

Local staging of colon cancer: the current role of CT

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Learning objectives

To illustrate the role of CT in preoperative local staging of colon cancer, emphasizing the imaging findings with prognostic value (invasion beyond the bowel wall and nodal involvement).

Background

Colorectal carcinoma is a common malignancy in developed countries, with significant morbidity and mortality, which translates into 5-year relative survival rates around 54% in Western Europe and 34% in Eastern Europe.

Although much of the literature does not differentiate colon from rectal cancer, these are two different entities in terms of diagnostic workup and treatment. Patients with rectal cancer are locally staged with MRI, and patients with high-risk tumors receive neoadjuvant chemoradiotherapy before surgery. On the other hand, CT has been the preferred method of imaging for local staging of colon cancer but, unlike rectal cancer, imaging staging has not been used to stratify patients into different risk groups, and no neoadjuvant treatment is currently being used.

CT staging of colon carcinoma is usually performed using the TNM system, in which the "T stage" refers to identification of the tumor and stratification on the basis of the existence of infiltration into the different layers of the colonic wall and surrounding structures: T1 - invasion of the submucosa, T2 - invasion of the muscularis propria, T3 - invasion through the muscularis propria into the pericolorectal tissues (T3ab when tumor invasion beyond the bowel wall is 5 mm or less and T3cd when greater than 5 mm) and T4 - penetration into visceral peritoneal surface (T4a) or invasion of other organs or structures (T4b) (Fig.1).

Besides primary tumor staging, CT is also used to evaluate the involvement of regional lymph nodes (N stage). The most commonly used criteria for describing a lymph node as suspicious is size, and a 10 mm (long axis) cut-off, despite fallible, is usually used. Other features that suggest metastatic nodal disease is the presence of a cluster of 3 or more nodes, nodal enhancement greater than 100 HU, irregular margins and heterogeneous structure. Finally, CT is also used to evaluate the presence of distant metastases (M stage).

Images for this section:

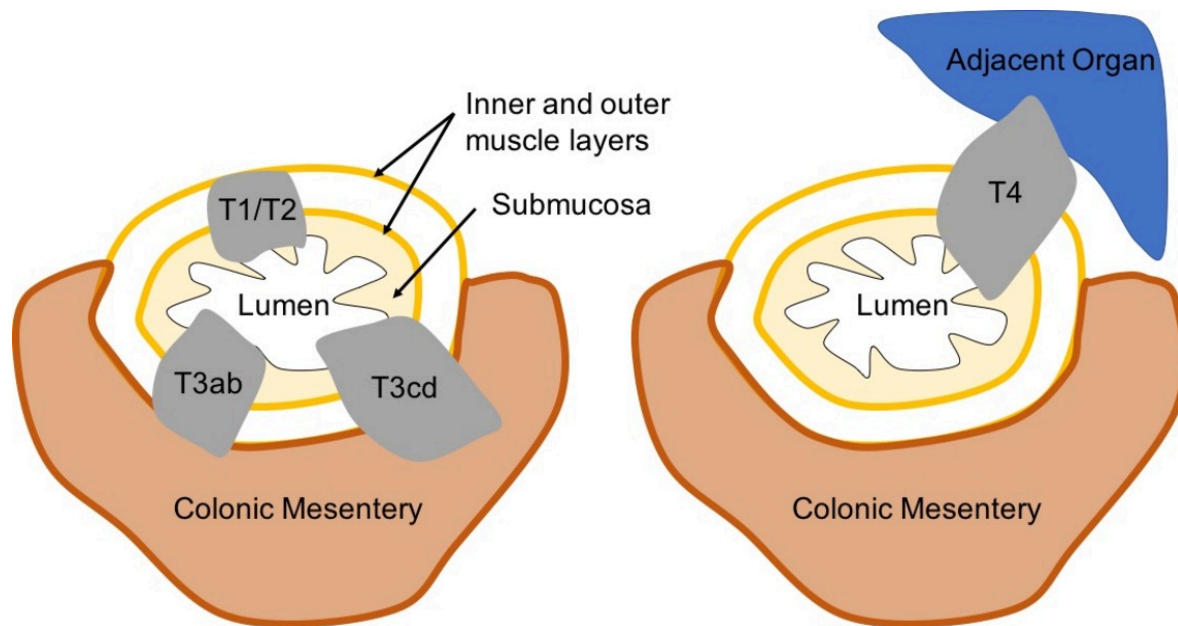


Fig. 1: Schematic images of T staging (adapted from Nerad et al, November 2016.)

