surgeries

MDPI

Article

Postoperative Complications in Urinary Diversion: The Value of Computed Tomography in Clinical Management

Thomas Büttner [1,†], Clarissa Julia Schmidt [1,*,†], Yannick Pollhaus [1], Guido Fechner [1], Alexander Isaak [2], Manuel Ritter [1] and Philipp Krausewitz [1]

[1] Department of Urology and Paediatric Urology, University Hospital Bonn, 53127 Bonn, Germany
[2] Department of Diagnostic and Interventional Radiology, University Hospital Bonn, 53127 Bonn, Germany
* Correspondence: clarissa.schmidt@ukbonn.de
† These authors contributed equally to this work.

Abstract

Background/Objectives: This study aimed to evaluate the diagnostic accuracy of computed tomography (CT) in detecting postoperative complications following reconstructive urinary diversion. **Methods:** We retrospectively analyzed 151 patients (2004–2024) who underwent urinary diversion and required abdominal CT within 30 days postoperatively due to a complicated course. CT accuracy for detecting intestinal anastomotic leakage, urinoma, and hemorrhage was assessed against the composite reference standard of final clinical diagnosis. Predictive values of imaging, clinical signs, and laboratory markers were evaluated using logistic regression and ROC analyses. **Results:** CT demonstrated low sensitivity for intestinal leakage (33.3%), hemorrhage (50.0%), and urinoma (60.7%). However, specificity (>87%) and negative predictive values (>88%) were high for intestinal leakage, urinoma, and hemorrhage. In exploratory multivariable analyses, positive CT findings were strongly associated with intestinal leakage, hemorrhage, and urinoma. Valuable adjuncts included abdominal guarding for intestinal leakage and serum creatinine dynamics for urinoma. Conversely, general inflammatory markers (CRP, leukocytes) and hemoglobin levels failed to reliably discriminate specific complications. **Conclusions:** Abdominal CT stands out from clinical or laboratory parameters but lacks the sensitivity required for reliable primary detection of major complications. A negative scan should not provide false reassurance in a deteriorating patient. Effective clinical management requires an integrative approach, combining CT findings with physical examination and targeted laboratory trends rather than relying on non-specific inflammatory markers.

Keywords: radical cystectomy; urinary diversion; computed tomography; postoperative complications; anastomotic leak

Check for updates

Academic Editor: Salomone Di Saverio

Received: 17 July 2026
Revised: 27 September 2026
Accepted: 6 October 2026
Published: 9 October 2026

Copyright: © 2026 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license.

1. Introduction

Urinary diversion, frequently performed in the context of radical cystectomy (RC), ranges among the most invasive routine urological surgeries performed. Despite advances in surgical techniques, the postoperative period poses a significant risk of complications. Overall rates are reported as high as 45% for minor events (Clavien–Dindo I-II) and 15% for major events (Clavien–Dindo III-V) [1]. Among the most severe early complications are life-threatening conditions such as intestinal anastomotic leakage, which occurs in 0.3% to 8.7% of cases, urinoma from a leaking uretero-intestinal anastomosis (2 to 13%), and

significant postoperative hemorrhage (1 to 51%) [2]. Other common issues include paralytic ileus, infections, and wound healing disorders [3].

The timely and accurate diagnosis of these complications is essential to guide appropriate management, which can range from conservative measures to interventional radiology or surgical revision. Computed tomography (CT) of the abdomen has become the preferred imaging modality for investigating suspected postoperative complications due to its accessibility and ability to visualize complex postsurgical anatomy [4]. However, its diagnostic accuracy, particularly in the specific context of urological urinary diversion, is not well-established. While studies in colorectal surgery have evaluated CT for anastomotic leaks, these findings may not be directly transferable to the predominantly small-bowel anastomoses in urology [5]. Similarly, data on CT's ability to detect urinomas and postoperative bleeding in this patient population are scarce.

Alongside imaging, clinicians rely on laboratory parameters such as C-reactive protein (CRP), leukocyte count, creatinine, and hemoglobin levels, as well as on clinical examination. However, the predictive value of these markers is often debated and can be confounded by the normal postoperative inflammatory response [6,7].

This study aims to evaluate the diagnostic performance of abdominal CT in identifying specific early complications following reconstructive urinary diversion. We evaluated the accuracy of CT for detecting key postoperative complications. Furthermore, we analyzed the predictive value of CT findings in conjunction with laboratory and clinical parameters to better understand their role in the clinical management of these complex patients.

