

Comparison of Perioperative and Postoperative Outcomes in Patients with Urinary Diversions: Direct Cutaneous Ureterostomy versus Bricker Ileal Conduit Technique Following Radical Cystectomy

Cosmin-George Radu^{1,2}, Petrino-Cristian Călinoiu², George Daniel Rădăvoi^{2,3}, Justin Aurelian^{1,2*}, Ion-Florin Achim^{4,5}, Cosmin Medar^{1,6}, Iulia Andraș⁷, Maximilian Buzoianu⁷, Nicolae Crișan⁷, Silviu Constantinoiu^{4,5}, Viorel Jinga^{2,3,8}

¹Department of Nursing, Carol Davila University of Medicine and Pharmacy, 050474, Bucharest, Romania

²Department of Urology, Prof. Dr. Th. Burghel Clinical Hospital, 050659 Bucharest, Romania

³Department of Urology, Carol Davila University of Medicine and Pharmacy, 050474, Bucharest, Romania

⁴Department of Surgery, Carol Davila University of Medicine and Pharmacy, 050474, Bucharest, Romania

⁵Department of Surgery, General and Esophageal Surgery Clinic – Sfanta Maria Clinical Hospital, 011172, Bucharest, Romania

⁶Department of Radiology and Medical Imaging, Carol Davila University of Medicine and Pharmacy, 050474, Bucharest, Romania

⁷Department of Urology Iuliu Hașeganu University of Medicine and Pharmacy, 400347 Cluj-Napoca, Romania

⁸Medical Sciences Section, Academy of Romanian Scientists, 050085 Bucharest, Romania

*Corresponding authors:

Justin Aurelian, M.D.

Department of Nursing, Carol Davila

University of Medicine and Pharmacy

050474, Bucharest, Romania

E-mail: justin.aurelian@umfcd.ro

Ion-Florin Achim, M.D.

Department of Surgery

General and Esophageal Surgery

Clinic – Sfanta Maria Clinical

Hospital, 011172, Bucharest, Romania

E-mail: achim.florin@yahoo.com

Abbreviations:

RC: radical cystectomy;

MIBT: muscle-invasive bladder tumors;

NMIBT: non-muscle-invasive bladder

tumors;

UD: urinary diversion;

IC: ileal conduit;

SDCU: simple direct cutaneous

ureterostomy;

Rezumat

Compararea rezultatelor perioperatorii și postoperatorii la pacienții cu derivații urinare tip ureterostomie cutanată directă respectiv conduct ileal Bricker în urma cistectomiei radicale

Introducere: Tumorile vezicale musculo-invasive necesită de obicei cistectomie radicală, urmată de o derivație urinară pentru a menține fluxul urinar. Cele două metode principale utilizate sunt ureterostomia cutanată directă simplă (USC) și derivația prin conduct ileal Bricker (CIB), fiecare având avantaje și dezavantaje specifice. Acest studiu compară rezultatele acestor două tehnici în două centre universitare din România, cu abordări chirurgicale diferite.

Material și Metodă: Am efectuat un studiu retrospectiv pe 64 de pacienți cu tumori vezicale musculo-invasive, repartizați în două grupuri egale. Într-un centru s-a utilizat tehnica USC prin abord clasic, iar în celălalt CIB prin abord laparoscopic. S-au evaluat ratele de filtrare glomerulară, pierderile de sânge, durata intervenției, durata spitalizării și complicațiile postoperatorii.

Rezultate: Ambele tehnici au oferit rezultate similare privind funcția renală postoperatorie. Grupul CIB a prezentat o scădere mai accentuată a hemoglobinei (mediana scăderii de 2,1 g/dL comparativ cu 1,8 g/dL pentru USC, $p=0.007$) și o durată a spitalizării semnificativ mai scurtă (mediana de 11 zile pentru CIB față de 15 zile pentru USC, $p<0.001$). În plus, incidența infecțiilor de tract urinar a fost mai redusă în grupul CIB ($p=0.016$).

Concluzii: Tehnica CIB este preferabilă pentru pacienții cu risc crescut de infecții datorită unei durate de spitalizare reduse și a unei incidențe mai mici a ITU. În schimb, tehnica USC rămâne o opțiune viabilă pentru pacienții

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BICD: Bricker ileal conduit diversion;
 GFR: glomerular filtration rate;
 Hb: hemoglobin;
 UTIs: urinary tract infections.

vârstnici. Diferența semnificativă în durata spitalizării (11 vs. 15 zile) subliniază necesitatea unei selecții riguroase și personalizate a tipului de derivație urinară, adaptată la nevoile individuale ale pacientului și la abordul specific al fiecărui centru.

Cuvinte cheie: ureterostomie cutanată directă, conduct ileal Bricker, cistectomie radicală, derivație urinară

Abstract

Background: Muscle-invasive bladder tumors (MIBT) usually require radical cystectomy (RC) followed by urinary diversion to maintain urinary flow. The two main methods used are simple direct cutaneous ureterostomy (SDCU) and Bricker ileal conduit diversion (BICD), each with distinct advantages and disadvantages. This study compares the outcomes of these two techniques across two university centers in Romania, with each center employing a different surgical approach

Material and Methods: A retrospective study was conducted on 64 patients with MIBT, divided into two equal groups. One center performed the SDCU technique with a classical approach and the other used BICD via a laparoscopic approach. Glomerular filtration rates (GFR), blood loss, operative time, length of hospitalization and postoperative complications were assessed.

Results: Both techniques provided similar postoperative renal function outcomes. The BICD group exhibited a more pronounced decrease in hemoglobin levels (median decrease of 2.1 g/dL compared to 1.8 g/dL in the SDCU group, $p=0.007$) and a significantly shorter hospital stay (median of 11 days for BICD versus 15 days for SDCU, $p<0.001$). Moreover, the incidence of urinary tract infections was significantly lower in the BICD group ($p=0.016$)

Conclusions: The BICD technique is preferable for patients at increased risk of infections due to a shorter hospital stay and a lower incidence of urinary tract infections. Conversely, the SDCU technique remains a viable option for elderly patients. The significant difference in hospital stay duration (11 vs. 15 days) underscores the necessity for a rigorous and individualized selection of the urinary diversion type, tailored to the patient's specific needs and the surgical approach of each center.

