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Review Article

Artificial intelligence in jejunal diverticulosis: emerging applications in imaging recognition, risk stratification and surgical decision support

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ABSTRACT

Jejunal diverticulosis is a rare small-bowel disorder that is frequently under-recognized and may present with severe complications including diverticulitis, perforation, haemorrhage, and intestinal obstruction. Diagnosis relies primarily on cross-sectional imaging, particularly computed tomography (CT) and CT enterography, yet diverticula are often overlooked due to their subtle appearance and the rarity of the disease. In parallel, artificial intelligence (AI) has rapidly advanced across gastrointestinal imaging and clinical decision support, offering new opportunities for automated lesion detection, imaging phenotyping, and risk prediction. Aim of the study was to review current and emerging applications of artificial intelligence relevant to jejunal diverticulosis, with emphasis on imaging recognition, complication risk stratification, and surgical decision support. A structured narrative review was conducted using a literature search informed by the PRISMA framework. Electronic databases including PubMed/MEDLINE, Scopus, and Google Scholar were searched for studies published between January 2000 and February 2026. Search terms included combinations of "jejunal diverticulosis," "small bowel diverticula," "artificial intelligence," "machine learning," "deep learning," "capsule endoscopy," "CT enterography," and "diverticulitis." Studies describing AI applications in capsule endoscopy, cross-sectional small-bowel imaging, diverticular disease, and surgical decision support were included. Findings were synthesized narratively due to heterogeneity in study design and methodologies. AI has demonstrated high diagnostic accuracy in gastrointestinal imaging, particularly in capsule endoscopy where convolutional neural networks can detect small-bowel lesions, including diverticula, with very high sensitivity and specificity. In cross-sectional imaging, machine-learning and radiomics models applied to CT enterography can identify and quantify small-bowel pathology and predict clinically relevant outcomes. AI applications in colonic diverticulitis and acute abdominal CT have shown promising performance in differentiating disease entities, predicting complications, and guiding clinical triage. These advances provide a methodological foundation for applying AI to jejunal diverticulosis. Potential applications include automated detection of jejunal diverticula on CT or CT enterography, multimodal risk stratification models integrating clinical and imaging data, and AI-assisted decision support for conservative versus surgical management. Although AI models specifically targeting jejunal diverticulosis have not yet been reported, advances in gastrointestinal imaging analytics and clinical prediction models suggest substantial potential for future development. Multi-institutional data sharing, standardized imaging annotation, and prospective validation studies will be essential to develop reliable AI tools capable of improving early detection, risk assessment, and surgical decision-making in this rare but clinically significant condition.

Keywords: Jejunal diverticulosis, Artificial intelligence, Machine learning, Capsule endoscopy, CT enterography, Small bowel imaging, Diverticulitis, Risk stratification, Surgical decision support, Radiomics

INTRODUCTION

Small-bowel diverticulosis, excluding Meckel's diverticulum, is an uncommon clinical condition characterized by the presence of mucosal outpouchings along the small intestine.[1] Radiographic studies estimate its prevalence to be approximately 1–2% on small-bowel contrast examinations, with the majority of diverticula occurring in the jejunum. The condition predominantly affects older adults and is believed to result from pulsion-type herniation of the mucosa and submucosa through weak points in the muscularis propria, particularly along the mesenteric border where the vasa recta penetrate the bowel wall. Because these outpouchings lack a full muscular layer, they are considered false diverticula. In many patients, jejunal diverticulosis remains clinically silent and is often discovered incidentally during imaging or surgical exploration. However, a significant proportion of individuals develop complications over time, and several case series suggest that up to 30–40% of diagnoses are made only after the onset of complications (Figure 1).[2]

The clinical presentation of jejunal diverticulosis is variable and may range from asymptomatic disease to severe acute abdominal conditions. Reported complications include jejunal diverticulitis with localized inflammation or phlegmon, perforation leading to localized abscess or generalized peritonitis, gastrointestinal haemorrhage presenting as obscure small-bowel bleeding, and small-bowel obstruction caused by enterolith formation, inflammatory strictures, or adhesions associated with diverticular segments. Chronic stasis within diverticula may also predispose to small-bowel bacterial overgrowth, resulting in malabsorption, anaemia, abdominal bloating, and nonspecific gastrointestinal symptoms. Despite these potentially serious outcomes, jejunal diverticulosis frequently remains under-recognized in clinical practice because presenting symptoms are often vague and may mimic more common abdominal disorders such as peptic ulcer disease, appendicitis, pancreatitis, colonic diverticulitis, or inflammatory bowel disease.[3,4] Table 1 represents clinical presentations and complications of jejunal diverticula. Figure 1 shows a resected specimen of complicated perforated jejunal diverticula.

Despite rapid advances in artificial intelligence in gastrointestinal imaging, no disease-specific AI models exist for jejunal diverticulosis. This represents a critical gap, particularly given the condition's diagnostic difficulty and risk of severe complications. The present review addresses this unmet need by synthesizing transferable AI methodologies and identifying pathways for disease-specific model development.

Table 1: Clinical presentation and complications of jejunal diverticulosis.

Feature category	Typical manifestations	Notes
Asymptomatic disease	Incidental finding on imaging or surgery	Up to 40% of patients may be asymptomatic; often discovered after complication.
Acute diverticulitis	Localized abdominal pain, low-grade fever, leukocytosis; may mimic appendicitis, cholecystitis, or colonic diverticulitis	Often centered in mid-abdomen; CT shows focal wall thickening and fat stranding.
Perforation	Signs of peritonitis: sudden severe pain, guarding, rebound tenderness; pneumoperitoneum on imaging	Perforation may be contained (abscess) or free, with varying management implications.
Hemorrhage	Acute or occult GI bleeding; melena, hematochezia, or iron-deficiency anemia	Jejunal diverticula can harbor angioectasia or ulcerated mucosa.
Small-bowel obstruction	Intermittent or acute obstructive symptoms; sometimes due to enteroliths in diverticula	CT may show dilated small bowel, transition point, and intraluminal stone originating from diverticulum.
Malabsorption/SIBO	Chronic abdominal discomfort, bloating, diarrhea, weight loss	Stasis in diverticular segments can promote bacterial overgrowth.

With advances in imaging technology, cross-sectional imaging has become central to the diagnosis of jejunal diverticulosis and its complications. Contrast-enhanced computed tomography (CT) is the most commonly utilized modality in the evaluation of acute abdominal pain, while CT enterography and magnetic resonance enterography provide improved visualization of small-bowel anatomy in chronic or subacute cases. On CT, jejunal diverticula typically appear as round or ovoid gas-, fluid-, or contrast-filled outpouchings arising from the mesenteric border of the jejunum. Complicated cases may demonstrate associated findings such as bowel wall thickening, surrounding mesenteric fat stranding, abscess formation, pneumoperitoneum, or small-bowel obstruction. Nevertheless, these features can be subtle, and diverticula are frequently overlooked on routine imaging interpretation, particularly when attention is directed toward more common causes of acute abdomen.[5]

In recent years, artificial intelligence (AI) has emerged as a powerful tool in gastrointestinal imaging and clinical decision support. Advances in machine learning and deep learning have enabled automated detection of lesions in capsule endoscopy, quantitative analysis of small-bowel pathology on CT enterography, and predictive modelling of disease outcomes in conditions such as diverticulitis and small-bowel obstruction. These developments provide a methodological foundation for applying AI to jejunal diverticulosis. AI-assisted imaging analysis could improve detection of diverticula, facilitate early identification of complications, and support risk stratification and surgical decision-making by integrating imaging findings with clinical data.[6]

This narrative review aims to examine the emerging role of artificial intelligence in the detection, risk stratification, and management of jejunal diverticulosis, and to highlight future research directions for integrating AI-based tools into clinical practice.