2. Materials and Methods

2.1. Patient Cohort

This retrospective study included adult patients who underwent reconstructive urinary diversion at our institution between 2004 and 2024. From an initial cohort of 896 patients, 745 were excluded because they did not experience a complicated postoperative course and/or did not undergo abdominal CT within the first 30 postoperative days. The final study cohort therefore comprised 151 patients with postoperative complications of at least Clavien–Dindo Grade II [8] who underwent abdominal CT within 30 days after surgery. The cohort selection process is illustrated in Supplementary Figure S1. The study followed the STROBE guidelines.

2.2. Data Collection

Data were extracted from the hospital's electronic information system. We collected baseline patient characteristics, including age, sex, and length of hospital stay. Surgical details, such as the type of urinary diversion (e.g., ileal conduit, neobladder) and the type of intestinal anastomosis (e.g., ileoileostomy), were recorded. For uro-oncological cases, the TNM stage was documented.

We recorded the postoperative day of the CT scan, the clinical indication, and the findings from the radiology report. The CT examinations were performed based on the clinical indication, leading to variability in imaging protocols. Of these, 121 scans (80.1%) were performed with intravenous and oral contrast media, while 30 scans (19.9%) were performed with oral contrast only. Detailed acquisition-phase characteristics and contrast-timing parameters were not uniformly available for the present retrospective analysis. Accordingly, the present study reflects the diagnostic performance of routine clinical CT examinations rather than that of a standardized, indication-specific CT protocol.

The final clinical diagnosis for each complication was established by a comprehensive review of the discharge summary, surgical revision reports, interventional findings, and

the overall clinical course, serving as the composite reference standard for this study. Complications were systematically categorized into seven groups:

(1) Intestinal anastomotic leakage, defined as confirmed by revision surgery;
(2) Urinoma, defined as confirmed by revision surgery or measurement of creatinine levels in drainage fluids at least five times higher than the serum values;
(3) Postoperative hemorrhage, defined as confirmed by revision surgery or angiography;
(4) Fascial dehiscence, defined as confirmed by revision surgery;
(5) Lymphocele, defined as confirmed by revision surgery or interventional drainage;
(6) Paralytic ileus, defined as a temporary absence of stools, oral food tolerance, and peristalsis during clinical examination in the absence of the other diagnoses mentioned above;
(7) Infection, defined as an inflammatory response that improved with antibiotic therapy alone in the absence of the other diagnoses mentioned above.

When more than one postoperative complication was present, the underlying causal complication was assigned as the final clinical diagnosis for the purpose of the complication-specific analyses (e.g., if paralytic ileus occurred secondary to urinoma or fascial dehiscence occurred secondary to intestinal anastomotic leakage, the underlying complication was assigned as the final diagnosis). Clinical data included findings from the physical examination. Laboratory parameters (CRP, leukocytes, hemoglobin, and creatinine) were collected throughout the entire period from surgery until the day of the CT scan or revision, excluding the first two postoperative days to avoid confounding by the immediate surgical stress response. Maximum and minimum values, as well as their differences, were calculated to assess dynamic changes.

2.3. Statistical Methods

Descriptive statistics were used to summarize patient and treatment characteristics using frequencies and medians with ranges or interquartile ranges (IQRs), as appropriate.

To assess the diagnostic performance of the abdominal CT, we created cross-tabulations comparing the CT findings with the final clinical diagnosis. From these, we calculated the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) for the detection of each major complication.

Receiver Operating Characteristic (ROC) analyses were performed to evaluate the ability of laboratory parameters to discriminate between patients with and without a specific complication. The area under the curve (AUC) was calculated to quantify the diagnostic utility of CRP, leukocyte, hemoglobin, and creatinine levels.

To explore associations between CT findings, clinical signs, laboratory parameters, and the three most critical complications, we constructed multivariable binomial logistic regression models with a logit link. Predictors—including CT findings, clinical signs, and laboratory markers—were selected for inclusion based on a combination of univariable significance and established clinical reasoning. Given the limited number of outcome events for some complications, particularly postoperative hemorrhage, these models were considered exploratory. The dependent variables were coded as binary (complication present: yes/no) for the three most critical complications: intestinal anastomotic leakage, urinoma, and postoperative bleeding.

All statistical analyses were performed using RStudio v2025.05.1+513, with a significance level set at a two-sided $p < 0.05$.

3. Results

3.1. Patient and Treatment Characteristics

The study cohort comprised 151 patients with a complicated postoperative course. The median age of these patients was 70 years, and 80.1% of them were male. The median length of hospital stay was 23 days. The most common procedure was radical cystectomy (88.8%), with the majority of patients receiving an ileal conduit (51.7%), followed by the ileal neobladder (16.6%). An ileoileostomy was the most common intestinal anastomosis (68.9%). A uro-oncological diagnosis was the indication for surgery in 76.2% of cases. Baseline characteristics are summarized in Table 1.

