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ORIGINAL RESEARCH

Cutaneous ureterostomy versus ileal conduit – outcomes and cost implications post-cystectomy

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Background: Following radical cystectomy (RC), most centres reserve cutaneous ureterostomy (CU) for frail patients. The concern of ureter and stoma stenosis limits CU to a secondary choice despite potentially being a safer and faster option. Ileal conduit (IC) remains the most popular choice of urinary diversion in most centres. We aim to compare the complications and costs related to CU and IC after RC.

Methods: This is a retrospective study of 40 patients (20 CU, 20 IC) between April 2019 and January 2021 at Groote Schuur Hospital, South Africa. All patients underwent RC intended to treat bladder cancer. We compared perioperative, clinical outcomes and hospital costs between CU and IC.

Results: Both groups showed similar preoperative risk profiles. For the CU group, the intraoperative cutting time (p = 0.01) and blood loss (p = 0.12) were lower than the IC group. Postoperatively, the CU group had fewer ileus days (1.44 vs 4.65) (p = 0.09), total parenteral nutrition (TPN) days (1.58 vs 4.35) (p = 0.23), wound complications (1 vs 8) (p = 0.02), and shorter admission (p = 0.14). The CU group also required fewer second-line antibiotics than the IC group (10% vs 55%) (p = 0.003). Hospital costs were 40.32% more expensive in the IC group, accumulating an extra 89 431.37 ZAR (5 489.96 USD) per patient (p = 0.03).

Conclusion: Our study suggests that CU is faster, cheaper, and has fewer early postoperative complications. In our literature research, many studies show success with modifying surgical techniques of CU to decrease stomal and ureteric stenosis to acceptable rates. We believe CU may have a role as a primary incontinent urinary diversion and is not reserved for frail patients. However, larger-scale trials implementing these surgical modifications are needed to validate these findings.

Keywords: Cutaneous ureterostomy, ileal conduit, urinary diversion, bladder cancer, cost implications

Introduction

RC is the standard treatment for muscle-invasive bladder cancer.[1] However, it carries a high rate of early and late complications that are associated with the choice of urinary diversion.[2,3] CU is the safest and fastest technique of urinary diversion following RC.[4] Hence it is commonly the chosen technique in elderly or frail patients.[4] Despite CU being the fastest and safest method of urinary diversion, the concern of ureteric and stomal stenosis has resulted in CU being unpopular in most centres.[5,6] The true incidence of stomal and ureteric stenosis in CU is not well defined as the surgical techniques are highly variable.

The IC technique is the most widely used technique of urinary diversion after RC.[5] However, it carries a whole new set of risks due to bowel manipulation. The early postoperative complications such as prolonged ileus, bowel obstruction, and anastomotic breakdown are predictably more common in IC due to bowel resection and anastomosis.[7]

With studies showing the comparable quality of life between CU and IC, one should base the choice of urinary diversion on the comparison of the complications associated with each.[3] Our study aims to compare the postoperative complications between CU and IC. We also review the cost implications of complications in our resource-limited setting.

Method

Patients

This is a retrospective cohort study of patients diagnosed with muscle-invasive bladder cancer from April 2019 to January 2021 at Groote Schuur Hospital. Patients had undergone RC with either CU or IC as the form of urinary diversion. We excluded: (a) patients that underwent RC for other indications; (b) patients that received other forms of urinary diversion. The patient demographic consisted of South African nationals that made use of public healthcare. Data collection was through medical records, comprising of preoperative assessment, and operative and clinical outcomes.

Surgical technique

Standard RC with extended pelvic lymph node dissection was performed in all patients, staying extraperitoneal when possible, all patients had frozen sections of the urethral margin. Regarding IC, the conduit was formed with 15 cm of ileum taken from 15 cm of the ileocaecal valve with a stapled bowel anastomosis. The conduit was formed with a Wallace-type uretero-ileal anastomosis and a right-sided abdominal wall stoma fashioned. Regarding CU, our standard technique included mobilisation of the left ureter to the right side behind the sigmoid mesentery in the retroperitoneum. Both ureters were placed extraperitoneal behind the caecum and then spatulated with a side-to-side anastomosis at the stoma margin formed on the right side of the abdominal wall. All patients had bilateral ureteral stents placed intraoperatively and external urostomy bags placed over the stoma.

Statistical analysis

All data was collected by a single operator onto a Microsoft Excel sheet. SPSS version 29 was used for data analysis. Numerical data was first analysed with the Shapiro–Wilk test for data distribution, depending if the data was uniform or skewed, it was then further

analysed with an independent t-test (uniform) or a Mann–Whitney U test (skewed). Categorical data was analysed with a chi-squared test. A *p*-value < 0.05 was deemed statistically significant.