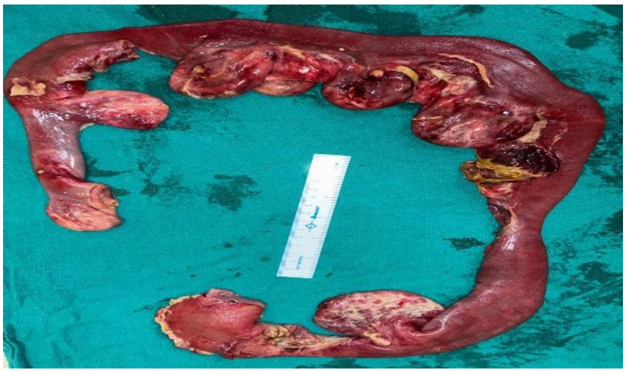

Figure 1: Resected specimen of complicated perforated jejunal diverticula.

METHODS

This narrative review was conducted using a structured literature search to identify and synthesize published evidence on AI applications relevant to jejunal diverticulosis. The objective was to provide a comprehensive overview of current evidence on AI-assisted gastrointestinal imaging, small-bowel pathology, diverticular disease, and surgical decision support, with particular emphasis on concepts that could be translated to the diagnosis, risk stratification, and management of jejunal diverticulosis. Given the paucity of disease-specific literature, evidence from related gastrointestinal disorders was included where it provided methodological or clinical insights applicable to jejunal diverticulosis.

A comprehensive literature search was performed using the electronic databases PubMed/MEDLINE, Scopus, and Google Scholar for studies published between January 2000 and February 2026. The search strategy incorporated combinations of keywords and Medical Subject Headings (MeSH) related to jejunal diverticulosis and AI in gastrointestinal imaging. Representative search terms included "jejunal diverticulosis," "jejunal diverticulitis," "small bowel diverticula," "artificial intelligence," "machine learning," "deep learning," "convolutional neural network," "capsule endoscopy," "CT enterography," "small bowel imaging," "radiomics," "diverticulitis," and "clinical decision support." Boolean operators ("AND" and "OR") were used to combine search terms appropriately, and the reference lists of eligible articles were manually reviewed to identify additional relevant publications.

Original research articles, clinical studies, imaging studies, systematic and narrative reviews, and selected landmark case series published in English were considered for inclusion. Studies describing AI applications in capsule endoscopy, CT enterography, cross-sectional abdominal imaging, diverticular disease, inflammatory bowel disease, and surgical decision support were preferentially included when they provided concepts or methodologies relevant to jejunal diverticulosis. Conference abstracts without sufficient methodological details, duplicate publications, non-English articles, and studies lacking relevance to the review objectives were excluded.

The identified literature was critically appraised and synthesized qualitatively. Owing to the rarity of jejunal diverticulosis and the absence of AI models specifically developed for this condition, the review adopts a translational approach by integrating evidence from related gastrointestinal diseases to discuss current capabilities, potential clinical applications, methodological challenges, and future research directions for AI-assisted diagnosis and management of jejunal diverticulosis.

CRITICAL APPRAISAL OF INCLUDED EVIDENCE

Although formal risk-of-bias assessment tools are typically applied in systematic reviews, a structured critical appraisal of the included studies was undertaken during synthesis.

Given the narrative nature of this review and the heterogeneity of the available literature, a structured critical appraisal of the included studies was undertaken to contextualize the strength and limitations of current evidence. Several important methodological concerns were identified across the reviewed studies.

First, dataset size limitations represent a significant constraint. Many AI studies in gastrointestinal imaging, particularly those relevant to small-bowel pathology, are based on relatively small or single-center datasets. This is especially pertinent for jejunal diverticulosis, where disease-specific data are scarce. Small sample sizes increase the risk of model overfitting and limit the robustness and reproducibility of reported performance metrics.

Second, a lack of external validation was observed in a substantial proportion of studies. While many models demonstrate high accuracy in internal validation cohorts, few have been tested on independent datasets from different institutions, imaging protocols, or patient populations. This limits the generalizability of findings and raises concerns regarding real-world clinical applicability.

Third, retrospective study design bias is a common limitation. Most included studies are retrospective in nature, relying on pre-existing datasets that may be subject to selection bias, incomplete clinical information, and inconsistencies in imaging acquisition or annotation. Prospective validation studies remain limited, further restricting the strength of available evidence.

Finally, there is considerable heterogeneity in AI models and methodologies. Studies vary widely in terms of model architecture (e.g., convolutional neural networks, radiomics-based machine learning, gradient boosting), input data (capsule endoscopy, CT, CT enterography), target tasks (lesion detection, classification, risk prediction), and reported performance metrics. This heterogeneity complicates direct comparison across studies and limits the ability to draw standardized conclusions.

Collectively, these limitations highlight that, while AI applications in gastrointestinal imaging show considerable promise, the current evidence base remains preliminary and methodologically variable. Future research should prioritize multicenter collaboration, standardized datasets, prospective validation, and transparent reporting to improve the reliability and clinical translation of AI models, particularly in rare conditions such as jejunal diverticulosis.

DISCUSSION

Artificial intelligence in gastrointestinal imaging: foundational developments

Artificial intelligence has rapidly transformed gastrointestinal imaging, particularly in endoscopic and cross-sectional modalities were large image volumes and subtle lesion morphology challenge human interpretation. In gastrointestinal endoscopy, AI applications have matured most prominently in colorectal polyp detection and characterization, where convolutional neural networks (CNNs) have consistently improved adenoma detection rates and sensitivity for diminutive lesions. Similar advances have been observed in the small bowel, particularly in small-bowel capsule endoscopy (SBCE), which is widely used for the evaluation of obscure gastrointestinal bleeding, Crohn's disease, and other mucosal pathologies. Manual interpretation of SBCE is inherently labour-intensive and susceptible to observer variability due to the enormous number of images generated during a single examination. Deep learning systems have therefore been developed to automate lesion detection across capsule image streams. In one of the largest studies to date, Ding and colleagues trained a CNN on more than 100 million capsule images to detect a broad spectrum of small-bowel abnormalities, including diverticula, ulcers, vascular lesions, polyps, and inflammatory changes.[7] The system achieved extremely high diagnostic performance, with sensitivity approaching 99.9% and specificity around 99.88%, outperforming experienced gastroenterologists in both per-patient and per-lesion sensitivity. Similar CNN-based systems designed to detect Angio-ectasias and bleeding sources have demonstrated high accuracy while substantially reducing capsule reading time. Other investigators, including Aoki and Klang, have shown that deep learning algorithms can detect Crohn's disease–associated ulcers on SBCE with accuracies approaching 90%, with sensitivities and specificities also in the high-80% to 90% range.[8,9] More recently, multicentre prospective studies have confirmed that AI-assisted capsule interpretation significantly improves diagnostic performance in suspected small-bowel bleeding. In one such study, AI assistance increased sensitivity for clinically relevant lesions from 79% to over 93% without compromising specificity, while markedly reducing reading time.[10] Beyond simple lesion classification, newer AI models are capable of localizing lesions along the small bowel and estimating capsule transit times, thereby assisting in procedural planning for device-assisted enteroscopy. Collectively, these developments demonstrate that AI has the potential to assist in detection and may support clinical decision-making, although such applications remain unvalidated in jejunal diverticulosis.