Table 1. Baseline characteristics.

Characteristic	Median [Range/IQR] or N (%)
Age (years)	70 (22–94)
Male Sex	121 (80.1%)
Length of hospital stay (days)	23 (16.5–41)
Primary Operation	
Radical Cystectomy	134 (88.8%)
Ureteral Reconstruction	17 (11.2%)
Type of Urinary Diversion	
Ileal Conduit	78 (51.7%)
Ileal Neobladder	25 (16.6%)
MAINZ Pouch I	16 (10.6%)
Ureterocutaneostomy	12 (7.9%)
Colon/Sigma Conduit	6 (4.0%)
Intestinal Interposition	14 (9.3%)
Type of Intestinal Anastomosis	
Ileoileostomy	104 (68.9%)
Ileoascendostomy	17 (11.3%)
Other	30 (19.8%)
T-Stage	
pTis/pTa/pT1	38 (25.2%)
pT2	29 (19.2%)
pT3	28 (18.5%)
pT4	20 (13.2%)
Unknown/Non-Oncologic Indication	36 (23.8%)
Nodal Status	
N0	87 (57.6%)
N+	27 (17.9%)
Unknown/Non-Oncologic Indication	37 (24.5%)
Metastatic Status	
M0	108 (71.5%)
M1	5 (3.3%)
Unknown/Non-Oncologic Indication	38 (25.2%)

3.2. Diagnostic Accuracy of Abdominal CT

The frequencies of final clinical diagnoses with concordance and discrepancies between the initial CT findings are detailed in a Sankey diagram (Figure 1). The diagnostic analyses presented in Figure 1 and Table 2 represent diagnosis-specific analytical subsets of the overall study cohort and should not be interpreted as a complete mutually exclusive participant flow. The overall agreement between the specific CT finding and the final diagnosis showed a moderate level of agreement, with a Cohen's Kappa of 0.53 (95% CI: 0.45–0.61; $p < 0.001$).