Results

Our cohort comprised 20 patients that underwent CU and 20 patients that underwent IC. The mean follow-up period was 338 days.

The preoperative assessment is shown in Table I. Both groups showed similar age, comorbidities, American Society of Anesthesiologists (ASA) score, and histopathology. However, existing renal dysfunction, likely obstructive type, was more prevalent in the CU group ($p = 0.002$). Clinical T-stage done with a CT scan revealed 85% of CU being T3 or T4, compared to 55% of the IC group (Table II).

Table I: Preoperative assessment

	Urinary diversion technique		
	CU (*n* = 20)	IC (*n* = 20)	*p*-value
Age (years) mean ± SD	60.85 ± 10.12	61.6 ± 8.65	0.80
Gender			
Male (%)	17 (85%)	14 (70%)	0.45
Female (%)	3 (15%)	6 (30%)	
Comorbidity			
Hypertension	9 (45%)	14 (70%)	0.11
Diabetes	2 (10%)	6 (30%)	0.24
Smoker	16 (80%)	15 (75%)	1.00
Cardiovascular disease	2 (10%)	3 (15%)	1.00
Existing renal dysfunction (Creatinine > 100 umol/l or > 1.13 mg/dl)	14 (70%)	6 (30%)	0.002
Existing hydronephrosis (%)	14 (70%)	7 (35%)	0.03
Histopathology			
Transitional cell carcinoma	18 (90%)	17 (85%)	0.31
Squamous cell carcinoma	2 (10%)	1 (5%)	
Adenocarcinoma	0 (0%)	2 (10%)	
ASA score mean ± SD	2.55 ± 0.51	2.3 ± 0.47	0.12
TURBT times prior RC mean ± SD	1.83 ± 1.58	1.85 ± 1.23	0.97

CU – cutaneous ureterostomy, IC – ileal conduit, ASA – American Society of Anesthesiologists, TURBT – transurethral resection of bladder tumour, SD – standard deviation
All variables used the chi-square test

Table II: Clinical T-stage (CT scan)

T-stage	CU (*n* = 20)	IC (*n* = 20)
T1	0 (0%)	2 (10%)
T2	3 (15%)	7 (35%)
T3	11 (55%)	9 (45%)
T4	6 (30%)	2 (10%)

CU – cutaneous ureterostomy, IC – ileal conduit
T-stage based on TNM classification for bladder cancer (interpreted via CT scan)

Open CU had significantly less operating time compared to open IC (287.88 min ± 58.23 vs 344.19 min ± 59.45) ($p = 0.01$). There was also less blood loss in the CU group (757.69 ml ± 490.68 vs 1 101 ml ± 764.35) ($p = 0.12$), although not statistically significant (Table III).

Postoperatively CU had a lower postoperative complication rate than IC (50% vs 70%) ($p = 0.11$). Wound infections occurred more frequently in the IC group (40% vs 5%) ($p = 0.02$). Furthermore, in the IC group, 62.5% of wound infections resulted in wound dehiscence. One patient with dehiscence developed an enterocutaneous fistula from an intestinal anastomotic breakdown, which ultimately lead to demise. Along with higher rates of wound infection, the IC group required second-line antibiotics for hospital-acquired infections more frequently than the CU group (55% vs 10%) ($p = 0.003$). Regarding the conduit, the IC group had two (10%) conduit anastomotic breakdowns, and two (10%) with conduit anastomotic stenosis. The CU group had one (5%) ureter stenosis managed with ongoing stent changes. Three patients in the IC group had reoperation, two with intestinal anastomotic breakdown and one with bowel obstruction due to Richter hernia. Two patients in the CU group had reoperation, one patient had an incisional hernia and the other patient revealed a non-therapeutic re-laparotomy. Three patients in the IC group had percutaneous nephrostomies placed postop for either an infected or obstructed system. The change in creatinine from preoperative assessment to most recent creatinine at follow-up showed that CU patients had improved creatinine, whilst IC patients had worsened creatinine on average (-0.60 mg/dl ± 2.87 vs + 1.23 mg/dl ± 2.60) ($p = 0.04$). This finding is likely influenced by the disparity in preoperative hydronephrosis being higher in the CU group. Ultimately, the CU group had a shorter hospital stay than the IC group when comparing open-type procedures (9.57 ± 7.28 vs 23.33 ± 34.22) ($p = 0.14$). But when accounting for skewed data, the length of stay becomes statistically significant ($p = 0.002$) (Table IV).