Artificial intelligence in cross-sectional small-bowel imaging

Advances in AI have also significantly influenced cross-sectional imaging of the small bowel, particularly CT enterography (CTE) and magnetic resonance enterography. Much of the early work in this domain has focused on Crohn's disease, where machine-learning and radiomics models have been applied to automatically detect characteristic imaging features such as mural thickening, hyperenhancement, stratification, and the mesenteric "comb sign".[11] These models have demonstrated diagnostic performance comparable to expert radiologists in identifying the presence, location, and extent of disease. More recently, machine-learning methodologies have been developed to quantify cumulative inflammatory injury in the ileum using CT enterography.[12] By automatically extracting radiologic features associated with inflammation burden, these systems can generate composite imaging scores that correlate with disease severity and predict clinically meaningful outcomes such as hospitalization, surgical intervention, and escalation of therapy. These studies illustrate that AI systems can accurately segment small-bowel loops, quantify pathological changes, and link imaging phenotypes with downstream clinical outcomes.[12,13]

Although these investigations have focused primarily on inflammatory bowel disease, the underlying methodological frameworks are highly relevant to jejunal diverticulosis. Similar approaches could theoretically be adapted to detect diverticula, quantify associated inflammatory changes, and identify imaging features associated with complications such as diverticulitis, perforation, or obstruction.

AI-based differentiation of jejunum and ileum

Anatomically, the jejunum is characterized by a thicker wall, prominent plicae circulares, fewer arterial arcades, and longer vasa recta, whereas the ileum demonstrates thinner folds, more complex vascular arcades, and abundant Peyer's patches.

From an AI perspective, differentiation between jejunal and ileal segments is theoretically feasible using multimodal features including spatial location, vascular architecture, and mucosal morphology. Emerging segmentation models such as 3D nnU-Net and UNet++ have demonstrated high accuracy in whole-bowel segmentation, although most current datasets do not provide sufficiently granular annotations to distinguish jejunal from ileal segments.

Therefore, while technically achievable, jejunum–ileum classification remains limited by lack of annotated datasets and requires further research.

Artificial intelligence applications in diverticular disease and acute abdominal CT

The application of AI to diverticular disease has been explored most extensively in the context of colonic diverticulitis. Deep learning models trained on abdominal CT images have demonstrated the ability to distinguish acute colonic diverticulitis from colon carcinoma with high diagnostic accuracy.[14] Importantly, radiologist performance improved further when AI-generated predictions were used as adjunctive decision support.[15] Machine-learning approaches have also been used to predict clinical outcomes in patients presenting with diverticulitis. For example, a gradient-boosting model developed using emergency department data from nearly 5,000 patients achieved an area under the receiver operating characteristic curve (AUC) of approximately 0.85 for predicting complicated diverticulitis, defined as cases requiring surgery, percutaneous drainage, or resulting in in-hospital mortality.[16] Such models offer the potential to support triage decisions and identify patients suitable for outpatient management. In another large study analyzing healthcare utilization data from approximately 82,000 patients with newly diagnosed diverticulitis, machine-learning algorithms predicted elective colon resection within one to two years with an AUC of around 0.75, suggesting that AI may assist in identifying patients likely to benefit from earlier surgical consultation.[17] Beyond diverticular disease, AI models have also been applied to other acute abdominal conditions. Deep learning systems analyzing abdominal CT scans have demonstrated the ability to identify patients with small-bowel obstruction who are at high risk of requiring surgery, thereby facilitating earlier operative intervention.[18] Similarly, AI algorithms have been developed to detect pneumoperitoneum on CT with high specificity, which may be particularly relevant in cases of small-bowel perforation.[19] These adjacent developments illustrate that AI can classify complex CT phenotypes, stratify disease severity, and assist in acute surgical decision-making—capabilities directly relevant to the management of jejunal diverticulosis.

AI-assisted imaging recognition in jejunal diverticulosis

Jejunal diverticulosis presents several unique diagnostic challenges that make it particularly well suited for AI-assisted imaging recognition. On CT and CT enterography, jejunal diverticula typically appear as multiple round or ovoid gas-, fluid-, or contrast-containing outpouchings arising from the mesenteric border of the jejunum, often clustered along affected segments.[20] These diverticula usually communicate with the bowel lumen through narrow necks and lack internal mucosal folds. In complicated cases, additional findings may include focal mural thickening, surrounding fat stranding, phlegmon formation, localized extraluminal gas, fluid collections, or frank abscess. Perforation may manifest as free intraperitoneal air and fluid associated with a regional inflammatory mass, whereas obstruction may present with proximal bowel dilatation and a transition point near a diverticular segment, sometimes accompanied by an intraluminal enterolith originating from a diverticulum.[21] Although CT is widely regarded as the imaging modality of choice for diagnosing jejunal diverticulitis and its complications, diverticula may be subtle and easily overlooked, particularly when imaging interpretation focuses on more common differential diagnoses such as appendicitis, Crohn's disease, or colonic diverticulitis. The reported observation that jejunal diverticulosis was mentioned in only a small fraction of CT reports despite being visible on retrospective review highlights the degree of under-recognition that may occur in routine practice.

Artificial intelligence may address several of these diagnostic challenges. Deep learning architectures capable of segmenting small-bowel loops and mesenteric structures—already developed for Crohn's disease imaging—could be adapted to detect diverticular outpouchings.[22] A potential workflow would involve automated segmentation of the small bowel and surrounding mesentery, followed by identification of candidate outpouching structures located outside the bowel centreline. Subsequent classification algorithms could distinguish true diverticula from confounding structures such as adjacent loops, collapsed segments, or vascular structures. Additional modules could then identify features associated with complications, including wall thickening, fat stranding, localized gas, and fluid collections, thereby differentiating uncomplicated diverticulosis from diverticulitis, abscess, or perforation. Given the rarity of jejunal diverticulosis, transfer learning from larger datasets of small-bowel imaging—such as Crohn's disease or small-bowel obstruction cohorts—would likely be essential to train robust models.[23]

These findings are derived from related gastrointestinal conditions and should be interpreted as hypothesis-generating rather than directly validated for jejunal diverticulosis.

Capsule endoscopy and multimodal AI detection of jejunal diverticula

Capsule endoscopy represents another domain in which AI could enhance the detection of jejunal diverticula. SBCE is frequently performed in patients with obscure gastrointestinal bleeding, where diverticula may serve as bleeding sources or harbor vascular lesions such as angioectasias.[24] In large-scale CNN studies of capsule endoscopy images, diverticula have already been included among lesion classes successfully detected with high sensitivity and specificity.[9] AI systems capable of identifying blood content, bleeding stigmata, and vascular abnormalities are particularly relevant in the context of diverticular haemorrhage. Automated algorithms could therefore flag jejunal diverticula during capsule studies even when they are not the primary clinical target. Moreover, AI-based localization of lesions along the small bowel could help guide subsequent device-assisted enteroscopy or surgical exploration. In complex cases, the integration of AI findings from both SBCE and CT enterography could theoretically enable multimodal “diverticular mapping” of the jejunum, allowing clinicians to visualize the distribution of diverticula and associated complications across the small bowel.[25] Although such integrated approaches remain largely conceptual at present, they represent a promising direction for future research.

Artificial intelligence–driven risk stratification in jejunal diverticulosis

The natural history of jejunal diverticulosis remains poorly characterized due to the rarity of the condition and the predominance of case reports and small case series. Many patients remain asymptomatic for years, whereas others may develop recurrent vague abdominal symptoms before experiencing acute complications such as bleeding, perforation, or obstruction.[26] At present, no validated risk-prediction models exist for jejunal diverticulosis comparable to the scoring systems used in colonic diverticular disease or inflammatory bowel disease. Consequently, decisions regarding surveillance, conservative management, or elective surgery are often individualized and based largely on clinician judgment. Insights from machine-learning models developed for colonic diverticulitis may provide a useful conceptual framework for addressing this gap.[14,16] For example, gradient-boosting models incorporating demographic, clinical, and laboratory variables have demonstrated strong predictive performance for complicated diverticulitis, while other machine-learning approaches using large healthcare datasets have successfully predicted the likelihood of elective colon resection following diverticulitis episodes.[17] These models rely primarily on routinely collected clinical variables, suggesting that similar approaches could be adapted to jejunal diverticulosis once sufficiently large datasets become available.