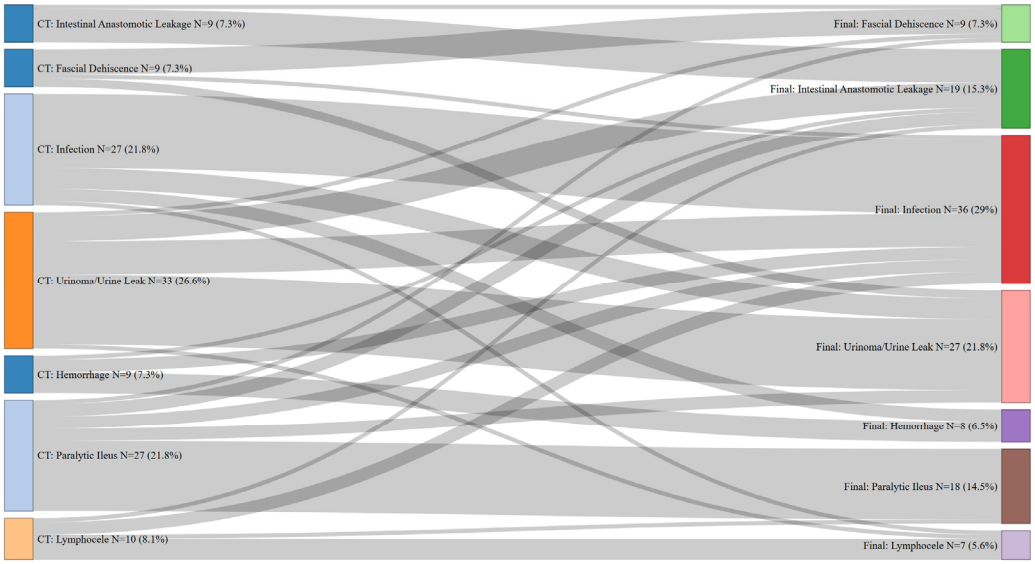


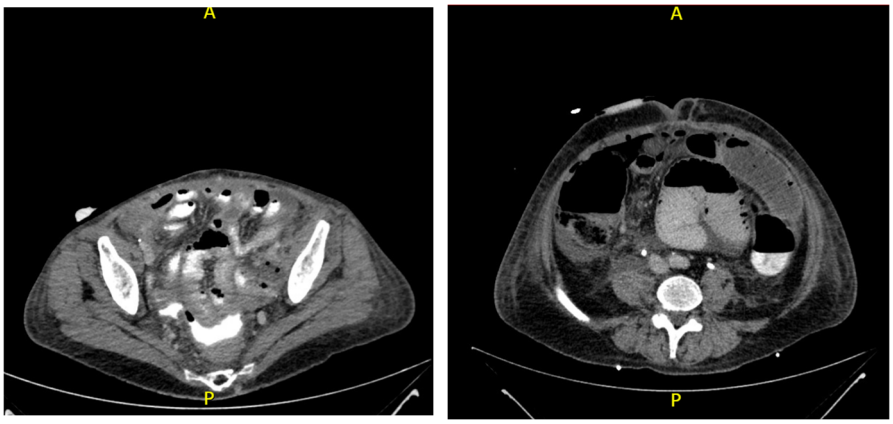
Figure 1. Diagnostic flow from initial CT finding to final clinical diagnosis. This Sankey diagram illustrates the diagnostic pathway for 125 patients with suspected postoperative complications. The left column represents the initial diagnosis based on the CT scan, and the right column represents the final clinical diagnosis. The thickness of the connecting ribbons is proportional to the number of patients for each specific pathway. Each node is labeled with the diagnosis, the absolute number of cases (N), and its percentage of the total cohort.

Table 2. Diagnostic performance of CT for specific postoperative complications.

Final Clinical Diagnosis	N (%)	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)
Intestinal Anastomotic Leakage	24 (15.9)	33.3% (16.1–55.1%)	98.4% (94.4–99.8%)	80.0% (44.4–97.5%)	88.7% (82.1–93.4%)
Urinoma/Urinary Leak	28 (18.6)	60.7% (40.6–78.5%)	87.0% (79.8–92.2%)	51.5% (33.5–69.2%)	90.7% (83.8–95.3%)
Postoperative hemorrhage	10 (6.6)	50.0% (18.7–81.3%)	97.2% (92.8–99.2%)	55.6% (21.2–86.3%)	96.5% (91.9–98.8%)
Paralytic Ileus	18 (11.9)	94.4% (72.7–99.9%)	92.5% (86.5–96.3%)	63.0% (42.4–80.6%)	99.2% (95.6–100.0%)
Fascial Dehiscence	13 (8.6)	46.2% (19.2–74.9%)	97.8% (93.8–99.6%)	66.7% (29.9–92.5%)	95.1% (90.1–97.9%)
Lymphocele	7 (4.6)	71.4% (29.0–96.3%)	96.5% (92.1–98.9%)	50.0% (18.7–81.3%)	98.6% (94.8–99.8%)
Infection	47 (31.1)	38.3% (24.7–53.5%)	91.3% (84.2–96.0%)	66.7% (46.0–83.5%)	76.6% (67.8–84.0%)

PPV = positive predictive value; NPV = negative predictive value.

The diagnostic performance of CT for specific complications varied significantly (Table 2). The scan was effective in detecting paralytic ileus, showing a high sensitivity of 94.4%. In contrast, its ability to positively identify other critical issues was limited. Sensitivity was particularly poor for intestinal anastomotic leakage (33.3%) and infections (38.3%) and modest for fascial dehiscence (46.2%), postoperative hemorrhage (50.0%), and urinoma (60.7%). The reliability of a positive finding also varied widely. While a CT positive for an anastomotic leak was highly dependable (PPV of 80.0%), a positive finding for other conditions required more cautious interpretation due to a significant rate of false positives, with PPVs of only 51.5% for urinoma, 55.6% for postoperative hemorrhage, and 50.0% for lymphocele. However, the NPV was high across most conditions, exceeding 95% for postoperative hemorrhage, fascial dehiscence, lymphocele, and paralytic ileus. Representative CT findings of selected major postoperative complications are shown in Figure 2.



(**A**) (**B**)

Figure 2. Illustrative CT examples of intestinal anastomotic leakage: (**A**) True-positive CT in a patient with confirmed intestinal anastomotic leakage, demonstrating enhanced peritoneum, abundant free intraperitoneal air, and contrast-opacified free fluid in the lower abdomen, interpreted as highly suspicious for a small-bowel fistula in the right lower quadrant. (**B**) False-negative CT in a patient with subsequently confirmed intestinal anastomotic leakage. The examination was initially interpreted as paralytic ileus with segmental circumferential small-bowel wall thickening and distal ileal wall thickening, considered postoperative/reactive or inflammatory, without evidence of an anastomotic leak on the initial report.

