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REVIEW PAPER

Role of diagnostic laparoscopy in preoperative staging and resectability assessment for cytoreductive surgery combined with hyperthermic intraperitoneal chemotherapy in peritoneal metastasis: a review

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Abstract

Introduction Diagnostic laparoscopy (DL) is increasingly used in the preoperative evaluation of patients with peritoneal metastasis (PM) who are considered for cytoreductive surgery combined with hyperthermic intraperitoneal chemotherapy (CRS-HIPEC). Cross-sectional imaging has limited accuracy for assessing small-bowel and mesenteric disease, which are key determinants of resectability. DL may improve patient selection and reduce nontherapeutic laparotomy.

Aim We aimed to summarize current evidence on the feasibility, diagnostic performance, and clinical impact of DL in patients with PM undergoing qualification for CRS-HIPEC.

Materials and methods A narrative review of the literature was conducted. The studies were identified through the searches of the PubMed, MEDLINE, and Scopus databases, and supplemented by manual reference screening. Eligible publications included prospective and retrospective cohorts, multicenter studies, diagnostic accuracy trials, and reviews reporting outcomes of DL for CRS-HIPEC. The data were synthesized thematically. No meta-analysis was performed.

Results A total of 29 studies were included. Across 3632 procedures, DL was successfully completed in 98.3% of the patients. As many as 1034 individuals (28.5%) were excluded from CRS-HIPEC based on laparoscopic findings. Reduction in futile laparotomy was reported across various tumor types, including colorectal metastasis (approximately 12%–17%), gastric cancer (approximately 30%), and ovarian cancer (approximately 58%, when combined with computed tomography findings). Peritoneal Cancer Index

underestimation occurred in 40%–63% of the mixed cohorts, mainly due to limited visualization of the small bowel. Positive predictive value for complete cytoreduction ranged from 80% to 95%. Major morbidity was below 2% in most series.

Conclusions DL is a safe and accurate staging tool that improves patient selection for CRS-HIPEC, reduces nontherapeutic laparotomy, and supports timely initiation of appropriate therapy. It should be considered a key component of contemporary staging pathways for PM.

Key words

cytoreductive surgery, diagnostic laparoscopy, hyperthermic intraperitoneal chemotherapy, Peritoneal Cancer Index, peritoneal metastasis

Introduction

Peritoneal metastasis (PM) represents a common pattern of failure in gastrointestinal and gynecologic malignancies, and is associated with limited survival in the absence of aggressive locoregional treatment [1-3]. Over the last 3 decades, cytoreductive surgery combined with hyperthermic intraperitoneal chemotherapy (CRS-HIPEC) has emerged as a potentially curative option for selected patients with primary peritoneal malignancies and PMs of colorectal, appendiceal, ovarian, gastric, and, less frequently, other cancers [2,4-6]. Careful selection is crucial, since treatment is complex, resource-intensive, and associated with nontrivial morbidity and mortality. Patient selection currently relies on a combination of tumor biology, performance status, completeness of cytoreduction (CC) that can realistically be achieved, and quantitative assessment of peritoneal disease burden [3,6,7].

The Peritoneal Cancer Index (PCI) proposed by Jacquet et al [7] is the most widely used tool to quantify intraperitoneal disease. The abdomen and pelvis are divided into 13 regions, and

each region receives a lesion size (LS) score from 0 to 3. LS 0 indicates no visible tumor, LS 1 refers to lesions of up to 0.5 cm, LS 2 corresponds to lesions between 0.5 and 5 cm, and LS 3 lesions larger than 5 cm or confluent. Regional scores are summed to obtain a PCI score ranging from 0 to 39. Higher PCI values correlate with a lower probability of achieving CC and worse postoperative outcomes and survival [3,6,8]. Many institutions apply pragmatic PCI cutoffs for CRS-HIPEC eligibility, which creates particular uncertainty in patients whose imaging-based PCI estimates fall near these thresholds [4-6,8].