Another promising avenue involves image-based severity quantification. Studies in Crohn’s disease have shown that machine-learning algorithms applied to CT enterography can generate composite imaging metrics that correlate strongly with disease activity and predict adverse outcomes such as hospitalization or surgery.[27] Analogously, AI models applied to jejunal diverticulosis could quantify features such as diverticular number and distribution, diverticular diameter and neck width, presence of retained material indicating stasis, and imaging evidence of chronic inflammation or prior subclinical diverticulitis. These imaging-derived variables could be integrated with clinical and laboratory parameters to produce individualized risk estimates for complications such as perforation, haemorrhage, or obstruction. Multimodal machine-learning architectures combining imaging embeddings with structured clinical data may therefore provide a powerful framework for personalized risk stratification in this rare disease.

Artificial intelligence in surgical decision support

Surgical management of jejunal diverticulosis is typically reserved for patients with complications such as perforated diverticulitis, persistent or recurrent inflammation refractory to conservative therapy, small-bowel obstruction related to diverticular segments, ongoing haemorrhage, or refractory symptoms associated with malabsorption.[2] Decisions regarding the timing of surgery, the extent of resection, and reconstruction strategy are currently guided primarily by surgeon experience and intraoperative findings, often extrapolating principles from colonic diverticular disease and other small-bowel pathologies.[28] However, the expanding field of AI-enabled surgical decision support offers potential opportunities to augment these decisions. Machine-learning models have already been developed to predict postoperative complications, ICU admission, and prolonged hospitalization across a range of surgical procedures.[29] In emergency surgery, AI tools analyzing CT imaging and clinical data have demonstrated improved accuracy in identifying patients with small-bowel obstruction who require operative intervention compared with traditional scoring systems.[30]

In the context of jejunal diverticulitis, AI-driven decision support could help determine which patients are likely to fail conservative management and therefore require early surgical intervention. Such models could integrate CT features such as the extent of pneumoperitoneum, abscess size, degree of bowel wall thickening, and inflammatory changes with clinical variables including hemodynamic status and laboratory markers. Similarly, AI-based image segmentation tools could help assess the feasibility of percutaneous drainage in patients with localized abscesses by characterizing their size, location, and relationship to adjacent structures. For elective decision-making, predictive models could estimate the future risk of complications and weigh these against individualized operative risk, thereby facilitating structured shared decision-making between clinicians and patients.

Tables 2-5 summarize the key diagnostic and emerging technological aspects of jejunal diverticulosis. Table 2 outlines the available imaging modalities and their characteristic findings, Table 3 highlights current AI applications in small-bowel and diverticular diseases relevant to jejunal diverticulosis, and Table 4 presents proposed AI-driven tasks that may enhance its diagnosis, risk stratification, and management.

Table 5 outlines potential AI tasks in the imaging and clinical management of jejunal diverticulosis, emphasizing applications in detection, segmentation, complication prediction, risk stratification, and clinical decision support.

Conceptual AI workflow for jejunal diverticulosis

The integration of AI into the diagnostic and management pathway of jejunal diverticulosis can be conceptualized as a multi-stage workflow that combines imaging analysis, clinical data integration, and decision-support systems. Such a framework aims to improve early detection, risk stratification, and individualized management of this uncommon but potentially serious small-bowel condition.

Table 2: Imaging modalities and key features of jejunal diverticulosis.

Modality	Primary role in jejunal diverticulosis	Typical imaging findings	Limitations
Small-bowel follow-through	Historical diagnosis; still useful where CT/CTE not available	Multiple round outpouchings from lumen, often on mesenteric side, with narrow necks	Lower spatial resolution; operator-dependent; now largely supplanted by CT.
CT/CT enterography	Primary diagnostic and staging modality in symptomatic patients	Gas-/fluid-/contrast-filled diverticula off the jejunum; focal wall thickening, fat stranding, abscess, or pneumoperitoneum in complicated cases	Under-recognition on initial CT reports; subtle findings may be missed.
MR enterography	Alternative for chronic or recurrent symptoms; avoids ionizing radiation	Similar diverticular morphology and inflammatory changes as CT, plus functional information	Limited availability; longer acquisition time; less standardized in some centers.
Capsule endoscopy	First-line for obscure GI bleeding; can detect diverticula and bleeding sources	Direct visualization of jejunal diverticula, often with mucosal abnormalities or blood pools	Cannot intervene; risk of retention in strictures or inflammatory segments.

Table 3: Current AI applications in small-bowel and diverticular disease relevant to jejunal diverticulosis.

Domain	Example AI application	Key performance/purpose	Relevance to jejunal diverticulosis
SBCE lesion detection (multi-class)	CNN models trained on millions of capsule images to detect ulcers, polyps, bleeding, and diverticula	Sensitivity ~99.9%, specificity ~99.9% for lesions; detects diverticula among other pathologies	Demonstrates feasibility of AI-assisted diverticula detection in small bowel.
SBCE bleeding detection	CNNs for automatic detection of small-bowel blood content and bleeding stigmata	High accuracy, reduced reading time; improves detection of obscure bleeding sources	Supports identification of diverticula-associated hemorrhage.
CT enterography for Crohn's	ML/radiomics models that quantify cumulative ileal inflammation on CTE	Image-based "burden of disease" scores predict future hospitalization and surgery	Prototype for quantifying diverticular burden/chronicity on CT.
CT-based diverticulitis versus cancer	Deep learning to differentiate acute colonic diverticulitis from colon carcinoma on CT	High discrimination; improves radiologist accuracy when used as decision aid	Proof-of-concept for AI-assisted diverticulitis recognition on CT.
ML for complicated diverticulitis	Gradient-boosting model using ED data to predict "complicated" diverticulitis	AUC ~0.85; identifies low-risk patients suitable for conservative management	Template for risk stratification in acute jejunal diverticulitis.
ML predicting elective resection	ML model using health-care utilization data to predict future elective colon resection after diverticulitis	AUC ~0.75; identifies patients likely to undergo surgery over 1–2 years	Conceptual model for elective surgery decisions in jejunal diverticulosis.

Table 4: Proposed AI-driven tasks for jejunal diverticulosis.

AI task domain	Potential AI function	Example input data	Intended clinical benefit
CT/CTE diverticula detection	3D CNN segmenting small-bowel loops and flagging diverticula on mesenteric side	Contrast-enhanced CT/CTE images, DICOM series	Reduce under-recognition and improve early detection.
Complication classification on CT	ML classifier distinguishing uncomplicated diverticulosis from diverticulitis, abscess, or perforation	CT-based features (wall thickness, fat stranding, extraluminal gas, fluid)	Aid triage (conservative vs drainage versus urgent surgery).
SBCE-based diverticula mapping	CNN detecting and localizing jejunal diverticula along transit	SBCE video frames and timestamps	Guide targeted enteroscopy or resection segments.
Risk-stratification model	Gradient-boosting or multimodal model predicting future major complications	Clinical/labs + imaging burden metrics + prior episodes	Inform watchful follow-up versus early elective surgery.
Surgical decision support (acute)	High-risk SBO/diverticulitis model estimating probability of requiring surgery	CT findings, hemodynamics, labs, prior interventions	Support timely operative versus image-guided intervention choices.
Surgical decision support (elective)	ML model predicting elective resection likelihood, analogous to colonic diverticulitis models	Comorbidities, symptoms, prior bleeding/perforation, imaging burden	Facilitate shared decision-making in complex cases.

Table 5: Potential artificial intelligence tasks in the imaging and clinical management of jejunal diverticulosis.