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Findings and procedure details

As stated before, imaging staging of colonic cancer has not been used to classify patients in different risk groups, being performed mainly to determine resectability (on the basis of tumor ingrowth through the bowel wall and into surrounding fat, recognized by the existence of fat stranding and spiculation) (Fig. 2).

However, a recent large trial (FOxTROT) is testing the hypothesis that tumor invasion of 5 mm or greater beyond the bowel wall, perforation and invasion of adjacent organs (T stages T3cd-T4) represent high-risk tumors, and these patients might benefit from neoadjuvant chemotherapy prior to surgery.

The results of a recent meta-analysis performed in 2016 suggest that this stratification could be obtained by CT imaging, reporting summary estimates of 90% sensitivity and 69% specificity in the detection tumor invasion beyond the bowel wall (T1-T2 vs T3-T4) (Fig. 3,4,5,6).

These results were even better when using thin slices (< 5 mm), improving summary estimates to 96% and 70%, respectively. However, the sensitivity and specificity of CT in the differentiation of T1-T3ab from T3cd-T4 tumors was lower (77% and 70%, respectively), probably due to the inability of CT to differentiate between desmoplastic and neoplastic pericolonic fat infiltration, resulting in false-positive cases. These results, plus the fact that 93% of the patients with T3ab tumors (less than 5mm extramural extension) had pathological features indicating a requirement for chemotherapy, led to the need of changing the inclusion criteria for the FOxTROT study, more recently including patients with T3 stage tumors and above.

Evaluation of nodal involvement also showed suboptimal results (sensitivity and specificity of 71% and 67%, respectively). This is largely explained by the fact that lymph node size is not a reliable indicator (micrometastases are unable to be detected by CT) and other lymph node features should be taken into consideration. In fact, the best results described in the literature for N+ staging (sensitivity and specificity of 91% and 68%, respectively) were obtained using the nodal enhancement greater than 100 HU criterion alone (Fig. 7).

Similarly to the evaluation of tumor invasion beyond the bowel wall, the use of thin slices improved the detection of malignant lymph nodes, increasing sensitivity and specificity to 78% and 68%, respectively.

Images for this section:

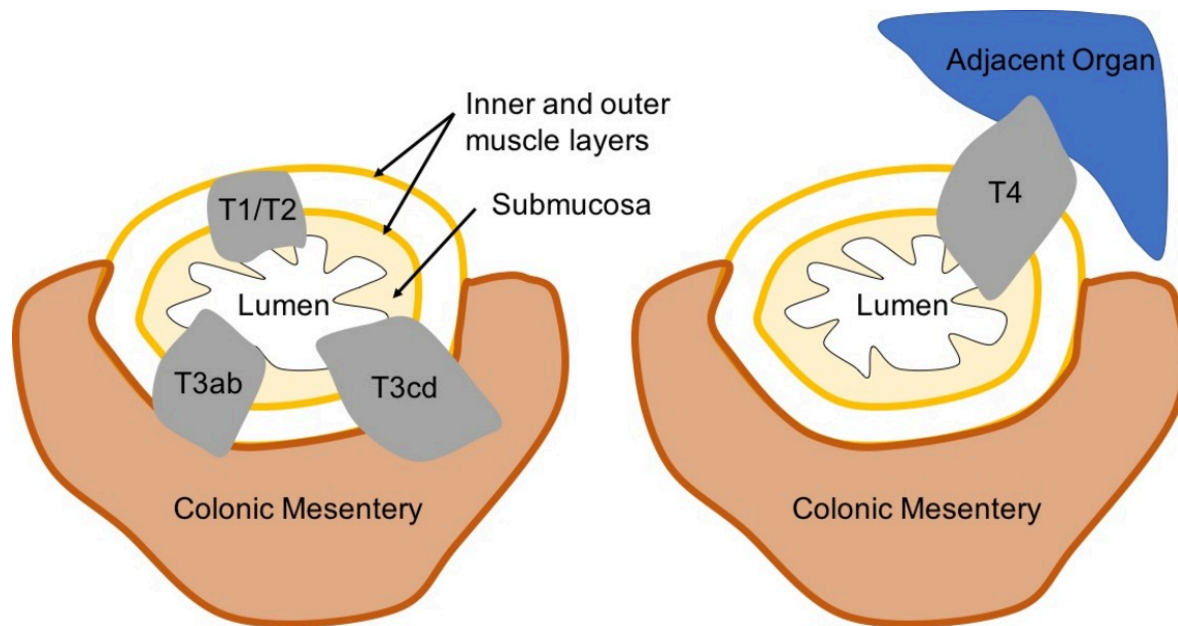


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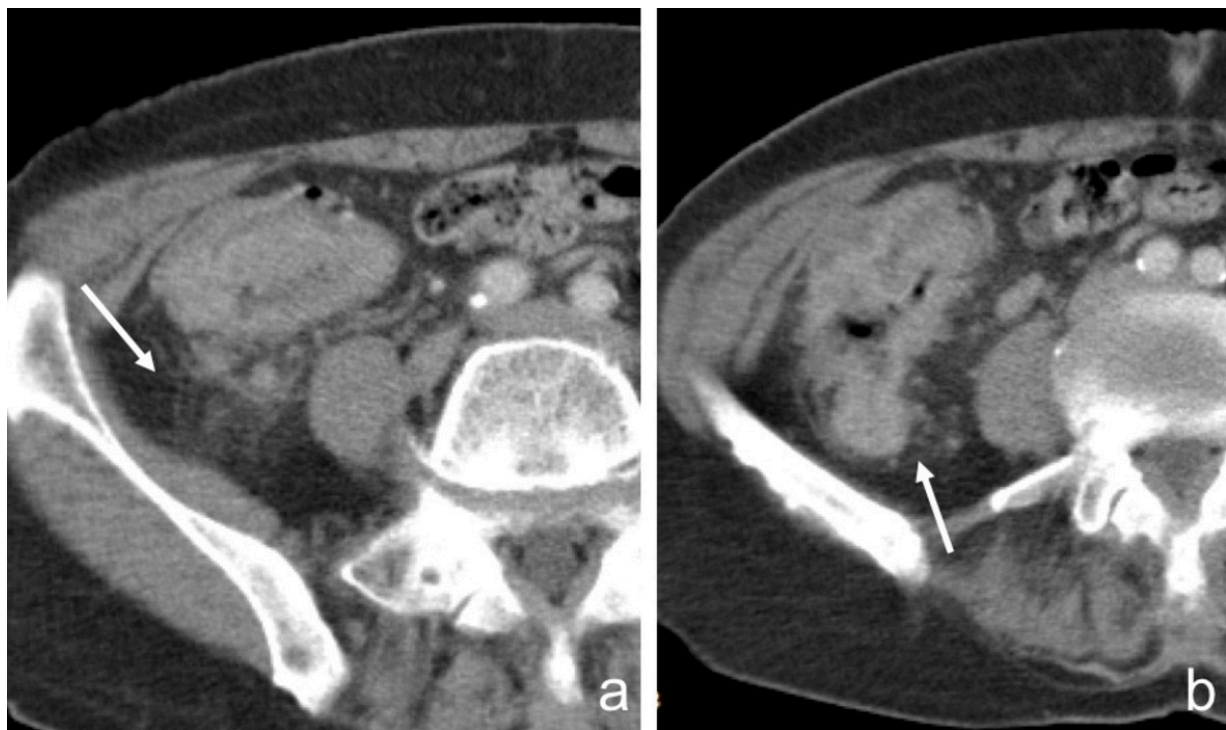


Fig. 2: Axial CT images after contrast administration (portal venous phase) showing a T3 cecal tumor with spread beyond the bowel wall (arrows).

