

Multimodal Ultrasound Phenotyping of Anorectal Dysfunction and Pelvic Floor Instability in Patients with Colorectal Tumors

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Hypothesis / aims of study

We hypothesized that anorectal dysfunction in colorectal cancer represents a multisystem disorder involving bowel motility, pelvic floor biomechanics, and lower urinary tract interaction.

The aim was to evaluate whether multimodal ultrasound (US), including standardized assessment of bladder neck mobility (BNM), enables integrated functional phenotyping and correlates with symptom dynamics and treatment response.

Study design, materials and methods

Prospective observational case series (n=6) with colorectal tumors (rectal, rectosigmoid, sigmoid, hepatic flexure). Multimodal US protocol included: - Intestinal assessment: wall thickness, tumor morphology, luminal patency, intraluminal fluid dynamics, peristalsis - Identification of functional obstruction (constipation-ileus spectrum), bowel dilation, and gastrostasis; - Pelvic US with dynamic BNM measurement during straining, performed according to a standardized method previously described in ICS studies [1-3] - Evaluation of tumor compression, pelvic organ invasion (bladder, prostate, cervix, ureters), and complications Serial US was used for monitoring during chemotherapy and supportive interventions, including dietary and microbiome-oriented strategies.

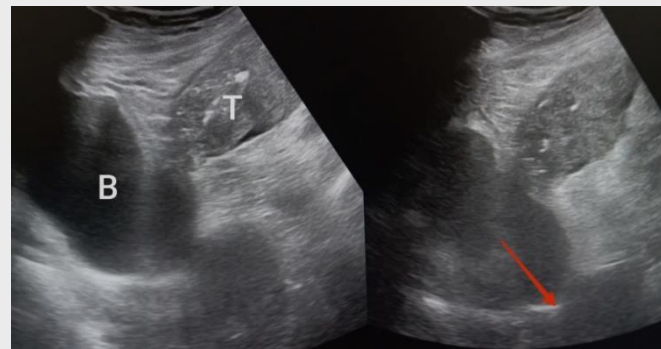


Fig 1. Bladder (B) neck hypermobility with focal fixation in sigmoid tumor (T) invasion (dual-panel dynamic ultrasound). Left: Fixed contact between sigmoid tumor and bladder. Right (Valsalva): bladder neck descent, tumor-bladder interface remains immobile.

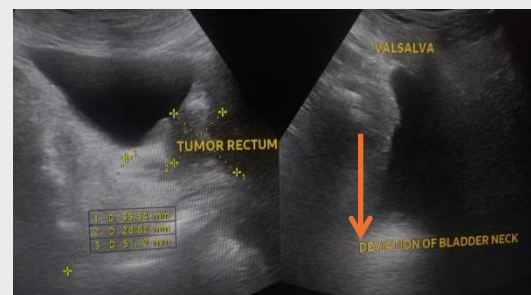


Fig 2. Dynamic transabdominal ultrasound in a 67-year-old man with upper rectal adenocarcinoma invading the bladder wall. At rest, tumor infiltration distorts the rectovesical interface. During Valsalva maneuver, marked bladder neck displacement (60 mm) demonstrates pelvic floor instability.

Results

All patients demonstrated a combined anorectal and pelvic floor dysfunction phenotype: BNM was markedly increased (70-100 mm) in all cases and strongly correlated with symptom severity (incontinence, urgency, instability). Periods of clinical improvement corresponded to reduced BNM (40-60 mm). A functional obstruction spectrum was observed, including constipation and ileus-like states with loop dilation (up to 30 mm), impaired peristalsis, and gastrostasis. In selected cases, preserved luminal patency with bidirectional fluid movement within tumor segments indicated partial functional continuity. Tumor compression and invasion of adjacent pelvic organs contributed to combined anorectal and urinary dysfunction. Chemotherapy-related effects included motility alterations (diarrhea vs hypomotility) and features of neuromuscular/autonomic impairment. Dietary modulation and microbiome-oriented approaches (including probiotics) were associated with stabilization of bowel transit and reduction of ileus-like episodes in selected cases.

In addition to bowel abnormalities, multimodal ultrasound identified tumor-related distortion of pelvic support structures, including bladder wall traction/invasion, ureteral compression, and altered pelvic organ dynamics. Dynamic imaging demonstrated excessive pelvic floor excursion during straining, supporting the concept of pelvic floor instability as a contributor to symptom generation.

Interpretation of results

These findings support a multilevel model of anorectal dysfunction integrating: 1. Mechanical factors (tumor mass, compression, invasion) 2. Motility disturbances (constipation-ileus-diarrhea spectrum, gastrostasis) 3. Neuromuscular impairment (pelvic floor weakness, increased BNM) 4. Systemic/autonomic influences (chemotherapy, neuropathy, inflammation, microbiome alterations) Bladder neck mobility, measured using a standardized ultrasound approach, represents a reproducible dynamic biomarker of pelvic floor instability and treatment response. Multimodal US enables real-time assessment of these interacting mechanisms, bridging bowel and lower urinary tract dysfunction.

Concluding message

Anorectal dysfunction in colorectal cancer should be considered a multisystem functional syndrome rather than isolated sphincter pathology. Multimodal ultrasound, integrating bowel function and pelvic floor dynamics, provides a novel tool for real-time functional phenotyping. Incorporation of dynamic biomarkers such as standardized BNM assessment and bowel motility parameters may improve personalized management, monitoring, and interdisciplinary care, including dietary and microbiome-targeted interventions.

References

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