AI application domain	Potential AI task	Data source	Clinical utility
Imaging detection	Automated identification of jejunal diverticula on CT or CT enterography	CT, CT enterography	Improves recognition of subtle diverticula and reduces under-reporting in routine imaging interpretation
Lesion characterization	Differentiation between uncomplicated diverticulosis and diverticulitis	CT, CT enterography	Supports radiologists in identifying inflammatory changes such as wall thickening, fat stranding, and localized abscess
Complication detection	Automated detection of perforation, abscess, or pneumoperitoneum	CT imaging	Enables rapid identification of life-threatening complications and prioritization of urgent cases
Capsule endoscopy analysis	Automated detection and localization of jejunal diverticula and bleeding sources	Small-bowel capsule endoscopy	Improves diagnostic yield and reduces interpretation time in obscure gastrointestinal bleeding
Disease burden quantification	Measurement of diverticular number, size, and segmental distribution	CT enterography, capsule endoscopy	Enables objective assessment of diverticular burden and monitoring of disease progression
Risk stratification	Prediction of complications such as diverticulitis, perforation, bleeding, or obstruction	Multimodal datasets (imaging, laboratory data, clinical history)	Supports early identification of high-risk patients and personalized monitoring strategies
Surgical decision support	Prediction of failure of conservative management and need for surgical intervention	Imaging features + clinical parameters	Assists clinicians in determining optimal timing of surgery versus conservative treatment
Clinical workflow optimization	Automated triage of abdominal CT scans highlighting suspected small-bowel diverticular pathology	Emergency radiology CT datasets	Prioritizes radiologist review and may shorten time to diagnosis in acute abdominal presentations

AI: Artificial intelligence; CT: computed tomography; CT enterography: contrast-enhanced CT technique optimized for small-bowel imaging

The first stage involves image acquisition and preprocessing, where patients presenting with abdominal symptoms undergo cross-sectional imaging, typically contrast-enhanced CT or CT enterography. These imaging datasets can then be processed by AI algorithms trained to recognize small-bowel anatomy and segment intestinal loops and mesenteric structures. Automated segmentation of the small bowel provides the anatomical foundation for further lesion detection and characterization.[31]

In the second stage, AI-assisted detection of jejunal diverticula is performed. Deep learning models—such as CNN or transformer-based architectures—can analyze CT images to identify diverticular outpouchings along the mesenteric border of the jejunum. These algorithms may highlight candidate structures consistent with diverticula and distinguish them from confounding structures such as adjacent bowel loops, vascular shadows, or collapsed bowel segments. Automated labelling or visual overlays could assist radiologists by drawing attention to subtle findings that might otherwise be overlooked during routine interpretation.[14]

The third stage focuses on imaging phenotyping and complication assessment. AI systems can quantify relevant radiologic features associated with diverticular disease, including the number and distribution of diverticula, diverticular size, bowel wall thickening, mesenteric fat stranding, localized fluid collections, or extraluminal gas. These features can help differentiate uncomplicated diverticulosis from diverticulitis, abscess formation, perforation, or obstruction. Quantitative imaging analysis may therefore provide an objective measure of disease burden and inflammatory activity.[32]

The fourth stage involves multimodal risk stratification, in which imaging-derived features are integrated with clinical and laboratory data such as age, comorbidities, leukocyte count, inflammatory markers, and prior episodes of abdominal pain or gastrointestinal bleeding. Machine-learning models—such as gradient boosting algorithms or multimodal neural networks—can analyze these combined datasets to estimate the probability of adverse outcomes, including diverticulitis, perforation, hemorrhage, or need for surgical intervention. Such predictive models may assist clinicians in identifying high-risk patients who require closer monitoring or early surgical evaluation.[33]

Finally, the fifth stage incorporates clinical decision support and management guidance. AI-generated outputs can be presented to clinicians as risk scores or visual dashboards that summarize imaging findings and predicted complication risks. These tools may support multidisciplinary decision-making between radiologists, gastroenterologists, and surgeons when determining whether conservative management, image-guided drainage, or surgical resection is most appropriate. Importantly, AI systems should function as supportive tools rather than autonomous decision-makers, with final management decisions remaining under clinician oversight.[34]

Although this conceptual workflow remains largely theoretical for jejunal diverticulosis at present, similar AI-assisted pipelines have already been successfully implemented in other areas of gastrointestinal imaging and acute abdominal pathology. Future research integrating imaging recognition, predictive modeling, and clinical decision-support systems may enable the development of comprehensive AI-assisted frameworks capable of improving diagnostic accuracy and optimizing management strategies for patients with jejunal diverticulosis.

Methodological and data challenges in developing jejunal-specific AI models

Despite the theoretical promise of AI applications in jejunal diverticulosis, several methodological challenges must be addressed before such tools can be implemented in clinical practice. The most significant barrier is data scarcity. Because jejunal diverticulosis is rare, single-center datasets are unlikely to contain sufficient cases to train robust deep learning models, and class imbalance may further increase the risk of overfitting. Multi-institutional registries and collaborative datasets will therefore be essential. Retrospective mining of radiology archives using natural language processing to identify reports mentioning jejunal diverticula may provide an additional strategy for assembling larger datasets. Transfer learning from larger imaging cohorts, such as Crohn’s disease or small-bowel obstruction datasets, may also help mitigate data limitations. Weakly supervised learning approaches using report-level labels rather than pixel-level annotations could further accelerate early model development.

Robust annotation and ground-truth labeling are equally critical. Imaging datasets should ideally include case-level labels for the presence of diverticulosis and its complications, along with region-level annotations identifying individual diverticula or inflammatory changes. Whenever possible, surgical and pathological correlation should be incorporated to validate imaging findings.

For risk-prediction models, outcome labels such as need for surgery, success or failure of conservative therapy, recurrence, and mortality will be necessary. Interdisciplinary collaboration among radiologists, surgeons, and gastroenterologists may improve labeling accuracy and ensure clinically meaningful model development.

Common artificial intelligence and machine learning models used in gastrointestinal disorders

CNN

Deep learning models designed for image recognition and analysis. CNNs are widely used in gastrointestinal endoscopy and radiology for tasks such as real-time colorectal polyp detection during colonoscopy, lesion identification in capsule endoscopy (bleeding, ulcers, angioectasia), and automated analysis of CT or MRI images of the gastrointestinal tract.[35]

Residual neural network

A deep CNN architecture that uses residual connections to enable training of very deep networks without degradation in performance. Residual neural network (ResNet) models have been widely applied in capsule endoscopy image classification and endoscopic lesion detection, including identification of bleeding sources and inflammatory lesions.[36]

Visual geometry group network

A CNN architecture known for its simple and uniform structure with multiple stacked convolutional layers. Visual geometry group network (VGGNet) has been used in gastrointestinal endoscopy datasets for classification of polyps, ulcers, and mucosal abnormalities.[37]

You only look once

A real-time object detection model that identifies and localizes objects within images simultaneously. In gastroenterology, you only look once (YOLO)-based systems are used for real-time detection of colorectal polyps and gastrointestinal lesions during endoscopic procedures.[38]

U-Net

A deep learning architecture designed for biomedical image segmentation. U-Net is commonly used for segmenting gastrointestinal structures in CT or MRI images, delineating intestinal walls, inflammatory lesions, or tumors in imaging datasets.[39]

Random forest

An ensemble machine learning algorithm that combines multiple decision trees to improve predictive performance and reduce overfitting. Random forest models are commonly applied to clinical datasets to predict outcomes in diseases such as inflammatory bowel disease, gastrointestinal bleeding, and pancreatitis.[40]

Support vector machine

A supervised machine learning model used for classification and regression tasks. support vector machine (SVM) has been widely applied in radiomics studies to classify gastrointestinal tumors, differentiate inflammatory bowel disease activity, and predict treatment response.[41]