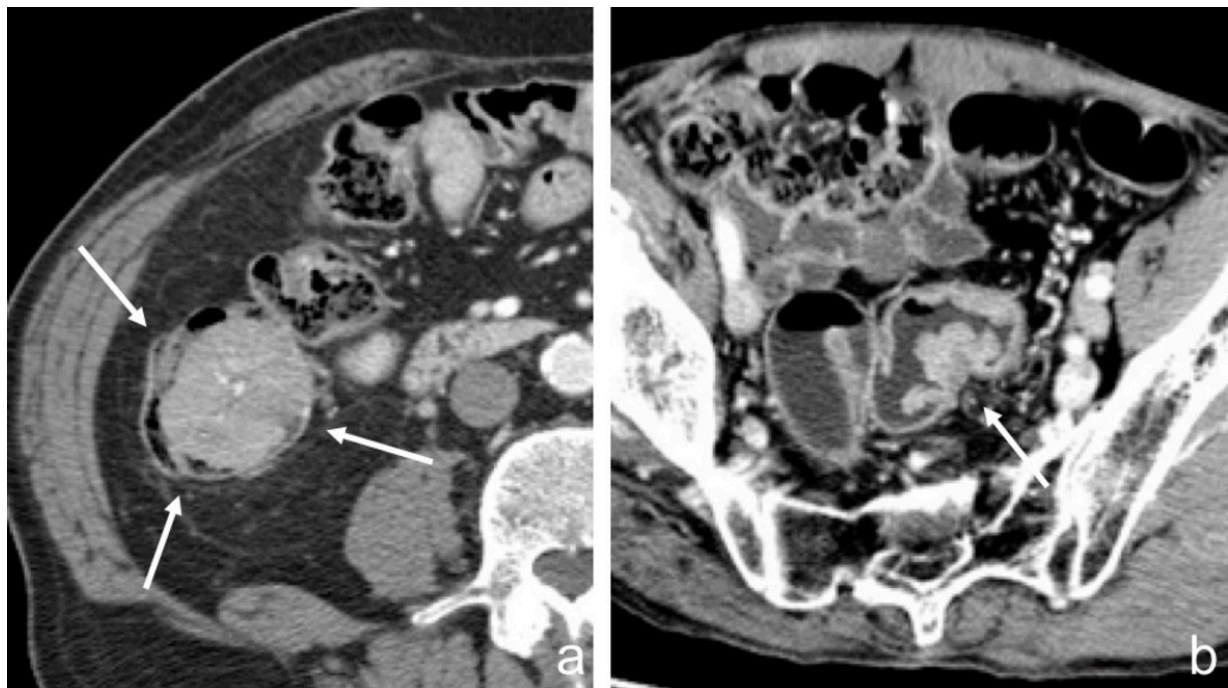


Fig. 3: Axial CT images after contrast administration (portal venous phase) showing T2 tumors (arrows) that do not invade beyond the bowel wall.

