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Diagnostic Performance of Computed Tomography for Preoperative Staging of Patients with Non-endometrioid Carcinomas of the Uterine Corpus

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Abstract

Purpose—The aim of this study was to assess the diagnostic performance of computed tomography (CT) for initial staging of non-endometrioid carcinomas of the uterine corpus.

Materials and Methods—Waiving informed consent, the Institutional Review Board approved this Health Insurance Portability and Accountability Act (HIPAA)-compliant retrospective study of 193 women with uterine papillary serous carcinomas, clear cell carcinomas, and carcinosarcomas, who underwent surgical staging between May 1998 and December 2011 and had preoperative CT within 6 weeks before surgery. Two radiologists (R1, R2) independently reviewed all CT images. Sensitivity, specificity, negative predictive value (NPV), positive predictive value (PPV), and area under the curve were calculated using operative notes and surgical pathology as the reference standard.

Results—The respective sensitivities and specificities achieved by R1/R2 were 0.79/0.64 and 0.87/0.75 for detecting deep myometrial invasion (MI) on CT; 0.56/0.63 and 0.93/0.79 for detecting cervical stromal invasion; 0.52/0.45 and 0.95/0.93 for detecting pelvic nodal metastases; and 0.45/0.30 and 0.98/0.98 for detecting para-aortic nodal metastases. Although CT had suboptimal sensitivity for the detection of omental disease, it had high PPV for omental seeding at surgical exploration (1.00 for R1 and 0.92 for R2). Inter-observer agreement ranged from

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moderate in the detection of deep MI ($\kappa = 0.42 \pm 0.06$) to almost perfect in the detection of para-aortic nodal metastases ($\kappa = 0.88 \pm 0.08$).

Conclusion—In patients with uterine non-endometrioid carcinomas, CT is only moderately accurate for initial staging but may provide clinically valuable information by ‘ruling-in’ isolated para-aortic lymph node metastases and omental dissemination.

Endometrial cancer is the most common gynecologic malignancy in the US, with an estimated 52,630 new cases and 8,590 deaths in 2014.¹ It is often subclassified into endometrioid adenocarcinomas and non-endometrioid carcinomas.² Endometrioid adenocarcinomas account for the majority of endometrial cancers and typically have an excellent prognosis. Non-endometrioid carcinomas are less common and include such histologies as papillary serous carcinomas (UPSC), clear cell carcinomas (UCCC), and carcinosarcomas (UCS).³ Compared with endometrioid adenocarcinomas, these tumors have a worse prognosis, in part due to increased risk for extra-uterine dissemination even in the absence of deep myometrial invasion (MI) and cervical stromal invasion (CSI).^{4,5}

Endometrial cancer is surgically staged using the 2009 International Federation of Gynecology and Obstetrics (FIGO) system. The standard comprehensive staging procedure consists of total hysterectomy (TH), bilateral salpingo-oophorectomy (BSO), pelvic washings, peritoneal/serosal/omental evaluation, and pelvic and para-aortic (PA) lymphadenectomy.⁶ The National Comprehensive Cancer Network (NCCN) guidelines include recommendations regarding peritoneal and omental biopsies for non-endometrioid tumors.⁷

Computed tomography (CT) is commonly obtained in women with newly diagnosed non-endometrioid carcinomas because, even when their clinical findings indicate stage I disease, their tumors frequently demonstrate extra-uterine dissemination at surgery. Several studies evaluated CT performance in the initial staging of endometrial cancer.^{8–10} However, these reports either did not distinguish between various endometrial cancer subtypes or included few non-endometrioid tumors. Therefore, the purpose of our study was to assess the diagnostic performance of CT for initial staging of non-endometrioid carcinomas of the uterine corpus.

MATERIALS AND METHODS

The Institutional Review Board approved and issued a waiver of informed consent for this retrospective study, which was compliant with the Health Insurance Portability and Accountability Act.