Extreme gradient boosting

A powerful gradient boosting algorithm widely used for clinical prediction models. In gastrointestinal research, extreme gradient boosting (XGBoost) models are used to predict outcomes such as severe acute pancreatitis, risk of gastrointestinal bleeding, or complications in diverticular disease.[42]

Light gradient boosting machine

A gradient boosting framework optimized for speed and efficiency when working with large datasets. Light gradient boosting machine (LightGBM) has been used in predictive modeling of gastrointestinal diseases and clinical risk stratification tasks.[43]

Transformer models (e.g., vision transformer – ViT)

Deep learning architectures based on attention mechanisms that process images or text by modeling relationships between data elements. In gastrointestinal research, transformer models are increasingly applied to endoscopic image analysis and multimodal data integration.[44]

Radiomics models

Analytical frameworks that extract quantitative features from medical imaging and use machine learning algorithms to identify disease patterns. Radiomics approaches are commonly used in CT enterography or MRI to quantify inflammation, tumor characteristics, or disease burden in gastrointestinal conditions.[45]

Multimodal deep learning models

AI systems designed to integrate multiple data sources, such as imaging, laboratory results, and clinical history. These models are increasingly used for comprehensive.[46,47]

Table 6 summarizes representative AI models and their applications across gastrointestinal disorders, highlighting their roles in detection, characterization, risk stratification, and clinical decision support.

Table 6: Representative AI models and their applications in gastrointestinal disorders.

AI model	Core function	Representative GI application	Example of landmark/representative study
CNN	Deep learning architecture optimized for image recognition and feature extraction.	Real-time colorectal polyp detection and classification during colonoscopy; lesion detection in capsule endoscopy.	Urban et al, 2018 – CNN for real-time polyp detection in colonoscopy showing improved adenoma detection rates.
ResNet	Deep CNN architecture using residual connections to enable training of very deep networks while maintaining accuracy.	Automated detection of ulcers, bleeding, and inflammatory lesions in capsule endoscopy images.	Ding et al., 2019 – CNN/ResNet-based system analyzing >100 million capsule images for small-bowel lesion detection.

Continued.

AI model	Core function	Representative GI application	Example of landmark/representative study
YOLO	Real-time object detection model capable of simultaneous lesion localization and classification.	Real-time detection of colorectal polyps during colonoscopy and lesion detection in endoscopic video streams.	Wang et al, 2019 – Real-time AI system for colonoscopy polyp detection using deep learning.
U-Net	Deep learning architecture designed for biomedical image segmentation.	Segmentation of intestinal wall inflammation on CT enterography or MR enterography in inflammatory bowel disease.	Studies applying U-Net architectures for automated segmentation of bowel wall thickening in Crohn's disease imaging.
XGBoost	Ensemble machine-learning algorithm used for predictive modeling with structured clinical data.	Risk prediction models for severe acute pancreatitis, diverticulitis complications, and GI bleeding outcomes.	Several clinical prediction studies demonstrating improved performance over traditional scoring systems.
ViT	Transformer-based deep learning architecture using attention mechanisms for image analysis.	Advanced endoscopic image classification and multimodal prediction models integrating imaging and clinical data.	Emerging studies applying transformer architectures to endoscopic lesion classification and GI cancer detection.

Clinical implications for surgeons and radiologists

The potential integration of AI into the diagnostic and management pathways of jejunal diverticulosis has important clinical implications for both radiologists and surgeons. Because jejunal diverticulosis is relatively rare and often presents with nonspecific symptoms, early recognition largely depends on careful interpretation of imaging studies, particularly CT and CT enterography. AI-assisted imaging tools could help radiologists detect subtle diverticula that may otherwise be overlooked during routine reporting. Automated detection algorithms capable of identifying small outpouchings along the mesenteric border of the jejunum and highlighting associated inflammatory features may function as a secondary review mechanism, improving diagnostic sensitivity and reducing missed findings. Such tools may be particularly useful in busy emergency radiology settings, where attention is frequently directed toward more common causes of acute abdominal pain.[48]

For surgeons, improved imaging recognition of jejunal diverticulosis may facilitate earlier diagnosis of complications such as diverticulitis, perforation, or obstruction. AI-assisted imaging analysis could help characterize the extent of disease, identify inflammatory changes, and detect complications such as localized abscess or pneumoperitoneum. These insights may support more accurate preoperative assessment and guide decisions regarding conservative management, image-guided drainage, or surgical intervention. In emergency settings, AI-based risk prediction models integrating imaging features with clinical and laboratory data could assist in identifying patients at higher risk of clinical deterioration or failure of non-operative management, thereby prompting earlier surgical consultation.[49]

In addition to acute decision-making, AI may contribute to more informed elective management strategies in patients with recurrent or chronic symptoms related to jejunal diverticulosis. Predictive models incorporating imaging-derived metrics—such as diverticular burden, segmental involvement, and evidence of prior inflammation—along with patient-specific clinical factors could help estimate the likelihood of future complications. Such information may facilitate individualized discussions regarding surveillance, medical management, or elective surgical resection. Importantly, AI systems are not intended to replace clinical expertise but rather to function as decision-support tools that augment physician judgment. By improving diagnostic accuracy, enabling objective risk assessment, and supporting multidisciplinary decision-making, AI-assisted approaches may ultimately help clinicians manage this uncommon yet potentially serious small-bowel disorder more effectively.[50,51]

Table 7 summarizes representative AI applications in gastrointestinal and small-bowel imaging relevant to jejunal diverticulosis, highlighting key studies, model types, imaging modalities, and their clinical utility in detection, characterization, and decision support.

Analytical synthesis of current evidence

Beyond descriptive reporting, a comparative evaluation of existing studies reveals several consistent strengths and limitations in AI applications across gastrointestinal imaging domains relevant to jejunal diverticulosis. A key strength observed across multiple studies is the consistently high diagnostic performance of deep learning models, particularly in image-rich modalities such as capsule endoscopy and CT-based imaging. Convolutional neural networks have demonstrated high sensitivity and specificity for lesion detection, often approaching or exceeding expert-level performance in controlled settings.

These findings are reproducible across different disease entities, including small-bowel bleeding, Crohn's disease, and colonic diverticulitis, suggesting a robust methodological foundation for image-based AI applications.

Table 7: Representative artificial intelligence applications in gastrointestinal and small-bowel imaging relevant to jejunal diverticulosis.

Study	Year	AI method	Application	Key contribution
Spada et al[52]	2024	Deep CNN	Capsule endoscopy reading	AI-assisted capsule endoscopy improved diagnostic yield and reduced reading time significantly
Kwon et al[53]	2025	Deep learning	Capsule endoscopy lesion detection	Automated localization and abnormality detection in small bowel capsule endoscopy
Saraiva et al[54]	2021	CNN	Capsule endoscopy blood detection	High accuracy AI detection of luminal blood in capsule endoscopy
Brejnebøl et al[19]	2022	Deep recurrent neural network	CT pneumoperitoneum detection	AI detection of pneumoperitoneum on CT in acute abdomen
Stidham et al[12]	2024	Machine learning + radiomics	CT enterography	AI quantification of small bowel inflammation predicting surgery in Crohn's disease
Wasnik et al[55]	2024	Random forest + CNN	CT enterography	Automated detection and localization of Crohn's disease imaging findings
Oh et al[18]	2023	3D CNN	CT imaging	AI model predicting high-risk small bowel obstruction requiring surgery
Klang et al[16]	2021	Gradient boosting ML	Diverticulitis risk prediction	ML model predicting complicated diverticulitis in ED patients
Thornblade et al[17]	2018	Gradient boosting ML	Diverticulitis outcomes	ML model predicting elective colon resection after diverticulitis
Rice et al[56]	2025	LLM-based AI	Emergency surgical diagnosis	AI diagnostic accuracy comparable to surgical trainees

AI: artificial intelligence; ML: machine learning; CNN: convolutional neural network; RF: random forest; CTE: computed tomography enterography; CT: computed tomography; SBCE: small-bowel capsule endoscopy; SBO: small bowel obstruction; CD: Crohn's disease; AUC: area under the receiver operating characteristic curve; ROC: receiver operating characteristic; ED: emergency department.