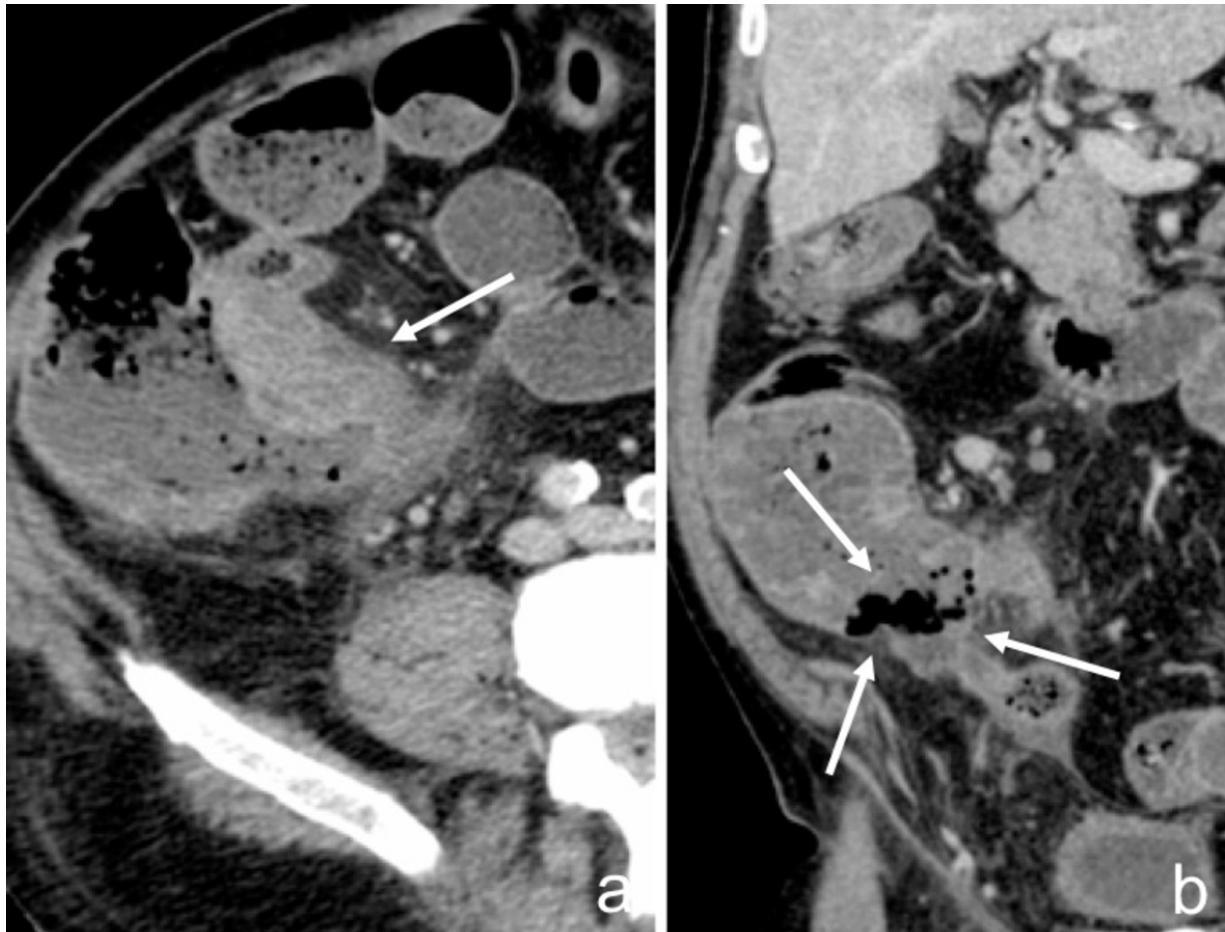


Fig. 4: Axial (a) and coronal (b) CT images after contrast administration (portal venous phase) showing a perforated T4 tumor with thickening of the wall of the caecum and an adjacent fluid-gas collection (arrows).

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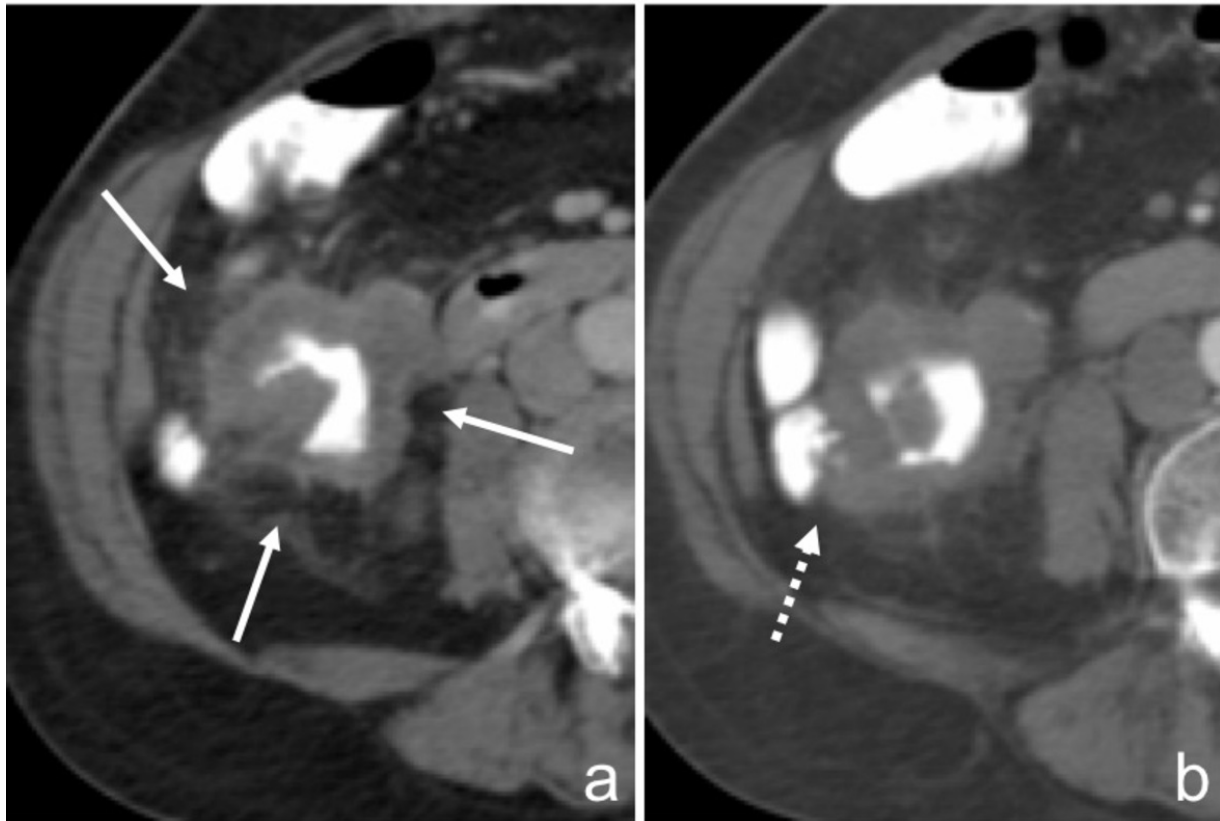