Eligibility

A retrospective search of the institutional database between May 1998 and December 2011 revealed 213 surgically-staged patients with UPSC, UCCC, and UCS who underwent CT scanning within 6 weeks before surgery. Sixteen patients were excluded because of concurrent metastatic tumors other than endometrial cancer (eight had breast cancer, three had lung/pleural cancer, two had lymphoma, one had renal cell carcinoma, one had rectal cancer, and one had multiple primaries). Three patients were excluded due to neoadjuvant

chemotherapy, and one patient was excluded because of a collagen vascular disease since chronic inflammatory conditions may cause lymphadenopathy and result in false positive findings on CT. The final study population consisted of 193 patients.

Computed Tomography (CT) Technique

Thirty of 193 CTs were obtained on either 1- or 4-channel CT scanners (i.e. an older generation of CT equipment) and 151 of 193 CTs were acquired on 16-, 40-, or 64-channel CT scanners (i.e. a newer generation of CT scanners). Scanner information was unavailable for 12 studies. A total of 185 of 193 CT scans were acquired with intravenous contrast.

Image Analysis and Interpretation

Two radiologists (a gynecological cancer imager and an abdominal imager) independently reviewed each CT scan. Both readers were blinded to all clinical information other than the fact that all patients were diagnosed with endometrial cancer.

Imaging findings regarding deep MI (i.e. depth of MI >50 %), CSI, and corpus uteri serosal extension were assessed as either present or absent. Imaging features of extra-uterine dissemination, such as adnexal involvement, pelvic and/or PA lymphadenopathy, peritoneal implants, and distant metastases, were assessed with a 5-point scale as follows: 1 = no tumor present; 2 = probably no tumor present; 3 = presence of tumor indeterminate/possible; 4 = tumor probably present; and 5 = tumor definitely present. Pelvic lymph nodes were considered enlarged if they measured over 0.8 cm in the short axis, while PA lymph nodes were judged abnormal if they measured more than 1 cm in the short axis. Additionally, a lymph node was considered metastatic regardless of size if it demonstrated central necrosis, heterogeneous contrast enhancement, and/or irregular borders.

Reference Standard

Operative notes and surgical pathology reports served as the reference standard. Sites at which no biopsy or resection occurred were excluded from the analysis.

Statistical Methods

Clinical parameters were summarized using descriptive statistics. Means, medians, ranges, and standard deviations were used for continuous variables; frequencies with corresponding percentages were used for discrete variables.

For binomial accuracy analysis, CT readers' impressions regarding tumor presence at each extra-uterine location were grouped into two categories: (1) tumor absent (scores 1–3); or (2) tumor present (scores 4–5). For each reader, the diagnostic accuracy of CT was assessed with sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV), along with exact 95 % confidence intervals (CIs). The accuracy of CT for the evaluation of extra-uterine dissemination was analyzed by plotting the receiver operating characteristic curves and examining the area under the curve (AUC) with asymptotic 95 % CI. The locations with tumor present in fewer than ten patients were excluded from the accuracy analysis. Analyses were repeated for the subsample of patients whose imaging was performed with the newer generation of CT scanners.

Inter-rater agreement was analyzed using Cohen's Kappa (κ) statistic; agreement regarding local staging was assessed using the simple κ statistic, while agreement pertaining to extra-uterine dissemination was analyzed with a weighted κ with quadratic weights. The kappa values were interpreted as follows: 0.00–0.20 = slight agreement, 0.21–0.40 = fair agreement, 0.41–0.60 = moderate agreement, 0.61–0.80 = substantial agreement, and 0.81–1.00 = almost perfect agreement.¹¹ All statistical analyses were performed using the SAS 9.2 statistical software package (SAS Institute, Cary, NC, USA) and Stata SE11 (StataCorp LP, College Station, TX, USA).

RESULTS

Patients and Surgical Procedures

Patient characteristics and all surgical procedures are summarized in Tables 1 and 2. At a minimum, each patient underwent TH, BSO, and pelvic fluid cytological evaluation. The majority of patients also had pelvic lymphadenectomy (189/193; 98 %), PA lymph node dissection (139/193; 72 %), and omentectomy (149/193; 77 %).