Key words: simple direct cutaneous ureterostomy, Bricker ileal conduit, radical cystectomy, urinary diversion

Introduction

Bladder tumors rank as the seventh most common neoplasm in men and eleventh overall across both sexes. Approximately 75% of patients diagnosed with bladder cancer are aged over 65, with a mean age at diagnosis of 73 years (1-5). It is estimated that between 30% and 75% of cancer patients develop depression, anxiety, or an adjustment disorder during treatment (6,7,8).

According to the NCCN Clinical Practice Guidelines in Oncology, as well as recommendations from the European Association of Urology

(EAU), radical cystectomy (RC) is the treatment of choice for muscle-invasive bladder tumors (MIBT) as well as for high-risk non-muscle-invasive bladder tumors (NMIBT) or those resistant to intravesical chemotherapy (9-13). Urinary diversion (UD) and lymph node dissection remain integral components of RC (9,12).

Radical cystectomy may also be performed for locally advanced prostate cancer. Genetic predisposition plays a role in the development of aggressive and invasive forms of prostate cancer that may extend to the bladder (14).

The urinary diversion procedure was first

described by Simon in 1852, who reported bilateral ureterosigmoidostomy in a 13-year-old child with bladder exstrophy (15,16). In 1950, BICD introduced the ileal conduit (IC) technique. Johnston later described ureterocutaneostomy in 1963 for a patient diagnosed with congenital urinary obstruction (15).

Options for urinary diversions (UD) include continent cutaneous diversions, orthotopic neobladders, intestinal diversions, and simple direct cutaneous ureterostomy (SDCU) (11,17).

Cutaneous ureterostomy is the simplest form of urinary diversion, involving the direct anastomosis of both ureters to the skin, while the ileal conduit (IC) technique is more complex (18,19,20).

Consequently, cutaneous ureterostomy is generally the preferred technique for elderly or immunosuppressed patients (21,22). However, the BICD-type urinary diversion is often preferred by patients due to its association with improved quality of life (23).

Early complications such as paralytic ileus and bowel obstruction may contribute to the high morbidity associated with radical cystectomy (RC) (24). Additionally, long-term complications may include ureteroenteric strictures, parastomal hernias and metabolic disturbances (24,25). Compared to ileal diversion, cutaneous ureterostomy (CU) has been associated with shorter intraoperative times and hospital stays, reduced blood loss, and fewer intra- and postoperative complications in elderly patients (24).

In conclusion, selecting an appropriate urinary diversion is crucial in determining the course of radical cystectomy (26). Choosing a specific technique requires consideration of the limitations imposed by disease progression, patient comorbidities, and surgeon experience (27).

This study aims to compare the perioperative and postoperative outcomes of simple direct cutaneous ureterostomy (SDCU) versus Bricker ileal conduit diversion (BICD) by evaluating renal function, blood loss, operative time, hospital stay duration, pre- and postoperative staging, and possible complications to identify the optimal method between two university centers in Romania. This article significantly contributes to urological oncology surgery, providing essential data for selecting the urinary diversion technique by comparing outcomes from one center with a laparoscopic approach and another with an open approach. The study is relevant for improving the quality of life for patients.

Materials and Methods

This retrospective study included 64 patients diagnosed with muscle-invasive bladder tumors who underwent radical cystectomy with urinary diversion in two university centers in Romania between July 2019 and July 2024. At Cluj-Napoca Municipal Clinical Hospital (Center 1), urinary reconstruction was performed according to the BICD technique using a laparoscopic approach. At Prof. Dr. Th. Burghel Clinical Hospital in Bucharest (Center 2), the procedure predominantly involved the open approach with simple direct cutaneous ureterostomy (SDCU). Patients were divided into two equal groups of 32 patients each.

In this study, the selection of the urinary diversion method was determined using decision-making algorithms specific to each center, reflecting both institutional protocols and surgical preferences.

At Prof. Dr. Th. Burghel Clinical Hospital in Bucharest, the decision was based on a comprehensive clinical assessment, taking into account factors such as tumor stage, renal function, and the presence of comorbidities. In this context, the simple cutaneous ureterostomy (SDCU) technique, performed via the open approach, was preferred in cases where patients had a favorable profile for extensive surgical interventions and optimal postoperative recovery. The decision-making process involved interdisciplinary consultations, integrating expertise from specialists in urology, oncology and anesthesia to customize the therapeutic strategy to each patient's individual characteristics.

At Cluj-Napoca Municipal Clinical Hospital, the decision-making approach evolved to predominantly support the use of the BICD technique. The selection of this method was based on a detailed analysis of preoperative parameters, including glomerular filtration rate (GFR), hemoglobin levels and the patient's history of associated diseases, which influence the risk of postoperative complications. Consequently, in cases where a faster surgical procedure and a reduced risk of infection were anticipated, the BICD technique was the preferred choice.

Inclusion Criteria

Patients diagnosed with muscle-invasive bladder tumors (T2-T4) requiring radical cystectomy, aged over 18 and without distant metastases. All patients had available preoperative and postoperative data to evaluate renal function and complications.

Patients were selected based on predefined inclusion criteria, ensuring consecutive enrollment of cases diagnosed with muscle-invasive bladder tumors undergoing radical cystectomy between July 2019 and July 2024, as well as the complete availability of the necessary preoperative and postoperative data for the analysis of renal function and complications. Furthermore, only patients with a minimum follow-up of 3 months, who received exclusively one of the two urinary reconstruction methods under investigation (BICD or SDCU), and who provided informed consent for participation were included. To ensure the comparability of results, the distribution of patients between the two centers was balanced. These measures were implemented to reduce selection bias and to ensure a representative sample.

Exclusion criteria encompassed severe comorbidities (NYHA class III heart failure, insulin-dependent diabetes mellitus, chronic obstructive pulmonary disease, ischemic cerebrovascular accident), previous surgical interventions on the urinary tract (pyeloplasty, percutaneous nephrolithotomy, ureterovesical reimplantation), or patients who refused to participate in the study. The exclusion criteria were established to ensure cohort homogeneity and to minimize confounding variables that could impact the study outcomes. Patients with severe comorbidities were excluded, as these conditions could significantly influence postoperative outcomes and the incidence of complications. Additionally, patients with a history of surgical interventions on the urinary tract were excluded due to the possibility that preexisting anatomical and functional modifications might affect the study results. Finally, patients who declined participation were excluded in accordance with ethical principles and the regulations governing informed consent in clinical research.

According to these exclusion criteria, 12 patients were excluded from the study: 5 refused participation, 4 presented with major comorbidities, and 3 had a history of surgical interventions on the urinary tract.