3.3. Diagnostic Accuracy of Laboratory Parameters

The ability of laboratory values to discriminate between patients with and without the specific complications of special interest was overall poor. Only for prediction of urinoma, the creatinine dynamics from baseline showed fair discriminative ability (AUC: 70.5%, 95% CI: 57.0–84.0%), exceeding the utility of absolute creatinine levels on the day of CT (AUC: 56.1%, 95% CI: 41.8–70.4%). For intestinal anastomotic leak, both the absolute values and the dynamic change in leukocytes or CRP demonstrated no relevant performance. Moreover, the dynamic change of hemoglobin to baseline showed poor discriminative ability in the detection of bleeding (All: AUC < 60%). Only absolute hemoglobin values on the day of CT were of modest discriminative ability regarding bleeding (AUC: 62.1%, 95% CI: 33.2–90.1%; Supplementary Table S1).

3.4. Predictors of Postoperative Complications

In the exploratory multivariable logistic regression analyses, positive CT findings showed strong associations with each of the three principal postoperative complications evaluated (Table 3).

Table 3. Multivariable generalized models of CT and clinical/laboratory parameters in prediction of complications.

Complication Sign	Odds Ratio (95% CI)	*p*-Value
Intestinal Anastomotic Leakage		
Leukocyte difference to baseline (cont.)	0.93 (0.83–1.02)	0.142
Abdominal guarding (yes vs. no)	16.3 (2.27–150)	**0.006**
Positive CT scan	87.1 (12.0–1510)	**<0.001**
Urinoma/Urinary Leak		
Creatinine difference to baseline (cont.)	1.79 (1.18–2.76)	**0.006**
Positive CT scan	11.0 (4.30–30.0)	**<0.001**
Postoperative hemorrhage		
Hemoglobin values (cont.)	0.86 (0.45–1.60)	0.637
Hemoglobin difference to baseline (cont.)	0.98 (0.43–2.10)	0.955
Positive CT scan	56.7 (9.60–439)	**<0.001**

CI = confidence interval; CT = computed tomography.

Positive CT findings were significantly associated with intestinal anastomotic leakage (OR 87.1, 95% CI 12.0–1510, $p < 0.001$), postoperative hemorrhage (OR 56.7, 95% CI 9.60–439, $p < 0.001$), and urinoma/urinary–intestinal leakage (OR 11.0, 95% CI 4.30–30.0, $p < 0.001$). Clinical and biochemical parameters also showed relevant associations. For intestinal anastomotic leakage, abdominal guarding was significantly associated with the diagnosis (OR 16.3, 95% CI 2.27–150, $p = 0.006$). For urinoma and urinary–intestinal leakage, the creatinine difference variable was also significantly associated with the diagnosis (OR 1.79, 95% CI 1.18–2.76, $p = 0.006$).

Conversely, and of substantial clinical relevance, commonly used laboratory parameters failed to demonstrate predictive utility. In the univariable regression analyses, neither CRP, nor maximum leukocyte count nor minimum hemoglobin level (nor its maximum drop) showed a significant association with any of the complications studied.

4. Discussion

This study provides a detailed evaluation of the diagnostic utility of abdominal CT and other clinical markers for early complications following complex urinary diversion surgery. Our findings highlight both the strengths and, more importantly, the significant limitations of relying on individual diagnostic modalities in this challenging clinical setting. This diagnostic challenge is particularly relevant after radical cystectomy, for which substantial early postoperative morbidity and a broad spectrum of gastrointestinal, infectious, wound-related, genitourinary, and bleeding complications have been documented [9].

The central finding of our study is that while abdominal CT seems highly specific for major postoperative complications, its sensitivity is low, particularly for detecting intestinal anastomotic leakage. With a sensitivity of only 33.3%, our results suggest that a CT scan cannot reliably detect an anastomotic leak. This finding is consistent with, and even lower than, the sensitivities reported in colorectal surgery literature, which range from 47% to 68% [5,10]. More recent colorectal data further indicate that CT performance may depend on both imaging technique and interpretation. A sensitivity of 71% for the original clinical CT interpretation compared with 82–87% on blinded retrospective review has been reported, while retrograde contrast administration reduced false-negative or indeterminate interpretations [11]. The clinical implication is critical: over-reliance on a ‘normal’ CT

scan in a clinically deteriorating patient may lead to a dangerous delay in diagnosis and intervention. The diagnostic challenge is further complicated by the potentially delayed and clinically subtle presentation of anastomotic leakage. A mean time to diagnosis of 12.7 postoperative days has been reported, with 42% of leaks diagnosed only after hospital readmission, underscoring the importance of continued clinical vigilance beyond the initial postoperative assessment [12]. The high specificity of nearly 99%, resulting in rarely false-positive results, and an NPV of about 90% seem to be of modest clinical benefit in this context.