Tumor Spread on CT

Local Extent of Disease—Of the 193 patients in the study, 185 had contrast-enhanced preoperative CT and were included in the assessment of local tumor extent. At final surgical pathology, 36 % (66/185) of patients had deep MI and 31 % (57/185) had CSI. All details regarding CT performance in local tumor staging are listed in Table 3. Briefly, for the detection of deep MI, CT demonstrated sensitivities of 0.64 (95 % CI 0.51–0.75) and 0.79 (95 % CI 0.67–0.88), and specificities of 0.75 (95 % CI 0.67–0.83) and 0.87 (95 % CI 0.79–0.92). For the detection of CSI, CT had lower sensitivities of 0.56 (95 % CI 0.42–0.69) and 0.63 (95 % CI 0.42–0.69), but similar specificities of 0.79 (95 % CI 0.39–0.94) and 0.93 (95 % CI 0.87–0.97). When only studies obtained on the newer generation of CT scans were analyzed, diagnostic performance for local tumor staging remained similar (Table 4).

Extra-Uterine Spread—Thirty percent (56/189) of women who underwent pelvic lymphadenectomy had pelvic lymph node metastases (LNM), while 24 % (33/139) of patients who underwent PA lymph node dissection had PA LNM. At pathology, 7 of these 33 patients (21 %) had PA nodal metastases in the absence of pelvic nodal metastases (isolated PA LNM). Omental implants were found at exploration in 16 % (28/170) of patients. Of these, 13 (46 %) patients had omental disease without deep MI at pathology; R1 identified omental disease in 46 % of these patients (6/13) and R2 identified it in 31 % of patients (4/13).

All results regarding extra-uterine staging with CT are detailed in Table 3. Briefly, CT demonstrated low to moderate sensitivities ranging from 0.30 (95 % CI 0.16–0.49) to 0.52 (95 % CI 0.38–0.65), but high specificities ranging from 0.93 (95 % CI 0.88–0.97) to 0.98 (95 % CI 0.94–1.00) for the detection of pelvic and PA LNM. The PPV for pelvic and PA LNM was moderate to high, ranging from 0.74 (95 % CI 0.56–0.87) to 0.88 (95 % CI 0.64–0.99).

Similarly, for identifying omental dissemination, CT had low to moderate sensitivities of 0.43 (95 % CI 0.24–0.63) and 0.64 (95 % CI 0.44–0.81), and high specificities of 0.99 (95 % CI 0.96–1.00) and 1.00 (95 % CI 0.97–1.00). Furthermore, the PPVs for omental dissemination were very high at 0.92 (95 % CI 0.64–1.00) and 1.00 (95 % CI 0.81–1.00). The diagnostic performance of CT in patients whose scans were obtained on the newer generation of CT scanners was similar to that in the entire cohort (Table 4).

Inter-observer Agreement—The inter-observer agreement ranged from moderate ($\kappa = 0.42$) to almost perfect ($\kappa = 0.88$), as summarized in Table 5.

DISCUSSION

For the definitive management of non-endometrioid carcinomas of the uterine corpus, most oncology centers perform TH, BSO, pelvic washings, selective biopsies, and bilateral pelvic lymphadenectomy with or without PA nodal dissection. There is ongoing controversy regarding the routine addition of PA lymphadenectomy and other procedures, including omentectomy.¹² Frequently, treating physicians feel that they have enough information from TH, BSO, peritoneal evaluation, and pelvic lymph node assessment to guide adjuvant therapy. The lack of widely accepted evidence-based treatment guidelines and the morbidity associated with PA lymphadenectomy have led to substantial variations in clinical practice across the gynecological oncology community.

Preoperative imaging that accurately stages endometrial cancer would be useful to tailor the extent of surgery to ensure optimal outcome with minimal postprocedural complications. Documentation of isolated PA LNM or peritoneal dissemination before surgery could be of particular clinical relevance.

No prior studies examining the diagnostic performance of CT for initial staging of non-endometrioid carcinomas of the uterine corpus were found in the literature. Our cohort included 13 patients who had omental dissemination in the absence of deep MI, and 7 patients with isolated PA LNM at surgical staging. We found CT to have moderate sensitivity and moderate to high specificity in predicting deep MI and CSI. For the detection of pelvic and PA LNM, CT had low to moderate sensitivity and high specificity, but it also had high PPV. For the detection of omental disease, CT had suboptimal sensitivity but high PPV. These findings remained similar when only studies acquired on the newer generation of CT scanners were analyzed. Furthermore, agreement between the readers was substantial for omental dissemination and almost perfect for PA LNM, meaning that these findings were reproducible. Thus, our results support the recommendation of surgical staging for non-endometrioid carcinomas as per the FIGO system, and suggest that CT may be useful in alerting the surgeon to the presence of PA LNM and omental dissemination.