Exclusion Criteria

Patients with severe comorbidities, previous urinary tract surgeries, or those who refused study participation were excluded.

Parameters Analyzed: sex, age, glomerular filtration rate (GFR) measured preoperatively and at three months postoperatively, hemoglobin (Hb) levels evaluated preoperatively and postoperatively

to assess intraoperative blood loss, incidence of urinary tract infections (UTIs) preoperatively and postoperatively, duration of surgery, length of hospital stay, pre- and postoperative staging according to TNM criteria and late postoperative complications (sepsis, wound dehiscence, postoperative ileus, pyelonephritis, pelvic abscess and other complications).

Statistical Analysis

Statistical analysis was conducted using IBM SPSS Statistics 25 and Microsoft Office Excel/Word 2021. Quantitative variables were tested for distribution using the Shapiro-Wilk test and expressed as means with standard deviations (or medians with interpercentile ranges, depending on distribution), while categorical variables were presented in absolute values or percentages.

Independent quantitative variables with a non-parametric distribution were compared between groups using the Mann-Whitney U test or Kruskal-Wallis H test. Independent quantitative variables with a normal distribution were compared between groups using the Student's T-Test or Welch's T-Test (based on variance equality assessed by Levene's test). Paired quantitative variables with a non-parametric distribution were compared between measurements using the Wilcoxon test, while paired quantitative variables with a normal distribution were tested using the Paired-Samples T-Test.

Independent categorical variables were compared between groups using Fisher's exact test. Bonferroni-corrected Z-tests were applied to clarify results in contingency tables. Paired categorical variables were compared between measurements using McNemar's test or the Related-Samples Marginal Homogeneity Test. The significance threshold chosen for this study was $\alpha = 0.05$.

Results

The characteristics of the cohort analyzed in this study are presented in *Table 1* and *Figs. 1, 2*. A total of 64 patients were included, with 50% undergoing the BICD technique and 50% the simple cutaneous ureterostomy (SDCU) technique. Most patients (57.8%) were treated at Prof. Dr. Th. Burghel Clinical Hospital in Bucharest, where SDCU was more frequently used (84.4% vs. 31.2%) compared to the Municipal Clinical Hospital in Cluj-Napoca, where the BICD technique predominated (68.8% vs. 15.6%) ($p < 0.001$). The

Table 1. Patient Characteristics According to Type of Urinary Diversion

Parameter	Total	BICD	SDCU	p-value
<i>Demographic variables</i>				
N (%)	100	50	50	-
Center 1 (%)	42.2	68.8	15.6	<0.001*
Center 2 (%)	57.8	31.2	84.4	
Male (%)	62.5	71.9	53.1	0.196*
Female (%)	37.5	28.1	46.9	
Age (Mean $\pm$ SD) (years)	66.08 $\pm$ 8.5	64.41 $\pm$ 9.37	67.75 $\pm$ 7.31	0.117**
<i>Approach</i>				
Open (%)	65.6	31.2	100	<0.001*
Laparoscopic (%)	34.4	68.8	0	
<i>Preoperative variables</i>				
Preoperative GFR (Mean $\pm$ SD) (ml/min/1.73m ²)	65.5 $\pm$ 22.46	68.2 $\pm$ 23.3	62.8 $\pm$ 21.62	0.340**
Preoperative Hb (Mean $\pm$ SD) (g/dl)	12.12 $\pm$ 1.44	12.26 $\pm$ 1.4	12 $\pm$ 1.49	0.460**
Preoperative UTI (%)	28.1	31.2	25	0.782*
Preoperative JJ Stents (%)	9.4	15.6	3.1	0.196*
<i>Postoperative variables</i>				
Postoperative GFR (Mean $\pm$ SD) (ml/min/1.73m ²)	69.3 $\pm$ 25.33	72.2 $\pm$ 25.04	66.4 $\pm$ 25.7	0.368**
Postoperative Hb (Mean $\pm$ SD) (g/dl)	10.17 $\pm$ 1.38	10.15 $\pm$ 1.37	10.19 $\pm$ 1.41	0.894**
Postoperative UTI (%)	10.9	9.4	12.5	1.000*
<i>Pre-postoperative comparison</i>				
Pre-post Comparison GFR (p)	0.078****	0.215****	0.220****	-
GFR Difference (Median (IQR))	-1.5			
(-10.7 – 3.7)	1.5			
(-11.5 – 8)	-4			
(-10.75 – 1)	0.166***			
Pre-post Comparison Hb(p)	<0.001****	<0.001****	<0.001****	-
Hb Difference (Median (IQR))	1.9 (1.6-2.2)	2.1 (1.7-2.4)	1.8 (1.5-1.9)	0.007***
Pre-post Comparison UTI (p)	0.001†	0.016†	0.125†	-
UTI Difference (%)	-61.1	-70	-50	0.509*
<i>Temporal variables</i>				
Surgery Duration (min) (Mean $\pm$ SD)	383.5 $\pm$ 75.7	400.7 $\pm$ 87.7	366.2 $\pm$ 57.8	0.068**
Hospitalization Duration (days) (Median (IQR))	13 (10-16)	11 (7.25-13)	15 (13.2-20)	<0.001***
<i>Complications</i>				
Complications (%)	40.6	46.9	34.4	0.446*
Wound Infection/Dehiscence (%)	3.1	6.3	0	0.492*
Ileus (%)	1.6	3.1	0	1.000*
Pyelonephritis (%)	10.9	9.4	12.5	1.000*
Recurrent Pyelonephritis (%)	3.1	0	6.3	0.492*
Other Complications (%)	40.6	46.9	34.4	0.446*
Additional Treatments (%)	32.8	21.9	43.8	0.109*

*Fisher's Exact Test, **Student T-Test, ***Mann-Whitney U Test, ****Paired-Samples T-Test, †Related-Samples McNemar Test