The second critical factor in CRS-HIPEC decision-making is the CC score. The CC score reflects the amount of visible residual disease after CRS. CC-0 indicates no macroscopic disease; CC-1 corresponds to residual tumor nodules below 2.5 mm, which are considered small enough for effective treatment with HIPEC; and CC-2 and CC-3 refer to larger residual disease, and are associated with limited benefits from CRS-HIPEC [3,7]. Achieving CC-0 or CC-1 is one of the strongest predictors of long-term survival, independently of tumor origin [2-4,6,8]. Patients with a low or moderate PCI score who undergo CC-0 or CC-1 resections may achieve several years of survival. Individuals with extensive disease or incomplete cytoreduction rarely benefit, and are mainly exposed to the risks of a major surgery. Reliable preoperative assessment of both PCI scores and the likelihood of achieving CC-0 or CC-1 is therefore central to proper qualification of patients for CRS-HIPEC [3,4,6-8].

Preoperative staging is usually based on contrast-enhanced multidetector computed tomography (CT), supplemented by magnetic resonance imaging (MRI) or positron emission tomography (PET) in selected cases [9]. Although modern imaging has improved, multiple studies show that radiologic PCI often fails to match surgical findings [10-12]. CT both over- and underestimates disease extent, with particular difficulty in detecting small implants in the small bowel and mesentery [11,12]. As a result, some individuals who appear eligible for resection on imaging are found during laparotomy to have extensive disease that precludes

CC. These “open-close” procedures expose patients to operative risks and an interruption of systemic therapy without oncologic benefit, and they likely have an adverse impact on quality of life and time to disease progression [9].

Diagnostic or staging laparoscopy has been proposed as an additional tool in the preoperative work-up of patients considered for CRS-HIPEC [13-15]. Laparoscopy allows for direct visualization of the peritoneal cavity, mapping of disease distribution, and PCI estimation using the same regional and lesion size system as laparotomy [13,14]. The technique is already integrated into routine staging algorithms for advanced gastric and ovarian cancer, where it improves detection of occult peritoneal disease and helps avoid nontherapeutic laparotomy [16,17]. In the context of CRS-HIPEC, early reports suggest that diagnostic laparoscopy (DL) is feasible, has a low morbidity rate, and rarely delays definitive treatment [18]. Recently, several large single-center cohorts and a systematic review including more than 3500 patients have confirmed the safety and feasibility of DL, and have quantified its impact on avoiding nontherapeutic laparotomy [19,20].

More recent series indicate that adding DL to imaging can reduce the rate of nontherapeutic laparotomies and improve patient selection for CRS-HIPEC [19]. At the same time, consistent evidence from multiple contemporary cohorts shows that laparoscopic PCI systematically underestimates disease burden, most notably in the small bowel and mesenteric regions, which are the dominant laparoscopy blind spots and frequent causes of unexpected unresectability [21]. Patients who remain inadequately staged may still be subjected to open-close procedures, with the associated interruption of systemic therapy and poor prognosis [14]. This is especially relevant in individuals with borderline or equivocal findings on CT, where the decision to interrupt ongoing systemic treatment for a major operation is particularly delicate [22]. Recent outcome data of patients scheduled for CRS-HIPEC, but

ultimately not resected, highlight the urgent need for better preoperative distinction between truly resectable and unresectable cases [23].

Despite growing experience, the role of DL in CRS-HIPEC pathways remains heterogeneous. Indications, timing in relation to systemic therapy, technical protocols, and reporting standards differ between centers, and there is no widely accepted laparoscopic scoring system specifically tailored for CRS-HIPEC decision-making [24]. The balance between potential benefits of improved staging and the additional invasiveness of a staging operation is still not clearly defined, particularly in patients at the edge of institutional PCI limits or with indeterminate imaging.