For urinoma and postoperative hemorrhage, the sensitivity of CT was better (61% and 50%) but still suboptimal, meaning about 40% of urine leaks and 50% of significant bleeding were missed on imaging. This is significantly lower than the accuracy reported for dedicated CT cystography in trauma settings [13], but our study reflects the common clinical scenario where an abdominal CT with intravenous contrast is the first-line investigation for a septic patient, rather than a specific study with retrograde urography. Also, while CT is effective at identifying a postoperative hematoma, it is less sensitive in detecting signs of active extravasation, particularly in cases of venous or intermittent bleeding, unlike in high-flow trauma scenarios [14]. Again, as missing the complication and delaying treatment seems intolerable, the high specificity and NPV do not alter the conclusion that a CT scan cannot be a standalone indicator to assess urinoma or bleeding. Positive and negative predictive values are prevalence-dependent and should therefore be interpreted in the context of the selected study population. In the present cohort, the comparison group for each individual complication consisted predominantly of patients with other postoperative complications rather than an unselected postoperative population. Consequently, the reported predictive values should not be directly extrapolated to all patients undergoing urinary diversion. Importantly, the present findings reflect the performance of original clinical CT reports obtained using heterogeneous real-world imaging protocols and should not be interpreted as the maximum diagnostic performance achievable with optimized, indication-specific CT protocols or specialist retrospective image review. However, our regression analyses reinforce the central role of imaging. A positive CT finding was consistently the most powerful predictor for all three major complications. Likely, this is rather a consequence of the general non-specificity of the included clinical or laboratory parameters than an indication of the unique advantages of CT. Still, our study identified key complementary markers. The clinical sign of abdominal guarding was a strong and significant predictor of intestinal anastomotic leakage, underscoring the irreplaceable value of hands-on clinical examination. The significant association of urinomas with a rising serum creatinine likely reflects the systemic absorption of urine from an intra-abdominal collection and provides a simple, non-invasive clue to the diagnosis. Bedside ultrasonography was not systematically assessed in the present cohort; therefore, its potential role as an additional point-of-care imaging modality cannot be determined from our data and warrants evaluation in future studies. Our data suggest that monitoring serum creatinine remains valuable, especially in modern fast-track protocols where drains are often omitted [15].

In contrast, our study found that commonly used laboratory markers of inflammation, such as CRP and leukocyte count, were poor predictors of specific complications. Although often elevated in complicated postoperative courses, they lacked the discriminatory power to differentiate between intestinal anastomotic leakage, infection, or other causes. The AUC values from our ROC analyses were consistently low, indicating that these markers are non-specific indicators of systemic inflammation rather than diagnostic tools for a particular pathology. This is consistent with recent questioning of the utility of CRP as a standalone marker for intestinal anastomotic leakage [7]. However, CRP may still be useful for postoperative risk stratification because of its high negative predictive value

for infectious complications, despite limited specificity for the underlying pathology [16]. Likewise, a postoperative drop in hemoglobin was not a reliable predictor of clinically significant bleeding, likely because hemodilution and baseline anemia are common in this patient population.

In summary, CT was the most informative of the routinely evaluated diagnostic parameters in this cohort, although its diagnostic performance varied substantially across specific postoperative complications. Given the general trend towards imaging patients rather than conducting clinical examinations [17], the low sensitivity regarding major complications is alarming. However, our study is centered around CT reports rather than the scan itself. It is possible that these issues are less related to imaging and more related to its clinical translation. Future prospects could include more direct bidirectional feedback between radiologists and urologists, enabling enhanced CT evaluation and reporting, or even training of modern automated processing tools [18].

A primary limitation of this study is the composite nature of the reference standard, which relied on a combination of surgical findings, interventional procedures, and the overall clinical course. The retrospective design of this study introduces the potential for selection bias and variability in the timing, indications, and technical protocols of CT examinations. In particular, the lack of intravenous contrast in a subset of examinations may have reduced sensitivity for active hemorrhage or urinary extravasation. Furthermore, the long study period from 2004 to 2024 spans substantial changes in CT technology, surgical practice, and postoperative care, introducing additional temporal heterogeneity. Because CT findings formed part of the routine clinical work-up and may have influenced the decision to proceed to revision surgery, angiography, or drainage, incorporation and differential verification bias cannot be excluded. In addition, the hierarchical assignment of a single underlying causal complication may have underrepresented coexisting secondary complications and may have resulted in a clinically correct secondary CT finding being classified as discordant with the assigned final diagnosis. This could result in suboptimal contrast enhancement for the detection of complications such as intestinal anastomotic leakage [19]. The low absolute number of certain complications, such as bleeding, restricts the statistical power of our analyses. The multivariable regression analyses should therefore be considered exploratory, particularly for postoperative hemorrhage, for which the limited number of outcome events and wide confidence intervals indicate a risk of sparse-data effects, model instability, and overfitting. Accordingly, the large odds ratios observed for positive CT findings should be interpreted as associations rather than as causal effects or evidence of diagnostic superiority. The patient cohort was, by design, composed only of complicated cases, so in the absence of a control group these findings on diagnostic accuracy cannot be generalized to all patients undergoing urinary diversion. Despite these limitations, this work represents the first focused analysis of CT performance specifically in a urological urinary diversion cohort, piloting empirical evidence-based medicine in a postoperative patient workup traditionally influenced by anecdotal evidence.