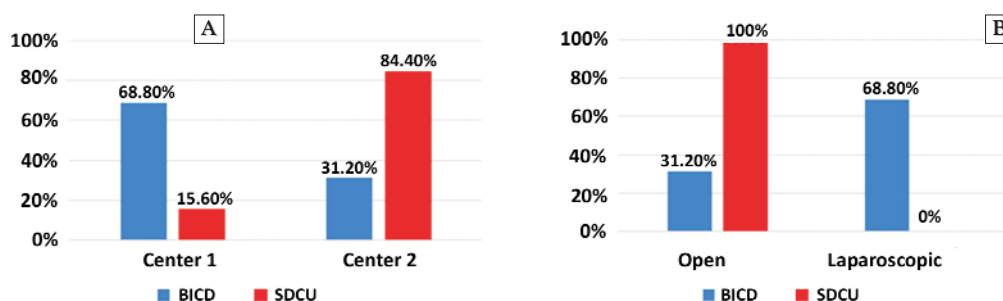
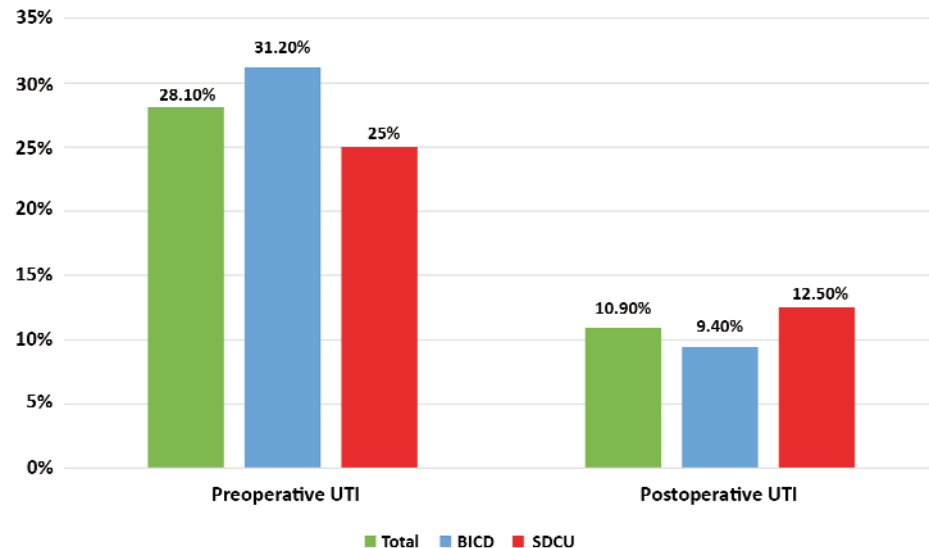
**Figure 1.** Distribution of patients according to surgical technique and university center (A) or surgical approach (B).

Figure 2. The evolution of UTI frequency in patients from the total cohort and in patients who underwent surgery using the BICD/SDCU technique.



majority of patients were male (62.5%), with a mean age of 66.08 ± 8.5 years. The open surgical approach was most commonly used (65.6%), exclusively in SDCU cases (100% vs. 31.2%) ($p < 0.001$).

The mean preoperative glomerular filtration rate (GFR) was 65.5 ± 22.46 , while the postoperative GFR was 69.3 ± 25.33 , with no significant differences between techniques ($p > 0.05$), indicating no clinically relevant variation in GFR changes. Hemoglobin levels significantly decreased postoperatively (10.17 ± 1.38 vs. 12.12 ± 1.44 , $p < 0.001$) for both techniques, with a greater decrease in the BICD group (median = 2.1 g/dL) compared to the SDCU group (median = 1.8 g/dL) ($p = 0.007$).

The incidence of urinary tract infections (UTIs) significantly decreased postoperatively (10.9% vs. 28.1%, $p = 0.001$), particularly in the BICD group ($p = 0.016$), whereas no significant change was observed in the SDCU group ($p = 0.125$), and no significant intergroup difference in UTI reduction rates was found ($p = 0.509$). The reduction in postoperative urinary tract infections (UTIs) observed with the BICD technique represents a critical aspect, as demonstrated by the significant decrease in incidence (10.9% vs. 28.1%, $p = 0.001$). This reduction is particularly notable among patients undergoing the BICD procedure ($p = 0.016$), whereas no significant changes were recorded for the SDCU technique ($p = 0.125$).

JJ stent use was low (9.4%), with a mean surgery duration of 383.5 ± 75.7 minutes and a median hospital stay of 13 days, longer for SDCU (median =

15 days) compared to BICD (median = 11 days) ($p < 0.001$). Approximately 40.6% of patients experienced complications, most commonly pyelonephritis (10.9%) and wound infection (3.1%). Additionally, 32.8% required adjunct treatments.

The average duration of hospitalization was significantly longer in patients who underwent the USC technique compared to those treated with the BICD technique (15 days vs. 11 days, $p < 0.001$).

Postoperative complications, present in 40.6% of patients, included pyelonephritis and wound infections, factors that can prolong the hospital stay. Differences between the techniques in terms of the postoperative decrease in hemoglobin - more pronounced in patients undergoing the BICD procedure ($p = 0.007$) - may indicate the necessity for additional interventions, such as blood transfusions, thereby impacting the duration of hospitalization.

Patient distribution by urinary diversion type and tumor staging is shown in Table 2. Preoperative tumor staging indicated that most patients were in stage T2 (64.1%) or T1 (28.1%), with no significant difference between techniques ($p = 0.329$). Postoperative stages were most commonly T3 (35.9%) and T2 (29.7%), also without significant differences between techniques ($p = 0.255$).

Differences between techniques were primarily noted in hospital stay duration and hemoglobin decrease rate, while renal function evolution and complication rates showed no significant variation between BICD and SDCU techniques.

Table 2. Patient distribution by type of urinary diversion and staging

Parameter	Total	BICD	SDCU	p-value
<i>Preoperative Staging</i>				
Tis (%)	1.6	1.6	0	0.329*
T0 (%)	1.6	1.6	0	
T1 (%)	28.1	34.4	21.9	
T2 (%)	64.1	53.1	75	
T3 (%)	1.6	3.1	0	
T4 (%)	3.1	3.1	3.1	
<i>Postoperative Staging</i>				
Tis (%)	4.7	6.3	3.1	0.255*
T0 (%)	6.3	12.5	0	
T1 (%)	18.8	21.9	15.6	
T2 (%)	29.7	25	34.4	
T3 (%)	35.9	28.1	43.8	
T4 (%)	4.7	6.3	3.1	
Pre-post Comparison (p)	0.089**	0.535**	-	-
Change T1 pre-post	0.327***	0.424***	0.774***	-
Change T2 pre-post	0.001***	0.064***	0.004***	-
Change T3 pre-post	<0.001***	0.021***	<0.001***	-
Decrease in T2 frequency (%)	-26.8	-29.4	-25	1.000*
Increase in T3 frequency (%)	+2100	+800	13	0.430*