Aim

The aim of this review was to summarize the evidence on DL as a tool for the qualification of patients with PMs for CRS-HIPEC. We focused on feasibility, diagnostic accuracy, impact on patient selection and treatment pathways, and comparisons with imaging alone. We also identified gaps in the literature and proposed priorities for future research. In doing so, we sought to clarify in which clinical scenarios DL added most value, and how it might be integrated into contemporary multimodal staging algorithms for patients considered for CRS-HIPEC. The pathway illustrating DL integration into the diagnotic and treatment pathway is presented in Figure 1.

Materials and methods

The methods used for this review were defined a priori and followed a structured approach to literature identification, screening, and thematic analysis.

Search strategy A comprehensive search of the PubMed, MEDLINE, and Scopus databases was conducted. It included all articles published up to the most recent update of this review. The following keywords and controlled vocabulary terms were used in various combinations: “diagnostic laparoscopy,” “staging laparoscopy,” “peritoneal metastasis,”

“peritoneal carcinomatosis,” “cytoreductive surgery,” “CRS,” “HIPEC,” “PCI,” and “cytoreduction.” Boolean operators were applied to broaden or narrow down the search, as appropriate. Reference lists of key articles and relevant reviews were examined to identify additional studies not retrieved through the database search.

Eligibility criteria The inclusion criteria were as follows: 1) adults with known or suspected PM from any primary tumor; 2) diagnostic or staging laparoscopy performed as part of preoperative evaluation for CRS or CRS-HIPEC; 3) reported outcomes related to diagnostic accuracy, PCI estimation, resectability, conversion to CRS-HIPEC, nontherapeutic laparotomy, perioperative morbidity, or survival; and 4) study design involving retrospective or prospective cohorts, diagnostic accuracy analyses, or structured reviews from expert groups.

The exclusion criteria comprised: 1) case reports and case series with fewer than 10 patients; 2) studies focused on laparoscopy for malignancies where CRS-HIPEC was not considered; and 3) reviews without primary data, unless they contributed relevant context or high-level synthesis. No language restrictions were applied if an English abstract was available.

Study selection Titles and abstracts were screened to determine relevance. Full-text articles were reviewed when eligibility could not be confirmed based on the abstract. When multiple publications originated from the same institution and overlapped patient cohorts, the most complete or most recent dataset was used to avoid duplication. Discrepancies in the selection were resolved by consensus.

Data extraction Data were extracted into a structured template. The extracted items included: study design, sample size, primary tumor type, indications for laparoscopy, timing relative to systemic therapy, PCI score at laparoscopy and laparotomy, criteria for resectability, rate of conversion to CRS-HIPEC, nontherapeutic laparotomy rates,

perioperative morbidity, and follow-up duration. Key methodological features and limitations were also recorded.

Synthesis and analysis Given the heterogeneity in study design, patient populations, and reporting of outcomes, a quantitative meta-analysis was not planned. Instead, a thematic narrative synthesis was performed. Studies were grouped according to major domains of interest: technical feasibility and safety, accuracy of PCI estimation, prediction of CC, impact on selection for CRS-HIPEC, effect on nontherapeutic laparotomy, and integration with imaging-based staging.

Patterns, discrepancies, and evidence gaps were identified through comparative reading of all eligible studies. When available, findings regarding specific tumor types were analyzed separately due to their distinct biology and selection criteria.

Role of the Peritoneal Cancer Index and completeness of cytoreduction scores

Since PCI and CC scores are central to CRS-HIPEC decision-making, particular attention was paid to how studies reported the possibility of estimating PCI and predicting the likelihood of achieving CC-0 or CC-1 via laparoscopy. Differences in scoring techniques, underestimation patterns, and small bowel assessment were examined and incorporated into the synthesis.

Quality considerations The review considered methodological strengths and limitations of the included studies. Retrospective design, verification bias, inconsistent reporting of PCI components, and heterogeneous laparoscopic techniques were identified as common issues affecting quality. These factors were taken into account when interpreting the results.