5. Conclusions

Abdominal CT is an important diagnostic tool for major complications after reconstructive urinary diversion, but its limited sensitivity, particularly for intestinal anastomotic leakage, precludes its use as a standalone rule-out test. In clinically deteriorating patients, a negative CT should therefore be interpreted together with physical examination and complication-specific laboratory trends.

Supplementary Materials: The following supporting information can be downloaded at https://www.mdpi.com/article/10.3390/surgeries7040120/s1, Supplementary Figure S1: Cohort selection

process. Supplementary Table S1: AUCs for selected laboratory variables regarding intestinal anastomotic leakage, urinoma/urinary leakage, and postoperative hemorrhage.

Author Contributions: T.B.: Formal Analysis, Writing—Original Draft, Visualization. C.J.S.: Validation, Writing—Review & Editing. Y.P.: Data Curation, Project Administration. G.F.: Data Curation, Writing—Review & Editing. A.I.: Data Curation, Writing—Review & Editing. M.R.: Supervision, Writing—Review & Editing. P.K.: Conceptualization, Supervision, Writing—Review & Editing. All authors have read and agreed to the published version of the manuscript.

Funding: This publication was supported by the Open Access Publication Fund of the University of Bonn.

Institutional Review Board Statement: This study was approved by the local ethics committee (Medical Faculty at the University of Bonn, vote #301/23-EP) with a waiver of informed consent.

Informed Consent Statement: The requirement for informed consent was waived by the local ethics committee of the Medical Faculty of the University of Bonn (approval no. 301/23-EP).

Data Availability Statement: The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

Acknowledgments: During the revision and development of this manuscript, chat.openai.com (OpenAI, GPT-5.6) was used to check grammar and spelling, as the authors are non-native speakers. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

RC	Radical cystectomy
CT	Computed tomography
CRP	C-reactive protein
PPV	Positive predictive value
NPV	Negative predictive value
ROC	Receiver operating characteristic
AUC	Area under the curve
GLMs	Generalized linear models

References

1. Katsimperis, S.; Tzelves, L.; Tandogdu, Z.; Ta, A.; Geraghty, R.; Bellos, T.; Manolitsis, I.; Pyrgidis, N.; Schulz, G.B.; Sridhar, A.; et al. Complications After Radical Cystectomy: A Systematic Review and Meta-analysis of Randomized Controlled Trials with a Meta-regression Analysis. *Eur. Urol. Focus* **2023**, *9*, 920–929. [CrossRef] [PubMed]
2. Rodríguez Faba, O.; Parada Moreno, R.; Malca, L.; Martínez, A.P.; Nervo, N.; Breda, A.; Esquinas, C.; Palou, J. Postoperative management of radical cystectomy. Review of the evidence on the prevention and treatment of urological complications. Manejo postoperatorio de cistectomía radical. Revisión de la evidencia sobre la prevención y el tratamiento de las complicaciones urológicas. *Actas Urol. Esp. (Engl. Ed.)* **2018**, *42*, 143–151. [CrossRef] [PubMed]
3. Froehner, M.; Brausi, M.A.; Herr, H.W.; Muto, G.; Studer, U.E. Complications following radical cystectomy for bladder cancer in the elderly. *Eur. Urol.* **2009**, *56*, 443–454. [CrossRef] [PubMed]
4. Kawamoto, S.; Fishman, E.K. Role of CT in postoperative evaluation of patients undergoing urinary diversion. *AJR Am. J. Roentgenol.* **2010**, *194*, 690–696. [CrossRef] [PubMed]
5. Kornmann, V.N.; Treskes, N.; Hoonhout, L.H.; Bollen, T.L.; van Ramshorst, B.; Boerma, D. Systematic review on the value of CT scanning in the diagnosis of anastomotic leakage after colorectal surgery. *Int. J. Colorectal Dis.* **2013**, *28*, 437–445. [CrossRef] [PubMed]
6. Jin, D.; Chen, L. Early prediction of anastomotic leakage after laparoscopic rectal surgery using creactive protein. *Medicine* **2021**, *100*, e26196. [CrossRef] [PubMed]