*Fisher's Exact Test, **Related-Samples Marginal Homogeneity Test, ***Related-Samples McNemar Test (p<0.0167 – Significance threshold chosen by Bonferroni correction)

The characteristics of BICD patients by university center are presented in *Table 3* and *Fig. 3*. Thirty-two patients were analyzed, with the majority treated at the Municipal Clinical Hospital in Cluj-Napoca (68.8%). The mean preoperative GFR was 70.9 ± 24.82 in center 1 and 62.26 ± 19.34 in Center 2, and the postoperative GFR was 66.55

± 26.25 in center 1 and 84.6 ± 17.4 in Center 2, with no significant differences between centers (p > 0.05). However, a significant postoperative increase in GFR was observed in Center 2 (p = 0.006; mean increase = 22.34 ± 19.7), while a significant decrease was noted in Center 1 (p = 0.021; mean decrease = 4.36 ± 8.2), with a significant inter-

Table 3. Characteristics of Patients Operated on with the BICD Technique Reported to the University Center

Parameter	Center 1	Center 2	p-value
<i>Demographic variables</i>			
N (%)	68.8	31.2	-
Male (%)	72.7	70	1.000*
Female (%)	27.3	30	
Age [Median (IQR)](years)	65.5 (60.75-69.25)	69 (53.75-74.5)	0.411***
<i>Approach</i>			
Classical (%)	0	100	<0.001*
Laparoscopic (%)	100	0	
<i>Preoperative variables</i>			
Preoperative GFR (Mean $\pm$ SD) (ml/min/1.73 m ²)	70.9 ± 24.82	62.26 ± 19.34	0.339**
Preoperative Hb (Mean $\pm$ SD)(g/dl)	12.47 ± 1.38	11.8 ± 1.37	0.212**
Preoperative UTIs (%)	36.4	20	0.440*
Preoperative JJ Stents (%)	4.5	40	0.024*
<i>Postoperative variables</i>			
Postoperative GFR (Mean $\pm$ SD) (ml/min/1.73 m ²)	66.55 ± 26.25	84.6 ± 17.4	0.054**
Postoperative Hb (Mean $\pm$ SD) (g/dl)	10.46 ± 1.37	9.46 ± 1.16	0.054**
Postoperative UTIs (%)	13.6	0	0.534*

Table 3. Cont'd

Parameter	Center 1	Center 2	p-value
<i>Pre-postoperative comparison</i>			
Pre-Post Comparison GFR (p)	0.021****	0.006****	-
Difference in GFR (Mean $\pm$ SD)	4.36 $\pm$ 8.2	-22.34 $\pm$ 19.7	0.002\$
Pre-Post Comparison Hb(p)	<0.001****	<0.001****	-
Difference in Hb (Mean $\pm$ SD)	2 $\pm$ 0.3	2.34 $\pm$ 0.88	0.276\$
Pre-Post Comparison UTIs (p)	0.063 [†]	0.500 [†]	-
Difference in UTIs (%)	-62.5	-100	1.000*
<i>Temporal variables</i>			
Duration of Surgery (min) (Mean $\pm$ SD)	415 $\pm$ 100.97	369.5 $\pm$ 34.03	0.069\$
Length of Hospital Stay (days) [Median (IQR)]	9 (7-13)	12.5 (10.75-14.25)	0.077***
<i>Complications</i>			
Complications (%)	54.5	30	0.265*
Wound Infection/Dehiscence (%)	0	20	0.091*
Ileus (%)	4.5	0	1.000*
Pyelonephritis (%)	13.6	0	0.534*
Other Complications (%)	54.5	30	0.265*
Complementary Treatments (%)	18.2	30	0.648*

*Fisher's Exact Test, **Student T-Test, ***Mann-Whitney U Test, ****Paired-Samples T-Test,

[†]Related-Samples McNemar Test, \$Welch T-Test

center difference ($p = 0.002$). The difference between centers regarding the evolution of GFR was statistically significant ($p=0.002$), suggesting a possible impact of the surgical approach on postoperative renal function.

Hemoglobin levels significantly decreased postoperatively at both Center 1 (12.47 ± 1.38 vs. 10.46 ± 1.37 , $p < 0.001$) and Center 2 (11.8 ± 1.37 vs. 9.46 ± 1.16 , $p < 0.001$). The differences in UTIs frequency pre- and postoperatively between centers were not significant ($p > 0.05$). Another distinguishing feature was the use of JJ ureteral stents, which were employed significantly more frequently in patients from Center 2 (40% vs. 4.5%, $p=0.024$). This difference reflects divergent strategies in protecting renal function and preventing post-

operative anastomotic complications. Postoperative complication rates did not significantly vary between centers ($p = 0.265$), with similar incidence rates ($p > 0.05$). Adjunct treatments were similarly used across centers (30% vs. 18.2%; $p = 0.648$).

Staging distribution by center for BICD patients is shown in Table 4, with most patients in stage T2 (59.1% in Center 1, 40% in Center 2) or T1 (27.3% in Center 1, 50% in Center 2), with no significant differences between centers ($p = 0.569$). Postoperative staging showed significant differences ($p = 0.001$); T1 stage cases were more common in Center 1 (31.8% vs. 0%), while T2 cases were more frequent in Center 2 (70% vs. 4.5%).

The characteristics of SDCU patients by university center are presented in Table 5 and Fig. 4.

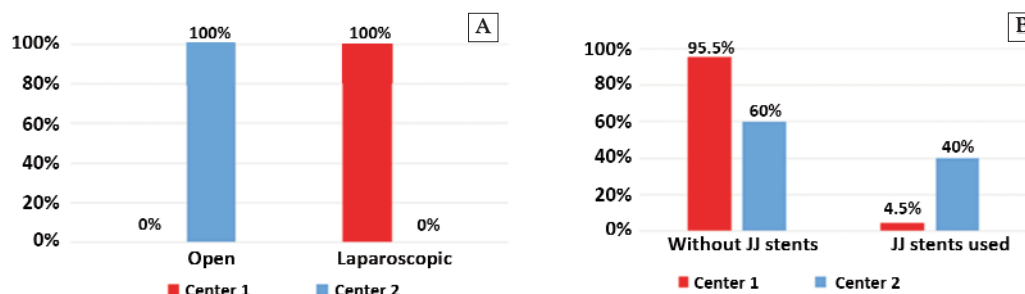


Figure 3. Distribution of patients operated on using the BICD technique related to the university center and surgical approach (A) or the presence of JJ stent use (B)

Table 4. Distribution of patients operated on with the BICD technique reported to the University Center and Staging