While magnetic resonance imaging (MRI) is the imaging modality of choice for local staging, information about CT performance is clinically relevant due to the widespread availability and relative affordability of CT.¹³ Kinkel et al. identified substantial variations in CT performance for endometrial cancer staging, with sensitivities and specificities of 40–100 % and 75–100 %, respectively, for the assessment of MI, and 40–71 % and 100 %, respectively, for the assessment of LNM.

respectively, for the assessment of CSI.¹⁴ However, that meta-analysis was based on several small studies that relied on an older 1988 FIGO staging system and now outdated CT technology. Recently, Tsili et al. studied patients who underwent CT before resection of endometrial cancer but their study was limited by a small number of patients ($n = 21$) and also relied on the 1988 FIGO staging system.¹⁵

Our results are concordant with prior reports documenting low sensitivities and moderate to high specificities for both CT and MRI for preoperative detection of LNM in endometrial cancer.^{10,16–19} In studies from the 1980s and 1990s, the reported sensitivities and specificities of CT were 28–64 and 69–94 %, respectively.^{10,16–18} Similarly, a recent multicenter prospective study found MRI to have 59 % sensitivity and 93 % specificity for detecting LNM.¹⁹ The low sensitivities of both imaging modalities can be explained by their inability to identify LNM in the absence of abnormal nodal enlargement or other morphologic changes. 18F-fluorodeoxyglucose positron emission tomography/computed tomography (FDG-PET/CT) is superior to both CT and MRI, with somewhat higher sensitivities of 67–74 % and comparable specificities of 93–94 %.^{19,20} However, FDG-PET/CT still cannot identify metastases in lymph nodes that are smaller than 0.6 cm in the short-axis diameter.²¹

Non-endometrioid carcinomas, especially UPSC, share the tendency of ovarian epithelial carcinomas to spread over peritoneal surfaces.^{22,23} Based on the ovarian cancer literature, the depiction of peritoneal implants at imaging is influenced by their size and the presence of ascites (since ascites may obscure small tumor deposits). In the absence of ascites, both CT and MRI excel at detecting implants ≥ 2 cm, with reported sensitivities of 92 and 95 %, respectively.²⁴ On the other hand, the imaging diagnosis of small peritoneal implants remains a challenge. In the detection of implants less than or equal to 1 cm in size, sensitivity is only 25–50 %, but in the detection of peritoneal disease greater than 1 cm, sensitivity improves to 85–93 % and specificity is quite high at 91–96 %.^{25,26} Due to the retrospective nature of our study, accurate information regarding the size of omental implants was unavailable from the pathology records. Nonetheless, we found CT to have suboptimally low sensitivity for the detection of omental disease. However, almost all omental implants noted on CT were confirmed at the subsequent surgical exploration (PPV 1.00, 18/18 for R1; and 0.92, 12/13 for R2). In a small study of 30 patients with endometrial cancer, Suzuki et al. found that sensitivity for the detection of distant metastases was 83.3 % for FDG-PET but only 66.7 % for CT and MRI.²¹ As has been found with other malignancies, the sensitivity of FDG-PET/CT decreased with decreasing tumor size. Additional, larger studies are needed to accurately assess the added value of FDG-PET/CT for initial staging of endometrial cancer, including non-endometrioid carcinomas.

Our study had several limitations. First, this was a retrospective study of a patient cohort from a single institution accumulated over more than 10 years. We attempted to examine the potential effects of evolving CT technology on the diagnostic performance of CT by separately analyzing all studies acquired on the newer generation of scanners, but a large majority of patients (151/193) had their studies performed on newer scanners. The direct comparison of the diagnostic accuracy of CT studies performed on older versus newer scanners was not statistically meaningful as fewer than ten patients in the older scanner

subgroup had pathologically confirmed key imaging findings (such as deep MI or omental implants). Second, since 2008, both ovaries and fallopian tubes have been submitted in their entirety for pathology review and have been sectioned serially rather than in half. However, this change in tissue processing would not have any effect on the ability to detect disease outside of the adnexa. Third, although the majority of patients underwent omentectomy, a minority only had visual inspection of the omentum with or without omental biopsy. This situation parallels clinical practice across the gynecologic oncologic community, but it could potentially have led to overestimation of sensitivity and underestimation of specificity for the detection of omental dissemination at CT. Finally, we could not examine the influence of various surgical approaches (i.e. laparoscopy and robotic surgery vs. open laparotomy) for the detection of omental implants and rectosigmoid involvement because most patients underwent open surgery.