However, these strengths are counterbalanced by several important limitations. Many studies rely on retrospective, single-center datasets, which may not adequately capture real-world variability in imaging protocols, patient populations, and disease presentations. Furthermore, the lack of external validation remains a persistent concern, limiting the generalizability of reported performance metrics. While high accuracy is frequently reported, it is often derived from curated datasets with predefined lesion characteristics, raising the possibility of overestimation of real-world performance.

In terms of consistency across studies, AI applications in capsule endoscopy demonstrate the most mature and reproducible performance, with multiple studies confirming high diagnostic accuracy and reduced interpretation time. In contrast, AI applications in cross-sectional imaging, such as CT enterography, show promising but more variable results, particularly in tasks involving disease characterization and outcome prediction.

Studies focusing on diverticular disease and acute abdominal imaging further support the feasibility of AI-assisted classification and risk stratification, although methodological differences limit direct comparison.

From a clinical applicability perspective, current AI models appear most immediately translatable in domains involving automated detection and triage, where they may function as adjunctive tools to improve diagnostic sensitivity and workflow efficiency. In contrast, applications involving risk prediction and surgical decision support remain more exploratory, requiring further validation before integration into routine practice. Importantly, the absence of jejunal diverticulosis-specific datasets necessitates cautious interpretation, and all extrapolated findings should be considered hypothesis-generating rather than definitive.

Overall, while the available evidence supports the technical feasibility of AI in gastrointestinal imaging, its clinical translation in jejunal diverticulosis remains at an early stage. Greater emphasis on prospective validation, multicenter data, and standardized reporting will be essential to bridge the gap between experimental performance and real-world implementation.

Ethical, regulatory, and implementation considerations

The deployment of AI tools in rare but potentially life-threatening conditions such as jejunal diverticulitis requires careful consideration of safety, interpretability, and equity. False-negative predictions in cases of perforation or severe diverticulitis could have serious clinical consequences; therefore, early implementations should function as assistive systems that flag suspicious findings for expert review rather than autonomous diagnostic tools.[57] Interpretability mechanisms such as heatmaps highlighting suspected diverticula or inflammatory changes may enhance clinician trust and facilitate verification. Bias and generalizability are also important considerations. Training datasets must include diverse imaging protocols, scanner types, and patient populations to ensure that model performance does not degrade in underrepresented groups. From a regulatory perspective, AI tools designed to identify imaging abnormalities may be classified as triage or notification systems, similar to existing AI applications for detecting intracranial haemorrhage or pneumothorax on imaging. Decision-support models for risk prediction or elective surgery planning would likely fall under the category of clinical decision support software and would require transparent reporting, rigorous external validation, and ongoing post-deployment monitoring to detect performance drift. Together, these considerations highlight the importance of careful methodological development and responsible implementation as AI technologies evolve toward clinical integration in the management of jejunal diverticulosis.[58]

Table 8 summarizes key methodological considerations and existing research gaps in the application of artificial intelligence to jejunal diverticulosis, including issues related to data quality, model generalizability, validation, interpretability, and clinical integration.

Table 8: Key methodological considerations and research gaps.

Domain	Current status	Gaps/challenges	Future research directions
Data availability	Small, single-center case series and occasional CT/SBCE reports	Limited sample size; few annotated imaging datasets for AI training	Multi-institutional registries, PACS mining, and retrospective labeling.
Ground-truth annotation	Mostly narrative case reports; only limited CT-based validation	Lack of standardized labels for diverticulosis, inflammation, perforation, obstruction	Multidisciplinary consensus labeling and central review processes.
AI-specific validation	No published AI models specific to jejunal diverticulosis	No benchmarks for detection, localization, or risk prediction	Prospective AI-augmented workflow studies and external validation.
Transfer learning	Transfer learning common in SB/CT models (e.g., Crohn's, SBO, colorectal cancer)	Optimal pre-training datasets and architectures for jejunal diverticulosis unclear	Compare transfer vs from-scratch models on small-bowel datasets.
Ethical/regulatory path	AI-assisted CT triage tools in other domains (e.g., hemorrhage, SBO) evolving	No clear framework for rare, high-risk small-bowel pathology	Define safety thresholds, alert strategies, and post-market surveillance.

Limitations of current evidence

Despite the promising potential of AI in gastrointestinal imaging and clinical decision support, several limitations currently constrain its application in the context of jejunal diverticulosis. Foremost among these is the scarcity of disease-specific data. Jejunal diverticulosis is a relatively rare condition, and most available information originates from case reports, small retrospective series, or incidental imaging findings.[59] Consequently, large, well-annotated datasets required for training and validating robust AI models are currently lacking. Without sufficient case volumes, the development of disease-specific deep learning systems remains challenging, and models trained on small datasets are at risk of overfitting and limited generalizability.[60,61]

Another important limitation is that much of the current evidence supporting AI applications in this domain is extrapolated from related gastrointestinal conditions rather than directly derived from studies of jejunal diverticulosis. Advances in AI-assisted lesion detection in capsule endoscopy, radiomics-based analysis of CT enterography in Crohn's disease, and machine-learning prediction models in colonic diverticulitis or small-bowel obstruction provide valuable methodological insights. However, these disease entities differ in pathophysiology, imaging characteristics, and clinical progression. As a result, the direct applicability of these models to jejunal diverticulosis remains theoretical and requires validation through dedicated research.[62,63]

Methodological heterogeneity in existing AI studies also presents a challenge. Many investigations use different datasets, imaging protocols, annotation strategies, and performance metrics, making comparisons across studies difficult. Furthermore, several published AI models in gastrointestinal imaging have been developed using retrospective single-center datasets and have not undergone rigorous external validation. Without multicenter validation across diverse patient populations, scanner types, and imaging protocols, the clinical reliability of these systems cannot be fully established.[64]

Another limitation relates to the quality and consistency of ground-truth labeling. Accurate annotation of diverticula, inflammatory changes, and complications requires expert interpretation by radiologists and often confirmation through surgical findings or pathological examination. In rare diseases such as jejunal diverticulosis, assembling datasets with reliable ground-truth labels can be particularly difficult. Variability in radiologic interpretation and incomplete clinical correlation may further affect the reliability of training datasets used for AI development.[65]

Finally, the integration of AI tools into routine clinical workflows remains an unresolved challenge. Even when AI algorithms demonstrate high diagnostic performance in controlled research settings, their real-world implementation requires careful consideration of interpretability, user interface design, regulatory approval, and clinician acceptance. AI systems must function as supportive tools that enhance clinical judgment rather than replace it, and their outputs must be transparent and easily interpretable by clinicians.[66]

Overall, while advances in AI provide a promising foundation for improving detection and management of jejunal diverticulosis, current evidence remains largely preliminary. Addressing these limitations through multicenter collaboration, standardized data collection, prospective validation studies, and integration of multimodal clinical data will be essential for translating AI-driven innovations into routine clinical practice.[67]

Figure 2 highlights the key challenges and barriers to implementing AI in jejunal diverticulosis, including limited data availability, heterogeneity of imaging, lack of standardized annotations, issues with model generalizability, interpretability concerns, and barriers to clinical integration.