Parametre	Center 1	Center 2	p-value
<i>Preoperative Staging</i>			
Tis (%)	0	10	0.569*
T0 (%)	4.5	0	
T1 (%)	27.3	50	
T2 (%)	59.1	40	
T3 (%)	4.5	0	
T4 (%)	4.5	0	
<i>Postoperative Staging</i>			
Tis (%)	9.1	0	0.001*
T0 (%)	18.2	0	
T1 (%)	31.8	0	
T2 (%)	4.5	70	
T3 (%)	31.8	20	
T4 (%)	4.5	10	
Change in T1 Pre-Post	1.000**	0.063**	-
Change in T2 Pre-Post	<0.001**	0.453**	-
Change in T3 Pre-Post	0.070**	0.500**	-
Decrease in Frequency T2 (%)	-38.4	0	0.155*

*Fisher's Exact Test, **Related-Samples McNemar Test

(p<0.0167 – Significance threshold chosen by Bonferroni correction)

Thirty-two patients were analyzed, most from Prof. Dr. Th. Burghel Clinical Hospital in Center 2 (84.4%), all operated on with the open surgical approach (100%). Mean preoperative GFR was significantly higher in Center 2 compared to Center 1 (67.3 ± 20.46 vs. 38.56 ± 5.6 , $p < 0.001$), with similar postoperative findings (71.52 ± 24.66 vs. 39 ± 6.67 , $p < 0.001$). Postoperative GFR changes showed no significant differences between centers ($p = 0.604$ / $p = 0.230$).

Hemoglobin levels decreased significantly postoperatively in both centers, with higher pre- and postoperative values in Center 2 compared to Center 1 ($p < 0.001$). The incidence of UTIs was significantly higher in Center 1 compared to Center 2, both preoperatively (100% vs. 11.1%, $p < 0.001$) and postoperatively (80% vs. 0%, $p < 0.001$). The utilization of JJ stents was significantly more frequent among patients in Center 2 (40% vs. 4.5%, $p=0.024$), and both the operative time ($378.52 \pm$

Table 5. Characteristics of patients operated on with the SDCU technique reported to the University Center

Parameter	Center 1	Center 2	p-value
<i>Demographic variables</i>			
N (%)	15.6	84.4	-
Male (%)	100	44.4	0.046*
Female(%)	0	55.6	
Age (Median (IQR)) (years)	64 (56.5-69)	68 (66-73)	0.122***
<i>Approach</i>			
Classical (%)	100	100	-
Laparoscopic (%)	0	0	
<i>Preoperative variables</i>			
Preoperative GFR (Mean $\pm$ SD) (ml/min/1.73 m ²)	38.56 ± 5.6	67.3 ± 20.46	<0.001 [§]
Preoperative Hb (Mean $\pm$ SD) (g/dl)	10.6 ± 0.74	12.25 ± 1.45	0.020**
Preoperative UTIs (%)	100	11.1	<0.001*
Preoperative JJ Stents (%)	0	3.7	1.000*
<i>Postoperative variables</i>			
Postoperative GFR (Mean $\pm$ SD) (ml/min/1.73 m ²)	39 ± 6.67	71.52 ± 24.66	<0.001 [§]
Postoperative Hb (Mean $\pm$ SD) (g/dl)	8.6 ± 0.63	10.49 ± 1.32	0.004**
Postoperative UTIs (%)	80	0	<0.001*
<i>Pre-postoperative comparison</i>			
Pre-Post Comparison GFR (p)	0.604****	0.230****	-
Difference in GFR (Median (IQR))	0 (-2.1 – 1)	-5 (-11.72 – 2)	0.136***
Pre-Post Comparison Hb (p)	<0.001****	<0.001****	-
Difference in Hb (Median (IQR))	2 (1.8-2.2)	1.7 (1.4-1.9)	0.077***
Pre-Post Comparison UTIs (p)	1.000†	0.250†	-
Difference in UTIs (%)	-20	-100	0.512*
<i>Temporal variables</i>			
Duration of Surgery (min) (Mean $\pm$ SD)	300 ± 37.41	378.52 ± 52.67	0.004**
Length of Hospital Stay (days)	12 (10-13)	16 (14-21)	0.001***
<i>Complications</i>			
Complications (%)	80	25.9	0.037*
Pyelonephritis (%)	80	0	<0.001*
Recurrent Pyelonephritis (%)	40	0	0.020*
Other Complications (%)	80	25.9	0.037*
Complementary Treatments (%)	100	33.3	0.010*

*Fisher's Exact Test, **Student T-Test, ***Mann-Whitney U Test, ****Paired-Samples T-Test, †Related-Samples McNemar Test,

§Welch T-Test

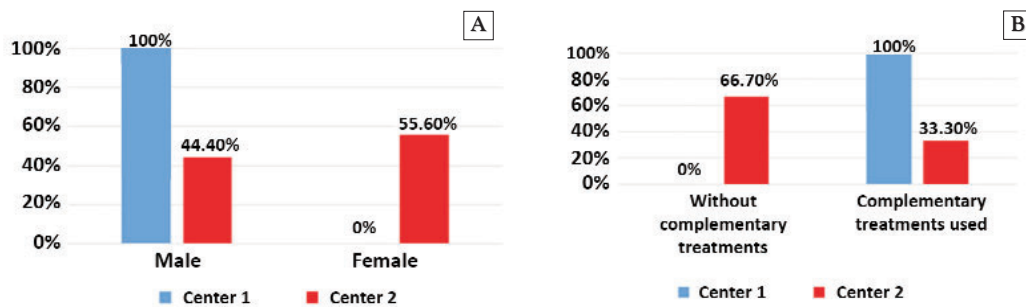


Figure 4. Distribution of patients operated using the SDCU technique reported to the university center and the patients' sex (A) or the presence of complementary treatments (B)

52.67 vs. 300 ± 37.41 , $p=0.004$) and the duration of hospitalization (median = 16 days, IQR = 14–21 vs. median = 12 days, IQR = 10–13, $p=0.001$) were significantly greater in patients from Center 2 compared to those from Center 1. Patients undergoing laparoscopic surgery, predominantly performed at the Center 1 center, had a shorter average hospitalization (9 days) compared to those who received open surgery (12.5 days) or those operated on using the USC technique (15 days).