CONCLUSIONS

Compared with surgical exploration, preoperative CT is only moderately accurate for initial staging of patients with non-endometrioid carcinomas of the uterine corpus. However, CT may provide clinically valuable information by 'ruling-in' omental dissemination and isolated para-aortic LNM. Consequently, the information gleaned from preoperative CT may improve preoperative patient counseling, alter the extent of the surgical staging procedure, and facilitate appropriate planning for adjuvant or neoadjuvant therapy.

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TABLE 1Patient characteristics ($n = 193$)

Variable	Value
Age (years)	
Mean $\pm$ SD	67.2 $\pm$ 8.1
Range	49.0–85.9
2009 FIGO stage [n (%)]	
IA	84 (44)
IB	12 (6)
II	17 (9)
IIIA	5 (2.5)
IIIB	0 (0)
IIIC1	22 (11)
IIIC2	20 (10)
IVA	1 (0.5)
IVB	32 (17)
Histology [n (%)]	
Papillary serous	116 (60)
Clear cell	27 (14)
Carcinosarcoma	50 (26)
Days between CT and surgery	
Mean $\pm$ SD	11.9 $\pm$ 8.9
Range	0–36.0

CT computed tomography, FIGO International Federation of Gynecology and Obstetrics, SD standard deviation

TABLE 2

Surgical procedures

Variables	<i>n</i> (%)
All	193
Surgical procedures	
TH + BSO	193 (100)
Pelvic lymphadenectomy	189 (98)
Para-aortic lymphadenectomy	139 (72)
Omental biopsy	21 (11)
Omentectomy	149 (77)
Paracolic gutter biopsy or resection	31 (16)
Rectosigmoid colon biopsy or resection	32 (17)
Urinary bladder biopsy or resection	28 (15)
Right diaphragmatic/perihepatic biopsy or resection	32 (17)
Hepatic resection	2 (1)
Splenic resection	1 (0.5)
Gastrohepatic ligament biopsy or resection	3 (1.5)
Mesenteric biopsy or resection	13 (7)

BSO bilateral salpingo-oophorectomy, *TH* total hysterectomy

TABLE 3

Diagnostic accuracy of preoperative CT for the entire study cohort ($n = 193$)