Fig. 5: Axial CT images after rectal and IV contrast administration (portal venous phase) showing a T4 tumor of the ascending colon with invasion of an adjacent small bowel loop (stippled arrow). Fat stranding around the tumor (arrows) translates into invasion beyond the bowel wall.

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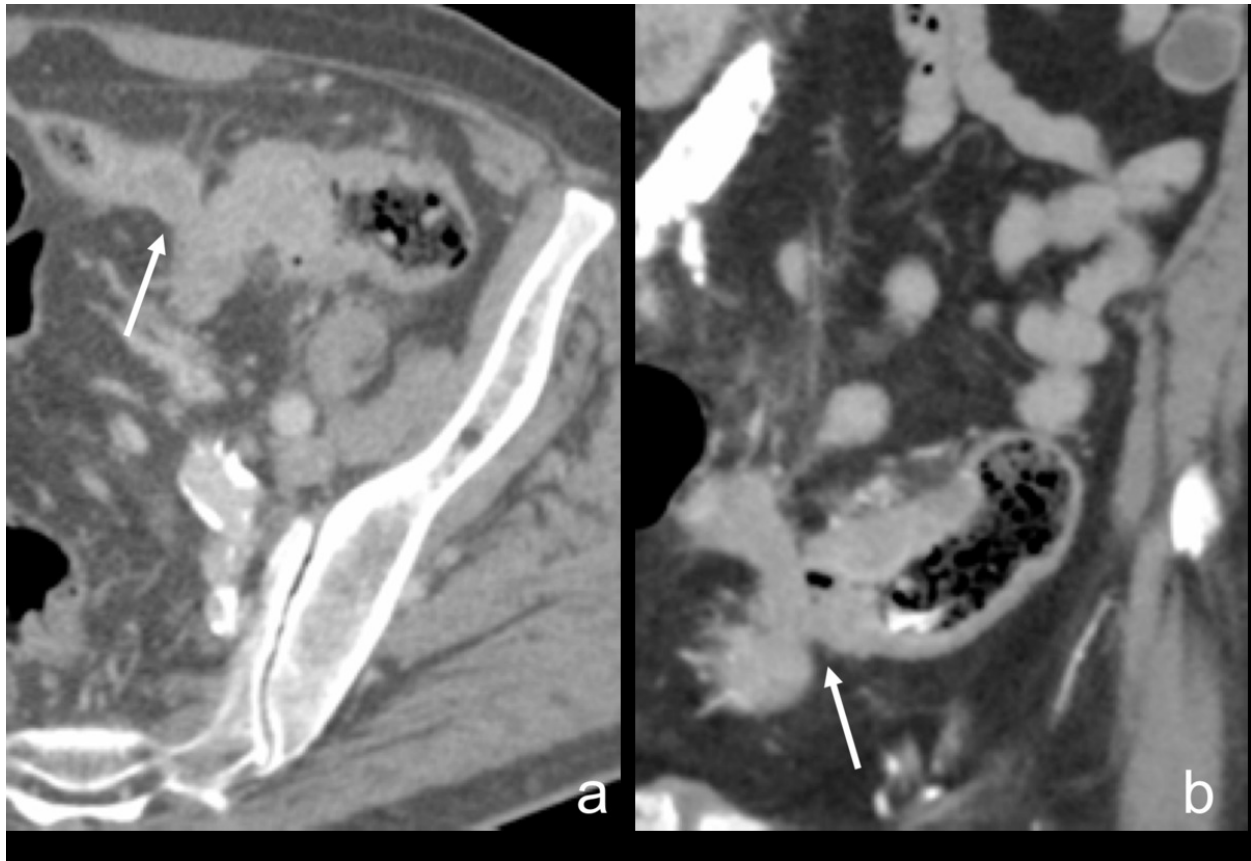