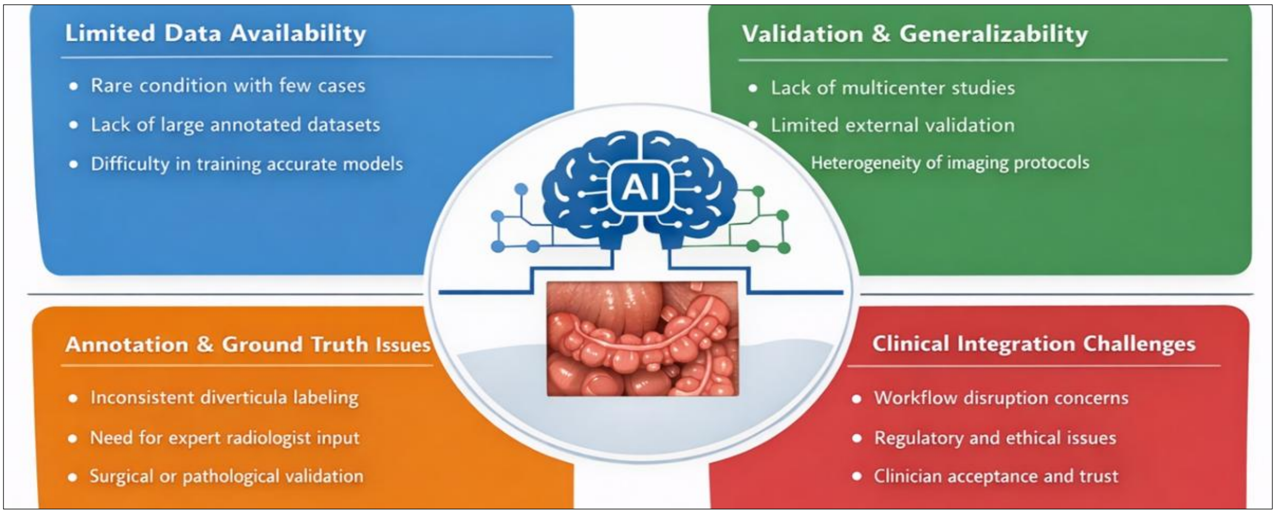

Figure 2: Challenges and barriers to implementing AI in jejunal diverticulosis.

Future directions and research agenda

Despite increasing interest in the role of artificial intelligence in gastrointestinal imaging and surgical decision support, the application of AI specifically to jejunal diverticulosis remains largely conceptual. The rarity of the disease, the heterogeneity of clinical presentation, and the limited availability of large annotated datasets have slowed systematic investigation in this area. Consequently, several priority research directions can be identified to bridge the gap between current technological capabilities and clinically meaningful implementation.[68]

A foundational step will involve epidemiologic and imaging phenotyping studies aimed at better characterizing the natural history and radiologic spectrum of jejunal diverticulosis. Multi-center collaborations should assemble cohorts of patients with confirmed jejunal diverticulosis and standardized CT or CT enterography review to define common imaging phenotypes, distribution patterns, and complication profiles. Such datasets would allow investigators to identify radiologic predictors of diverticulitis, perforation, bleeding, or obstruction using conventional statistical approaches before the development of AI models. Establishing robust phenotypic descriptors is essential, as machine-learning systems rely on clearly defined imaging features and outcome labels for effective training.[18]

Building on this foundation, proof-of-concept imaging recognition models should be developed using retrospective CT and CT enterography datasets in which jejunal diverticulosis or diverticulitis has been confirmed radiologically or surgically. Initial models may focus on case-level detection, determining whether diverticulosis is present or absent on imaging studies. Once reliable performance is achieved, more granular models could be trained to detect diverticula at the segmental or regional level within the jejunum. Given the limited number of available cases, transfer learning strategies using pretrained models from related domains—such as Crohn's disease imaging or small-bowel obstruction detection—will likely be essential for achieving adequate model performance.[21]

Another promising research avenue involves leveraging existing AI systems developed for capsule endoscopy. Large capsule endoscopy datasets already exist in many centers, particularly for the investigation of obscure gastrointestinal bleeding. Retrospective labeling of capsule studies containing jejunal diverticula would allow investigators to assess how well existing multi-lesion CNN architectures detect diverticula and associated bleeding stigmata. If necessary, these models could be fine-tuned to improve the detection and localization of diverticular lesions. Such approaches may be particularly valuable in identifying diverticula associated with vascular abnormalities or bleeding sources, which are common indications for capsule endoscopy.[27]

Parallel efforts should focus on developing early risk-prediction models for complications of jejunal diverticulosis. Even relatively simple machine-learning frameworks integrating clinical variables, laboratory data, and basic imaging features—such as the number of diverticula or the length of affected bowel segments—may provide useful estimates of complication risk. These early models may initially demonstrate modest predictive performance, but they will help identify key predictors and inform the design of larger datasets required for more sophisticated modeling approaches. Insights from similar machine-learning models in colonic diverticulitis suggest that combining structured clinical data with imaging-derived variables may substantially improve predictive accuracy.[16]

Prospective investigations will also be required to evaluate AI-augmented clinical workflows. For example, CT-based triage algorithms could be implemented within radiology workflows to automatically flag imaging studies containing suspected jejunal diverticulosis or diverticulitis for prioritized expert review. Such systems could potentially reduce diagnostic delays and improve recognition of subtle diverticular pathology. Similarly, in capsule endoscopy units, comparative studies could assess whether AI-assisted interpretation improves the detection of jejunal diverticula and bleeding sources compared with conventional manual reading. Outcomes of interest would include diagnostic accuracy, reading time, and clinical impact on subsequent patient management.[11]

Finally, AI models specific to jejunal diverticulosis should ideally be integrated into broader decision-support systems for acute abdominal pain. Many patients with complicated jejunal diverticulosis present with nonspecific abdominal symptoms that overlap with more common conditions such as appendicitis, colonic diverticulitis, or small-bowel obstruction. Embedding jejunal-specific risk estimates into machine-learning frameworks designed to evaluate acute abdomen presentations could help identify patients in whom this rare diagnosis should be considered. Such integration may be particularly valuable in older patients with atypical symptoms, where missed jejunal perforation can result in significant morbidity and mortality.[1]

Taken together, these research priorities highlight the need for coordinated multi-institutional collaboration, standardized data collection, and iterative model development. Although the current evidence base remains limited, advances in AI-enabled imaging analysis, multimodal data integration, and clinical decision support provide a promising framework for improving the detection, risk stratification, and management of jejunal diverticulosis in the future.

CONCLUSION

Jejunal diverticulosis is an uncommon but clinically important small-bowel disorder in which delayed diagnosis frequently contributes to significant morbidity from diverticulitis, perforation, hemorrhage, and obstruction. Although computed tomography and CT enterography remain the cornerstone imaging modalities, under-recognition of subtle diverticular findings and the absence of validated risk-stratification tools continue to limit optimal patient management. At present, no AI models have been developed specifically for jejunal diverticulosis; however, substantial advances in AI-assisted capsule endoscopy, CT enterography, radiomics, and machine-learning–based prediction models for Crohn's disease, diverticulitis, and acute abdominal conditions provide a robust methodological foundation for future development. By synthesizing evidence across these related domains, this review proposes a conceptual framework illustrating how AI could enhance imaging recognition, quantify disease burden, predict complications, and support both acute and elective surgical decision-making in patients with jejunal diverticulosis. Furthermore, it identifies the principal barriers to clinical implementation—including limited disease-specific datasets, the need for standardized imaging annotation, multicenter collaboration, and prospective validation—and outlines a practical research agenda to address these challenges. In doing so, this review advances current understanding by bridging the gap between existing AI methodologies and their potential application to a rare but clinically significant small-bowel disorder, thereby providing a roadmap for future research and eventual clinical translation.

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