Table III: Operative data

Operative variable	CU (*n* = 20)	IC (*n* = 20)	*p*-value
Operation type			
Open (%)	16 (80%)	16 (80%)	-
Laparoscopic (%)	4 (20%)	4 (20%)	-
Operative time (min)			
Open (min) ± SD	287.88 ± 58.23	344.19 ± 59.45	0.01[a]
Laparoscopic (min) ± SD	346.25 ± 62.23	367.5 ± 53.31	0.62[a]
Blood loss (ml)			
Open (ml) ± SD	757.69 ± 490.68	1101 ± 764.35	0.12[b]
Laparoscopic (ml) ± SD	236.67 ± 109.70	343.75 ± 65.75	0.16[b]
Blood transfusion (%)	8 (40%)	7 (35%)	0.74[c]
With starting haemoglobin > 10 g/dl	4	4	1.00[c]

CU – cutaneous ureterostomy, IC – ileal conduit, SD – standard deviation
[a]Independent t-test used
[b]Mann–Whitney U test used
[c]Chi-square test used
[d]Fisher's exact test used

Table IV: Complications and course of admission

Complication	CU (*n* = 20)	IC (*n* = 20)	*p*-value
Intraoperative complication	3 - Stent perforated ureter - Stent migrated into upper tract - No drain left	3 - Obturator artery injury - Internal iliac vein injury - Right gonadal artery ligated	1.00[d]
Overall postoperative complication rate (any)	10 (50%)	14 (70%)	0.11[c]
Surgical complications			
Postoperative ileus (days) ± SD	1.44 ileus days per patient ± 2.79	4.65 ileus days per patient ± 7.36	0.09[b]
TPN use (days) ± SD	1.58 ± 3.85	4.35 ± 8.70	0.23[b]
Wound infection (%)	1 (5%)	8 (40%)	0.02[d]
Wound dehiscence (%)	1 (5%)	5 (25%)	0.18[d]
Intestinal anastomosis breakdown	NA	1 (5%)	-
Conduit anastomosis breakdown	NA	2 (10%)	-
Enterocutaneous fistula	NA	1 (5%)	-
Ureteric stenosis	1 (5%)	0	-
Stoma site stenosis	0	0	-
Conduit anastomotic stenosis	NA	2 (10%)	-
Medical complications			
Pyelonephritis	0	2 (10%)	-
Myocardial infarction	1 (5%)	0	-
Pulmonary embolism	1 (5%)	0	-
Renal failure	0	2 (10%)	-
Interventions postoperative			
Reoperation rate (%)	2 (10%)	3 (15%)	1.00[d]
Percutaneous nephrostomy (%)	0	3 (15%)	-
Percutaneous drain for collection (%)	0	0	-
Dialysis (sessions)	0	1 (5%)	-
ICU admission (days) ± SD	0.22 days per patient ± 0.94	0.6 days per patient ± 1.23	0.30[b]
Second-line antibiotic use for hospital-acquired infection (%)	2 (10%)	11 (55%)	0.003[c]
Days until discharge ± SD	10.28 ± 8.12	22.05 ± 31.11	0.12[b]
Open (days) ± SD	9.57 ± 7.28	23.33 ± 34.22	0.14[b]
Laparoscopic (days) ± SD	12.75 ± 11.53	13.80 ± 16.93	0.68[b]
Creatinine outcome ± SD	Improved -52.94 µmol/L ± 253.56 (-0.60 mg/dl ± 2.87)	Worsened +108.65 µmol/L ± 229.69 (+1.23 mg/dl ± 2.60)	0.04[b]

CU – cutaneous ureterostomy, IC – ileal conduit, TPN – total parenteral nutrition, ICU – intensive care unit, SD – standard deviation
[b]Mann–Whitney U test used
[c]Chi-square test used
[d]Fisher's exact test used

A total of four patients demised in our study (1 CU, 3 IC). One patient in the CU group had a sudden demise, two days postoperatively with an undetermined cause. Three patients in the IC group demised, two patients demised from anastomosis breakdown septic complications and one patient demised from a Richter hernia next to the anastomosis site resulting in necrotic bowel and further septic complications (Table V).

On long-term follow-up, the CU group had two (10%) successful stent removals and five (25%) with ongoing stent changes, whilst the IC group had eight (40%) successful stent removals, two (10%) failed removals with obstruction, and three (15%) have ongoing stent changes. Unfortunately, many patients in each group (65% CU, 45% IC) were lost to long-term follow-up due to palliation for recurrence (Table VI).