Statistical analysis Due to the heterogeneity in tumor types, study designs, and reported outcomes, no formal meta-analysis was performed. The data were summarized descriptively as counts, percentages, and ranges.

Results

Study characteristics A total of 29 studies were included, comprising retrospective and prospective cohort studies, multicenter diagnostic accuracy trials, population-based analyses, and systematic reviews. The characteristics of all included studies are presented in Table 1. Sample sizes ranged from 11 to 744 patients in original cohorts, with several large series reporting more than 100 DLs. Tumor types included colorectal and appendiceal PMs, gastric cancer (GC), ovarian cancer, pseudomyxoma peritonei, peritoneal mesothelioma, urachal adenocarcinoma, and mixed peritoneal surface malignancies. Three publications were narrative reviews, and 1 was a systematic review and meta-analysis encompassing 3820 patients.

Across all original cohorts, a total of 3632 DLs were reported, with 3569 successfully completed (98.3%). The rates of exclusion from CRS-HIPEC varied widely depending on tumor type and study design, ranging from 7% in selected ovarian cancer cohorts to more than 50% in mixed-disease HIPEC populations.

Feasibility and success of diagnostic laparoscopy DL was feasible in most patients, with technical success rates consistently above 95% in the majority of studies. The largest series reported success rates of 99%–100%, while smaller cohorts that included patients with extensive prior surgery or radiologic suspicion of adhesions reported lower, but still favorable, rates of 86%–96% [25].

Reasons for incomplete laparoscopic assessment included dense adhesions, restricted access, or inability to safely visualize small bowel loops or subphrenic spaces. Conversion to open staging occurred in 10%–20% of the cases in some colorectal cohorts, particularly in patients with prior operations, but rarely resulted in major morbidity. Across the studies, DL was typically completed within 20–40 minutes, and median length of hospital stay ranged from same-day discharge to 48 hours.

Exclusion from cytoreductive surgery combined with hyperthermic intraperitoneal chemotherapy and avoidance of nontherapeutic laparotomy DL identified unresectable disease in a substantial proportion of patients. Across all cohorts, the exclusion rates were as follows: 7.1% in a large ovarian cancer series (n = 350) [26], 12%–18% in colorectal PM–specific cohorts (n = 112; n = 85) [19,27], 27%–34% in mixed-tumor populations (n = 73; n = 197; n = 217) [13,28,29] 45%–55% in heavily pretreated or postsurgical patients (n = 102; n = 141; n = 31) [30-32], and up to approximately 50% in the largest single-center study (n = 744)[15].

Overall, across 3632 procedures, 1034 patients (approximately 28.5%) were excluded from CRS-HIPEC based on laparoscopic findings in published studies. Common reasons for exclusion comprised: high PCI scores exceeding institutional thresholds, diffuse small bowel or mesenteric involvement, disease at the porta hepatis, pancreatic capsular invasion, or retroperitoneum, and complete absence of peritoneal disease in some imaging-positive patients [13,15,27,28,30,31].

Several studies directly evaluated the effect of DL on nontherapeutic laparotomy rates. In colorectal cohorts, the introduction of DL reduced open-close laparotomy rates from 35.4% to 21%, and from 32.5% to 18% in before / after institutional comparisons [19,27]. In GC, staging laparoscopy resulted in 30% of the patients avoiding laparotomy altogether.

Overall, these data demonstrate that DL prevents a clinically meaningful number of futile laparotomies and contributes to more efficient patient selection [17].

Accuracy of the Peritoneal Cancer Index estimation and prediction of resectability

Several studies compared PCI scores in laparoscopy with those in open surgery. A consistent pattern of PCI underestimation was observed: 1) underestimation in 62.8% (n = 43) [21] and 44% (n = 50) of the cases [33]; 2) median PCI difference of 11 vs 17 (ovarian cancer)[34]; 3) a delay-dependent increase of approximately 0.2 PCI points per day between

laparoscopy and laparotomy [34]; and 4) good agreement in omental, pelvic, and diaphragmatic regions, but persistent limitations in small bowel and mesenteric regions [16,21,34,35].