Variable	Reader	Sensitivity [95 % CI; n]	Specificity [95 % CI; n]	PPV [95 % CI; n]	NPV [95 % CI; n]	AUC [95 % CI]
Deep myometrial invasion	1	0.79 [0.67–0.88; 52/66]	0.87 [0.79–0.92; 103/119]	0.76 [0.65–0.86; 52/68]	0.88 [0.81–0.93; 103/117]	NA
	2	0.64 [0.51–0.75; 42/66]	0.75 [0.67–0.83; 89/119]	0.55 [0.46–0.70; 42/72]	0.79 [0.70–0.86; 89/113]	NA
Cervical stromal invasion	1	0.56 [0.42–0.69; 32/57]	0.93 [0.87–0.97; 119/128]	0.78 [0.62–0.89; 32/41]	0.83 [0.75–0.88; 119/144]	NA
	2	0.63 [0.49–0.76; 36/57]	0.79 [0.71–0.85; 101/128]	0.57 [0.44–0.70; 36/63]	0.83 [0.75–0.89; 101/122]	NA
Corpus uteri serosal invasion	1	0.73 [0.39–0.94; 8/11]	0.93 [0.88–0.96; 161/174]	0.38 [0.18–0.62; 8/21]	0.98 [0.95–1.00; 161/164]	NA
	2	0.36 [0.11–0.69; 4/11]	0.95 [0.91–0.98; 166/174]	0.33 [0.10–0.65; 4/12]	0.96 [0.92–0.98; 166/173]	NA
Adnexal involvement	1	0.46 [0.31–0.63; 19/41]	1.00 [0.98–1.00; 152/152]	1.00 [0.82–1.00; 19/19]	0.87 [0.81–0.92; 152/173]	0.77 [0.69–0.85]
	2	0.51 [0.35–0.67; 21/41]	0.95 [0.91–0.98; 145/152]	0.75 [0.55–0.89; 21/28]	0.88 [0.82–0.92; 145/165]	0.85 [0.77–0.92]
Pelvic adenopathy	1	0.52 [0.38–0.65; 29/56]	0.95 [0.89–0.98; 126/133]	0.81 [0.64–0.92; 29/36]	0.82 [0.75–0.88; 126/153]	0.76 [0.69–0.83]
	2	0.45 [0.31–0.59; 25/56]	0.93 [0.88–0.97; 124/133]	0.74 [0.56–0.87; 25/34]	0.80 [0.73–0.86; 124/155]	0.75 [0.68–0.83]
Para-aortic adenopathy	1	0.45 [0.28–0.64; 15/33]	0.98 [0.94–1.00; 104/106]	0.88 [0.64–0.99; 15/17]	0.85 [0.78–0.91; 104/122]	0.78 [0.69–0.86]
	2	0.30 [0.16–0.49; 10/33]	0.98 [0.93–1.00; 104/106]	0.83 [0.52–0.98; 10/12]	0.82 [0.74–0.88; 104/127]	0.73 [0.63–0.82]
Ascites	1	0.55 [0.36–0.74; 16/29]	0.95 [0.91–0.98; 156/164]	0.67 [0.45–0.84; 16/24]	0.92 [0.87–0.96; 156/169]	NA
	2	0.48 [0.29–0.67; 14/29]	0.93 [0.88–0.97; 153/164]	0.56 [0.35–0.76; 14/25]	0.91 [0.86–0.95; 153/168]	NA
Omental implants	1	0.64 [0.44–0.81; 18/28]	1.00 [0.97–1.00; 142/142]	1.00 [0.81–1.00; 18/18]	0.93 [0.88–0.97; 142/152]	0.85 [0.77–0.94]
	2	0.43 [0.24–0.63; 12/28]	0.99 [0.96–1.00; 141/142]	0.92 [0.64–1.00; 12/13]	0.90 [0.84–0.94; 141/157]	0.73 [0.63–0.82]
Rectosigmoid involvement	1	0.26 [0.09–0.51; 5/19]	1.00 [0.80–1.00; 17/17]	1.00 [0.48–1.00; 5/5]	0.55 [0.36–0.73; 17/31]	0.68 [0.57–0.80]
	2	0.32 [0.13–0.57; 6/19]	1.00 [0.80–1.00; 17/17]	1.00 [0.54–1.00; 6/6]	0.57 [0.37–0.75; 17/30]	0.83 [0.71–0.85]

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AUC area under the curve, *CI* confidence interval, *CT* computed tomography, *NA* not applicable, *NPV* negative predictive value, *PPV* positive predictive value

TABLE 4

Diagnostic accuracy of preoperative CT utilizing the newer generation of CT scanners ($n = 151$)