Cost calculations were based on the private healthcare model in South Africa. Hospitalisation costs relating to choice of urinary diversion were tallied for both groups and compared using one of the country's largest private healthcare groups, Mediclinic's 2022 rates. All extra costs were taken into consideration relating to the choice of diversion used; on average IC appeared to be 40.32% more expensive. An extra 89 431.37 ZAR (5 489.96 USD) was accumulated in hospital costs ($p = 0.03$) with the majority of the cost arising from the length of stay (61.05%), theatre time (14.50%), and reoperation theatre time (10.07%) (Table VII).

Discussion

When looking at the perioperative period, our study shows that CU is faster, and associated with less wound infection, and ileus. Unfortunately, our cohort had high rates of disease recurrence

Table V: Clavien–Dindo early complication classification

Grade and type of complication	CU, *n* (%)	IC, *n* (%)
0 – No complication observed	10 (50)	6 (30)
I		
Paralytic ileus	7 (35)	10 (50)
Superficial wound sepsis	1 (5)	8 (40)
II		
Second-line antibiotics	2 (10)	11 (55)
Blood transfusion	8 (40)	7 (35)
Stoma site bleeding	1 (5)	0
Pyelonephritis	0	2 (10)
IIIa		
TPN use	3 (15)	6 (30)
Percutaneous drainage	0	3 (15)
IIIb		
Reoperation anastomosis breakdown	0	2 (10)
Reoperation bowel obstruction	1 (5)	1 (5)
Reoperation peritonitis	1 (5)	0
IVa		
Renal failure	0	2 (10)
Myocardial infarction	1 (5)	0
Pulmonary embolism	1 (5)	0
IVb		
Sepsis/multi-organ failure	2 (10)	2 (10)
V		
Death	1 (5)	3 (15)

CU – cutaneous ureterostomy, IC – ileal conduit, TPN – total parenteral nutrition

with palliation, therefore late complication rates were difficult to determine. Shorter operating time and less blood loss in CU have been verified in previous studies.[4,7-9] CU has been considered the urinary diversion of choice, particularly in elderly and frail patients when physiological functioning is of concern as there are fewer early postoperative complications.[3,10] Both CU and IC are incontinent diversions and previous studies show a comparable quality of life.[3]

Table VI: Stent outcome

Stent outcome	CU (*n* = 20)	IC (*n* = 20)
Stent removed – patent system	2	8
Stent removed – system obstructed	0	2
Ongoing stent changes	5	3
Inconclusive/palliated/lost	13	9

CU – cutaneous ureterostomy, IC – ileal conduit

RC is an operation associated with high morbidity and mortality.[11] When one has decided that an incontinent urinary diversion should be done, we need to weigh up the risks between CU and IC. Does the risk of bowel resection and anastomosis in IC justify the concern of stomal and ureter stenosis in CU? The true incidence of stomal and ureter stenosis is unknown due to the high variability in surgical technique. Some older studies have shown stenosis rates of 15–60%. However, even within these studies, there are many surgical technique variables which make the true incidence difficult to determine.[6,12,13]

We argue that newer surgical techniques that address key problems may reduce CU stenosis complications to acceptable rates and thereby make CU possibly a better alternative to IC. Some concepts highlighted in more recent studies are:

Table VII: Hospital costs and consumables

Item	Cost in ZAR	Difference in mean (IC – CU)	Extra cost to hospital per IC patient	% of extra cost
Ward bed	4 184.00/day	13.05 days	R 54 601.20	61.05
ICU bed	17 521.70/day	0.38 days	R 6 658.25	7.45
Theatre time (min)	269.50/min	48.13 min	R 12 971.04	14.50
Blood transfusion	2 787.35/unit	0.3 units	R 836.21	0.94
TPN days	833.75/day	2.77 days	R 2 309.49	2.58
Central line set	580.68/set	0 sets	R 0.00	0
X-ray confirming central line	457.60/X-ray	0 X-rays	R 0.00	0
Reoperation theatre time (min)	269.50/min	34.75 min	R 9 003.73	10.07
Dialysis session (SLEDD)	5 499.00/session	0.05 sessions	R 274.95	0.31
Percutaneous nephrostomy set	1 300.14/set	0.15 sets	R 195.02	0.22
Second-line antibiotic use	549.26/day	4.7 days	R 2 581.51	2.89