Fig. 6: Axial (a) and coronal (b) CT images after contrast administration (portal venous phase) showing a histology-proven T4b tumor, invading a small bowel loop.

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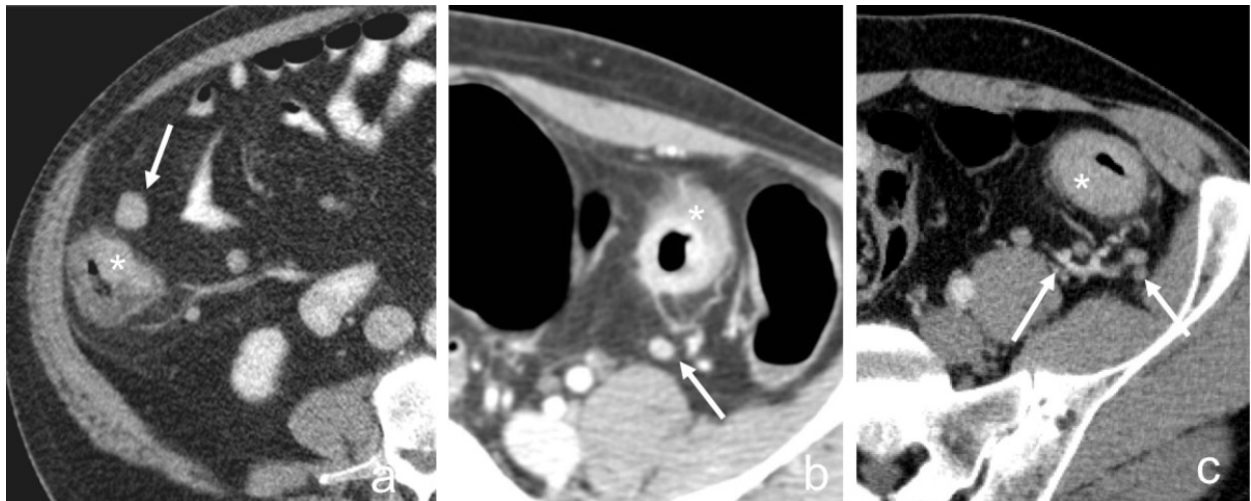


Fig. 7: Axial CT images after IV contrast administration (portal venous phase). (a) Circumferential thickening of the ascending colon (*), with an enlarged rounded lymph node, confirmed as malignant after histopathological examination. (b) Descending colon

tumor (*) with an adjacent small lymph node, with avid enhancement, confirmed to be malignant on pathology. (c) Multiple malignant small lymph nodes (arrows) are seen near a descending colon tumor (*).

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Conclusion

CT has some limitations in T (particularly in the differentiation of T3ab from T3cd-T4 tumors) and N staging of colon cancer.

CT has a high sensitivity for the detection of tumor invasion beyond the bowel wall (T1-2 vs T3-4), but overstaging still occurs in almost one-third of the patients. This fact can have considerable clinical impact in the future if neoadjuvant treatment is used in radiologically characterized high-risk colon tumors, unnecessarily exposing these patients to the side effects of chemotherapy. The use of thin slices has been proved to improve the detection of extra-mural spread (as well as the detection of malignant lymph nodes) and is therefore recommended.

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