Variable	Reader	Sensitivity [95 % CI; n]	Specificity [95 % CI; n]	PPV [95 % CI; n]	NPV [95 % CI; n]	AUC [95 % CI]
Deep myometrial invasion	1	0.82 [0.69–0.91; 45/55]	0.86 [0.77–0.92; 77/90]	0.78 [0.65–0.87; 45/58]	0.89 [0.8–0.94; 77/87]	NA
	2	0.62 [0.48–0.75; 34/55]	0.71 [0.61–0.8; 64/90]	0.57 [0.43–0.69; 34/60]	0.75 [0.65–0.84; 64/85]	NA
Cervical stromal invasion	1	0.57 [0.41–0.72; 24/42]	0.93 [0.860.97; 96/103]	0.77 [0.59–0.9; 24/31]	0.84 [0.76–0.9; 96/114]	NA
	2	0.64 [0.48–0.78; 27/42]	0.76 [0.660.84; 78/103]	0.52 [0.38–0.66; 27/52]	0.84 [0.75–0.91; 78/93]	NA
Corpus uteri serosal invasion	1	0.73 [0.39–0.94; 8/11]	0.91 [0.850.95; 122/134]	0.4 [0.19–0.64; 8/20]	0.98 [0.93–1; 122/125]	NA
	2	0.36 [0.11–0.69; 4/11]	0.95 [0.9–0.98; 127/134]	0.36 [0.11–0.69; 4/11]	0.95 [0.9–0.98; 127/134]	NA
Adnexal involvement	1	0.45 [0.28–0.64; 15/33]	1.00 [0.97–1.00; 118/118]	1.00 [0.78–1.00; 15/15]	0.87 [0.8–0.92; 118/136]	0.75 [0.66–0.84]
	2	0.52 [0.34–0.69; 17/33]	0.94 [0.88–0.98; 111/118]	0.71 [0.49–0.87; 17/24]	0.87 [0.8–0.93; 111/127]	0.82 [0.73–0.91]
Pelvic adenopathy	1	0.55 [0.39–0.7; 24/44]	0.95 [0.89–0.98; 100/105]	0.83 [0.64–0.94; 24/29]	0.83 [0.75–0.9; 100/120]	0.78 [0.7–0.85]
	2	0.45 [0.3–0.61; 20/44]	0.93 [0.87–0.97; 98/105]	0.74 [0.54–0.89; 20/27]	0.8 [0.72–0.87; 98/122]	0.77 [0.68–0.85]
Para-aortic adenopathy	1	0.57 [0.34–0.77; 13/23]	0.99 [0.93–1; 79/80]	0.93 [0.66–1; 13/14]	0.89 [0.8–0.94; 79/89]	0.82 [0.71–0.92]
	2	0.39 [0.2–0.61; 9/23]	1.00 [0.95–1.00; 80/80]	1.00 [0.66–1.00; 9/9]	0.85 [0.76–0.92; 80/94]	0.78 [0.67–0.89]
Ascites	1	0.52 [0.31–0.73; 12/23]	0.94 [0.88–0.97; 120/128]	0.60 [0.36–0.81; 12/20]	0.92 [0.85–0.96; 120/131]	NA
	2	0.52 [0.31–0.73; 12/23]	0.93 [0.87–0.97; 119/128]	0.57 [0.34–0.78; 12/21]	0.92 [0.85–0.96; 119/130]	NA
Omental implants	1	0.65 [0.43–0.84; 15/23]	1.00 [0.97–1.00; 112/112]	1.00 [0.78–1.00; 15/15]	0.93 [0.87–0.97; 112/120]	0.85 [0.75–0.94]
	2	0.39 [0.2–0.61; 9/23]	0.99 [0.95–1; 111/112]	0.9 [0.55–1; 9/10]	0.89 [0.82–0.94; 111/125]	0.69 [0.59–0.79]
Rectosigmoid involvement	1	0.24 [0.07–0.5; 4/17]	1.00 [0.75–1.00; 13/13]	1.00 [0.40–1.00; 4/4]	0.50 [0.3–0.7; 13/26]	0.68 [0.56–0.79]
	2	0.29 [0.1–0.56; 5/17]	1.00 [0.75–1.00; 13/13]	1.00 [0.48–1.00; 5/5]	0.52 [0.31–0.72; 13/25]	0.80 [0.67–0.94]

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AUC area under the curve, *CI* confidence interval, *CT* computed tomography, *NA* not applicable, *NPV* negative predictive value, *PPV* positive predictive value

TABLE 5Inter-observer agreement for the entire cohort ($n = 193$)

Variables	Simple Kappa	Standard error	Interpretation
Deep myometrial invasion	0.42	0.06	Moderate
Cervical stromal invasion	0.61	0.06	Substantial
Corpus uteri serosal invasion	0.44	0.11	Moderate
Weighted Kappa			
Adnexal invasion	0.64	0.06	Substantial
Pelvic adenopathy	0.86	0.04	Almost perfect
Para-aortic adenopathy	0.88	0.08	Almost perfect
Ascites	0.74	0.07	Substantial
Omental implants	0.73	0.07	Substantial
Rectosigmoid involvement	0.61	0.16	Substantial