Center 1 patients also had higher postoperative complication rates (80% vs. 25.9%, $p = 0.037$), particularly pyelonephritis (80% vs. 0%, $p < 0.001$), recurrent pyelonephritis (40% vs. 0%; $p = 0.020$), or other complications (80% vs. 25.9%, $p = 0.037$), compared to Center 2 patients. Additionally, Center 1 patients had significantly higher adjunct treatment use (100% vs. 33.3%, $p = 0.010$) compared to Center 2. The tumor staging distribution

by university center for SDCU patients is illustrated in Table 6. Preoperative staging showed significant differences ($p = 0.009$), with stage T1 cases more common in Center 1 (80% vs. 11.1%) and T2 cases more frequent in Center 2 (85.2% vs. 20%). Postoperative staging analysis indicated a significant decrease in T2 cases in Center 2 (85.2% vs. 37%, $p = 0.002$) and a significant increase in T3 cases (0% vs. 40.7%, $p = 0.001$).

Discussion

The findings from the two university centers reveal significant differences between the laparoscopic BICD technique employed in Center 1 and the open approach utilized in Center 2. Patients operated on laparoscopically had a shorter average hospitalization (9 days) compared to those who underwent open surgery (12.5 days), indicating a

Table 6. Distribution of patients operated on with the SDCU technique reported to the University Center and Staging

Parameter	Center 1	Center 2	p-value
Preoperative Staging			
T1 (%)	80	11.1	0.009*
T2 (%)	20	85.2	
T4 (%)	0	3.7	
Postoperative Staging			
Tis (%)	20	0	0.255*
T1 (%)	0	18.5	
T2 (%)	20	37	
T3 (%)	60	40.7	-
T4 (%)	0	3.7	
Change in T1 Pre-Post	0.125**	0.727**	
Change in T2 Pre-Post	1.000**	0.002**	-
Change in T3 Pre-Post	0.250**	0.001**	-
Decrease in Frequency T2 (%)	0	21.7	1.000*
Increase in Frequency T3	3	10	0.374*

*Fisher's Exact Test, **Related-Samples McNemar Test ($p < 0.0167$ – Significance threshold chosen by Bonferroni correction)

more rapid recovery time associated with the minimally invasive approach. However, this technique was correlated with a postoperative decrease in glomerular filtration rate (GFR), suggesting a possible negative impact from intraoperative transient renal ischemia. In contrast, the open approach used in Center 2 was associated with a significant increase in postoperative GFR, which may reflect more effective intraoperative hemostatic control.

Regarding postoperative complications, their incidence was higher in Center 1, highlighting the need for optimized prophylactic strategies for patients undergoing the laparoscopic technique. Conversely, the lower complication rate in Center 2 suggests a more effective perioperative management, with strong prevention of adverse effects. The more frequent use of complementary treatments in Center 1 indicates an increased need for additional measures to reduce morbidity, which may be associated with the specific challenges of the laparoscopic approach and a longer learning curve for the surgical team.

The use of JJ ureteral stents was significantly more frequent in Center 2 (40% vs. 4.5%, $p=0.024$), potentially indicating a different strategy for the prevention of anastomotic complications.

Furthermore, although patients' hemoglobin levels decreased significantly postoperatively in both centers, these variations were not influenced by the type of surgical approach. The differences in preoperative and postoperative staging between the two centers may reflect distinct case selection strategies and variability in histopathological assessment. In Center 1, a higher proportion of patients were initially classified as having stage T1 tumors, which may suggest either an overestimation of the initial staging or a different selection of cases for the laparoscopic approach. In contrast, the more frequent presence of stage T2 in Center 2 may indicate either a more accurate preoperative staging or increased tumor aggressiveness in the group of patients selected for open surgery. Postoperatively, a shift of patients to stage T3 was observed in Center 2, suggesting either a more rigorous histopathological reassessment or a higher biological aggressiveness of the tumors treated in this center.

The analysis of this study confirms trends observed by Saini et al. (2022) regarding the perioperative advantages of simple cutaneous ureterostomy (SDCU) over the BICD technique, particularly concerning shorter operative time and postoperative hospitalization duration (28). Our study

showed an average operative time of 383.5 ± 75.7 minutes and a longer hospitalization period for SDCU (15 days) compared to BICD (11 days). Saini et al. noted a shorter operative time and reduced hospital stay in patients with cutaneous ureterostomy, confirming that SDCU can be a faster and more operationally efficient option for selected patients (28).

In comparison, the study led by Chen in 2023 indicated similar outcomes in terms of hospitalization duration, suggesting that SDCU is associated with faster recovery and fewer days of postoperative ileus compared to BICD. However, Chen et al. also highlighted a significant reduction in postoperative complications in the SDCU group, including fewer wound complications and a reduced need for secondary-line antibiotics, underscoring a potentially more favorable perioperative profile for SDCU (21). However, in our study, the length of hospitalization varied depending on the surgical approach. This variation may be explained by the benefits of laparoscopic surgery, which, due to its minimally invasive nature, reduces tissue trauma, facilitates faster recovery, and decreases the need for postoperative analgesics. Additionally, avoiding extensive abdominal incisions contributes to a lower risk of infections and incisional hernias, factors that can prolong hospitalization.

In our study, we identified postoperative complications in 40.6% of patients, with a slightly higher incidence of pyelonephritis in the BICD group (10.9%) compared to SDCU, although this difference was not statistically significant. This observation is partially consistent with the data reported by Chen et al., who highlighted a lower incidence of postoperative complications in the SDCU group. The differences may be attributed to both the anatomical characteristics of each technique and the perioperative strategies implemented in each center. Thus, laparoscopic surgery demonstrates advantages in terms of faster recovery and reduced length of hospitalization, while SDCU provides a more favorable perioperative profile regarding infectious complications and morbidity associated with the surgical wound.

Renal functional outcomes represent another essential aspect of the analysis. The postoperative evolution of renal function varies depending on the type of urinary diversion and the surgical approach employed. In the early postoperative months, our study identified an increase in the glomerular filtration rate (GFR) in the SDCU group (Center 2), a phenomenon that may be explained by a shorter operative time and superior vascular control

associated with the open surgical approach. Conversely, patients in the BICD group (Center 1) exhibited an initial decline in GFR, most likely due to transient renal ischemia and prolonged operative duration, characteristics inherent to the laparoscopic approach.