Antibiotic	Cost per day
Piperacillin-Tazobactam	R 156.30
Meropenem	R 708.00
Ertapenem	R 589.32
Amikacin	R 136.19
Vancomycin	R 280.00
Imipenem	R 761.82
Fluconazole	R 72.64

Total	89 431.37	(*p* = 0.03[a])		

CU – cutaneous ureterostomy, IC – ileal conduit, ICU – intensive care unit, TPN – total parenteral nutrition, SLEDD – sustained low-efficiency dialysis, ZAR – South African rand, USD – United States dollar
US dollar to rand average 2022 exchange rate: 1 USD: 16.29 ZAR (R 89 431.37 = $ 5 489.96)
[a]Independent t-test used

1. Keeping as much parietal peritoneum on the ureter as possible, not to skeletonise the ureter (Figure 1)[14]
2. Extreme lateralisation of the stoma site to the anterior axillary line, thereby following a straighter and shorter course to the skin to minimise kinking and mobilisation (Figure 2)[15]
3. Various stoma site modifications – e.g. extreme smiley, V-shape flap (Figure 3)[15,16]
4. Longer routine ureter stenting over three months prior to removal[17]

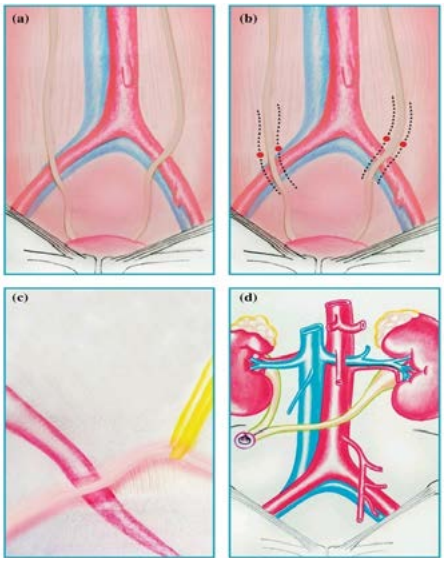

Figure 1: Keeping as much parietal peritoneum as possible[14]

Figure 2: Extreme lateralisation of the stoma site[15]

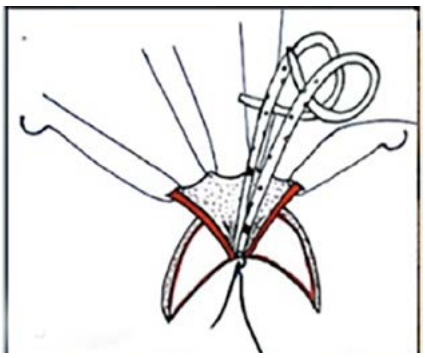

Figure 3: Extreme smiley, V-shape flap[16]

The above studies, although relatively small, ranging from 12 to 111 patients, all claimed to show low and acceptable stoma and ureter complication rates (3.8% to 9.1%) when applying the modified techniques. In comparison to IC, best shown in a series of 412 patients by Madersbacher et al., stoma complications appear to be 24% (mostly parastomal hernias) and ureter obstruction 14%.[18] If one combined the merits of the above technique modifications, would it be plausible to expect complications rates even lower than IC? This would build up the argument for CU to be offered as an alternative form of primary incontinent urinary diversion following RC.

Only one other study by Khalilullah et al. has looked into the cost implications of choosing CU, which found that CU saved 1 844.20 USD on average.[8] Our study shows that there is a substantial hospital cost saving of ± 8 9431.37 ZAR (5 489.96 USD) (p = 0.03), which is highly relevant in our resource-constrained setting.

Our study has limitations in the retrospective design, small sample size, and inadequate follow-up period for long-term complications. Future studies with high-quality prospective multicentre and randomised control trials with standardised surgical technique modifications are needed to evaluate and confirm that CU can in fact be the answer to the complications associated with IC.

Conclusion

Our study suggests that CU is faster, cheaper, and has fewer early postoperative complications than IC. In our literature research, many studies have shown success with the modification of surgical techniques when performing CU to decrease stomal and ureteric stenosis to acceptable rates. We believe CU may have a role as a primary incontinent urinary diversion after RC, and should not only be used in frail patients. However, larger-scale prospective randomised control trials implementing these surgical modifications are needed to validate these findings.

Conflict of interest

The authors declare no conflict of interest.

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None.

Ethical approval

This study obtained ethical clearances from the University of Cape Town, Faculty of Health Sciences, Human Research Ethics Committee (HREC 522/2022). Consent to participate was not applicable as this was a retrospective chart review.

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