7. Hoek, V.T.; Sparreboom, C.L.; Wolthuis, A.M.; Menon, A.G.; Kleinrensink, G.; D'HOore, A.; Komen, N.; Lange, J.F.; Collaborators, T.A.I. C-reactive protein (CRP) trajectory as a predictor of anastomotic leakage after rectal cancer resection: A multicentre cohort study. *Colorectal Dis.* **2022**, *24*, 220–227. [CrossRef] [PubMed]
8. Dindo, D.; Demartines, N.; Clavien, P.-A. Classification of Surgical Complications: A New Proposal With Evaluation in a Cohort of 6336 Patients and Results of a Survey. *Ann. Surg.* **2004**, *240*, 205–213. [CrossRef] [PubMed]
9. Shabsigh, A.; Korets, R.; Vora, K.C.; Brooks, C.M.; Cronin, A.M.; Savage, C.; Raj, G.; Bochner, B.H.; Dalbagni, G.; Herr, H.W.; et al. Defining Early Morbidity of Radical Cystectomy for Patients with Bladder Cancer Using a Standardized Reporting Methodology. *Eur. Urol.* **2009**, *55*, 164–176. [CrossRef] [PubMed]
10. Marres, C.C.M.; Engelmann, E.W.M.; Buskens, C.J.; Haak, H.E.; Bemelman, W.A.; van de Ven, A.W.H. The importance of rectal contrast in CT assessment to detect anastomotic leakage after colorectal surgery. *Colorectal Dis.* **2021**, *23*, 2466–2471. [CrossRef] [PubMed]
11. Kauv, P.; Benadjaoud, S.; Curis, E.; Boulay-Coletta, I.; Loriau, J.; Zins, M. Anastomotic leakage after colorectal surgery: Diagnostic accuracy of CT. *Eur. Radiol.* **2015**, *25*, 3543–3551. [CrossRef] [PubMed]
12. Hyman, N.; Manchester, T.L.; Osler, T.; Burns, B.; Cataldo, P.A. Anastomotic Leaks After Intestinal Anastomosis: It??s Later Than You Think. *Ann. Surg.* **2007**, *245*, 254–258. [CrossRef] [PubMed]
13. Fouladi, D.F.; Shayesteh, S.; Fishman, E.K.; Chu, L.C. Imaging of urinary bladder injury: The role of CT cystography. *Emerg. Radiol.* **2020**, *27*, 87–95. [CrossRef] [PubMed]
14. Kim, S.J.; Ahn, S.J.; Choi, S.J.; Park, D.H.; Kim, H.S.; Kim, J.H. Optimal CT protocol for the diagnosis of active bleeding in abdominal trauma patients. *Am. J. Emerg. Med.* **2019**, *37*, 1331–1335. [CrossRef] [PubMed]
15. Regmi, S.K.; Bearrick, E.N.; Hannah, P.T.F.; Sathianathen, N.; Kalapara, A.; Konety, B.R. Drain fluid creatinine-to-serum creatinine ratio as an initial test to detect urine leakage following cystectomy: A retrospective study. *Indian J. Urol.* **2021**, *37*, 153–158. [CrossRef] [PubMed]
16. Warschkow, R.; Beutner, U.; Steffen, T.; Müller, S.A.; Schmied, B.M.; Güller, U.; Tarantino, I. Safe and Early Discharge After Colorectal Surgery Due to C-Reactive Protein: A Diagnostic Meta-Analysis of 1832 Patients. *Ann. Surg.* **2012**, *256*, 245–250. [CrossRef] [PubMed]
17. Maskell, G. Why does demand for medical imaging keep rising? *BMJ* **2022**, *379*, o2614. [CrossRef] [PubMed]
18. Gunn, A.J.; Alabre, C.I.; Bennett, S.E.; Kautzky, M.; Krakower, T.; Palamara, K.; Choy, G. Structured Feedback From Referring Physicians: A Novel Approach to Quality Improvement in Radiology Reporting. *Am. J. Roentgenol.* **2013**, *201*, 853–857. [CrossRef] [PubMed]
19. Kim, M.G.; Kim, S.H.; Jeon, S.K.; Han, S. Added value of positive intraluminal contrast CT over fluoroscopic examination for detecting gastrointestinal leakage after gastrointestinal surgery. *Sci. Rep.* **2024**, *14*, 1011. [CrossRef] [PubMed]

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.