long-term outcomes using prospective follow-up studies.

Conclusion and recommendations
Conclusion

A total of 16.5% of the participants experienced poor outcomes following prostatectomy. The factors associated with these outcomes included venous thromboembolism prophylaxis intake, appropriate wound care, hypertension as a comorbidity, surgical modality, preoperative oral medication therapy for BPH, and prostate volume.

Recommendations

Health care providers should treat comorbid urinary tract infections before the patient has undergone prostatectomy for better outcomes. Besides this, proper wound care of the incision site and management of hypertension comorbidity is important for good outcomes of prostatectomy.

Data availability
All the data are available from the corresponding author upon a reasonable request.

Declarations

Ethics approval and consent to participate
Any activity performed in studies involving humans was performed according to ethical standards, institutional and/or national research committees, and the 1964 Declaration of Helsinki and its later amendments. Ethical clearance was obtained from Debre Markos University, College of Health Sciences Institutional Research Ethics Review Committee (IRERC) with ethical approval number HSC/R/C/Ser/Co/222/11/13. As the collected data is secondary and not directly obtained from patients, formal written or oral consent is not required. However, each hospital's medical director communicated orally and provided a formal letter of cooperation to the department responsible for data collection. In addition, a permission was obtained from the medical directors of both Debre Markos and Felege Hiwot Comprehensive Specialized Hospitals by ensuring that patient information was anonymized and no identifiable information was included in the data analysis or reporting to keep privacy and confidentiality. Moreover, the unit staff (i.e., card room workers, surgical ward and operating room staff) were informed about the purpose of the study. Besides this, COVID-19 precaution measures were undertaken throughout the data collection period.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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