These findings are consistent with observations from previous studies, including those conducted by Saini (2024), Wang (2022), and Kotaro (2020), which demonstrated that GFR outcomes between the two techniques were comparable up to one year postoperatively (28,29,30). However, in the long term, a more pronounced decline in renal function was observed in SDCU patients compared to those undergoing BICD, potentially indicating an increased risk of progressive renal dysfunction. Although this difference was not statistically significant in our study, the results highlight the necessity for rigorous long-term monitoring of renal function in these patients.

Regarding postoperative hemoglobin reduction, our study highlighted a significant decrease (10.17 ± 1.38 g/dL compared to 12.12 ± 1.44 g/dL preoperatively), aligning with Khalilullah's findings (2021), which showed a less pronounced hemoglobin decrease in SDCU patients than in those with BICD (3). The greater hemoglobin drop in the BICD group (median = 2.1 g/dL vs. 1.8 g/dL for SDCU, $p=0.007$) may be attributed to the longer operative time and more invasive approach involving intestinal resection, as confirmed by Khalilullah's data indicating higher blood loss with the BICD technique (15).

Intraoperative blood loss and the type of surgical intervention significantly influence the degree of postoperative hemoglobin decline. The open surgical approach used in SDCU ensures superior hemostatic control, which explains the comparatively lower reduction in hemoglobin levels relative to BICD, where uretero-intestinal anastomoses may contribute to more substantial hemorrhage. A marked decrease in hemoglobin levels can lead to severe anemia, necessitating blood transfusions and increasing the risk of postoperative complications.

Urinary tract infections (UTIs) represent another common issue, and in our study, their incidence decreased postoperatively (from 25% preoperatively to 12.5% postoperatively for SDCU). This observation aligns with Chen and Saini's studies, which reported an infection rate in the SDCU group, potentially explained by the avoidance of uretero-ileal anastomoses in SDCU, which can present an additional infection risk (13,28).

However, the differences between surgical techniques are also influenced by anatomical particularities. In BICD, the prevention of urinary stasis reduces the risk of infection, whereas in SDCU, the presence of reflux and urinary stasis predisposes to bacterial colonization. These considerations necessitate prophylactic measures tailored to the specific type of urinary diversion.

Additionally, an essential aspect in clinical practice is the reduced use of JJ stents in SDCU, which may contribute to a lower UTI risk, supported by Kobayashi's observations (2021) on frequent postoperative complications associated with BICD, including urinary obstructions and recurrent infections (31).

The comparison of the open and laparoscopic approaches in the BICD technique highlights significant differences in perioperative evolution and postoperative outcomes, as supported by both the specialized literature and the present study. According to Cardoso et al. (2024), laparoscopic radical cystectomy with intracorporeal ileal diversion provides significant advantages, such as reduced intraoperative blood loss, decreased postoperative analgesic requirements and a lower incidence of abdominal wall complications due to the absence of extensive incisions (32). Similarly, our analysis confirms that the laparoscopic approach leads to faster recovery and a shorter hospital stay compared to the open technique. However, both Cardoso's study and our findings indicate that laparoscopy is associated with a complex learning curve and adaptation process for the surgical team, a high technical difficulty, and an initially longer operative time, factors that may affect its widespread implementation (32).

Conversely, Bachir and Kassouf (2013) underscore the advantages of the open approach in ileal conduit diversion, noting benefits such as a shorter operative time and better management of intraoperative vascularization and hemostasis, which may help reduce the risk of ureteral ischemia and anastomotic complications - findings also reflected in our analysis (33). Nevertheless, these benefits are counterbalanced by a higher risk of wound infections, incisional hernias, and the need for long-term stoma care, which can adversely affect patients' quality of life. Furthermore, Bachir and Kassouf draw attention to the progressive deterioration of postoperative renal function due to factors such as uretero-intestinal obstructions and recurrent infections, necessitating rigorous follow-up (33).

Thus, the literature data, in conjunction with

our observations, indicate that while laparoscopy offers significant benefits in terms of postoperative recovery, the open technique remains a viable option. This underscores the importance of individualized patient selection based on anatomical characteristics, comorbidities, and the availability of technology (32,33).

In terms of patient quality of life, Nabil et al. (2024) observed that both patient groups experienced reductions in quality of life immediately postoperatively, with no significant long-term differences (9). In our study, while quality of life was not assessed through standardized questionnaires, the observation of reduced infections and shorter hospital stays in SDCU patients suggests a favorable impact on overall health and postoperative recovery. Nonetheless, further studies are needed to assess the quality-of-life impact comprehensively.

Our study presents several limitations. First, the analyzed cohort is relatively small and the uneven distribution of cases between the two hospitals, as well as the technical preferences between the university centers, may influence the objectivity of conclusions. Additionally, the lack of systematic postoperative quality-of-life assessment limits the evaluation of the psychological impact on patients. Future studies should include standardized quality-of-life assessments and larger cohorts to confirm the obtained results.

This study offers new insights into the perioperative and functional approach of SDCU compared to BICD in cases of radical cystectomy for muscle-invasive bladder tumors. The findings illustrate that SDCU presents significant perioperative benefits, but requires closer long-term renal function monitoring. These observations support the conclusions of recent studies and suggest that SDCU may be an efficient and less invasive alternative to BICD for selected patients, although further research is needed to validate this technique in clinical practice.

Conclusions

Patients operated on using the BICD method experienced a lower incidence of urinary tract infections compared to those who underwent direct cutaneous ureterostomy. Although the open approach for simple cutaneous ureterostomy led to a shorter operative time, it was associated with prolonged hospitalization, a milder decline in hemoglobin levels and a significant postoperative improvement in renal function. The selection of the

urinary diversion method should consider the individual patient's characteristics, particularly the risk of postoperative renal dysfunction. This study is one of the few that directly compares two distinct methods of urinary diversion in the context of muscle-invasive bladder tumors, utilizing data from two university centers in Romania. The study is retrospective, and the limited number of patients may restrict the generalizability of the findings. Furthermore, long-term follow-up could reveal additional late complications that were not captured. Additional studies are necessary to evaluate the feasibility of these surgical procedures in the treatment of muscle-invasive bladder tumors.

Author's Contributions

All authors (C.-G.R. P.-C.C. G.D.R. J.A. V.J. I.-F.A. S.C. I.A. M.B. N.C.) participated in the drafting, writing and editing of the manuscript. All gave final approval and agreed to be accountable for all aspects of work ensuring integrity and accuracy. C.-G.R. have full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

The authors declare no conflicts of interest

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Ethics Approval

The study was conducted in accordance with the Declaration of Helsinki.

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

The data presented in this study are available on request from the corresponding author due to privacy reasons.

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