Despite underestimation, laparoscopy provided high predictive accuracy for resectability in many cohorts: 1) positive predictive value (PPV) of 83%–88% in early HIPEC series [32,36]; 2) PPV of approximately 63% in more heterogeneous or complex populations [14]; 3) PPV of over 90% in several ovarian cancer studies [16,34,35]; 4) pooled PPV of 93% (a meta-analysis of 25 studies)[20].

Sensitivity and specificity were extremely high in accuracy studies [35] (sensitivity, 98.3%; specificity, 80.4%; accuracy, 95.7%).

The meta-analysis further demonstrated pooled sensitivity of 98.26%, pooled specificity of 83.67%, diagnostic odds ratio of 139, and area under the curve of 0.96 [20].

Together, these findings show that while PCI numeric estimates may be imprecise, DL is highly effective in identifying patients in whom CC is realistically achievable.

Comparison with cross-sectional imaging Cross-sectional imaging consistently underperformed, as compared with DL. CT-based PCI overestimated resectability (89% vs 84.8% with DL), and frequently failed to detect small-bowel disease [19]. In several studies, laparoscopy identified occult carcinomatosis despite negative CT findings (16%) [32], a PCI score above 20 despite normal imaging [27,32], and disease distributions that contraindicated CRS-HIPEC but were not visible radiologically [13,19,27,32].

MRI improved detection in selected settings but remained limited for small-bowel serosal disease. PET-CT added value for detecting extraperitoneal metastasis but did not reliably quantify PCI.

Altogether, laparoscopy provided the most accurate preoperative assessment of small volume and small-bowel disease—key determinants of operability.

Impact on cytoreductive surgery combined with hyperthermic intraperitoneal chemotherapy completion rates In several studies, the introduction of DL improved the proportion of patients achieving optimal cytoreduction: CC-0/1 of 85% with vs 67% without DL[18]. CRS completion improved from 56% to 70% after DL adoption[14], CRS-HIPEC completion rate rose to 68.7% after DL screening [29], and CRS-HIPEC was performed in 85.4% of patients selected for HIPEC after DL [13].

These findings suggest that, beyond excluding patients with extensive disease, DL enhances positive predictive selection, ensuring that patients who proceed to CRS-HIPEC are those most likely to benefit from it.

Safety of diagnostic laparoscopy Across all studies, DL demonstrated a remarkably low complication profile, with major morbidity typically in the range of 0%–3%, mortality rate of 0% in all series, rare port site metastases (reported in a very few early cases), and typical complications involving minor serosal injuries, trocar site infections, and diaphragm or bowel perforation (<2%) [13,15,18,28,31,32].

Large cohorts (744, 351, and 197 cases) study [15,28,37] consistently reported morbidity below 2% and no mortality. In the studies comparing DL vs exploratory laparotomy, laparoscopy showed substantially lower complication rates and shorter length of hospital stay [13,18]. One study [38]reported an increased risk of abdominal wall metastases (25% vs 3%), though this finding likely reflects selection bias and staging-to-surgery delays rather than laparoscopy-related issues itself. Overall, DL is a safe procedure with excellent tolerability, even in patients with prior surgeries.

Disease-specific observations In the cases of colorectal PM, DL prevented 12%–40% of futile laparotomies and improved CRS completion [14,19,27,39]. Small bowel involvement was the dominant limiting factor. PCI underestimation was common but clinically manageable [21,27,33]. In ovarian cancer, DL demonstrated high negative predictive value

and excellent accuracy [16,35,40]. Structured scoring systems (MitoScore / Fagotti)[16] showed reproducibility across centers. With regards to GC, staging laparoscopy excluded approximately 30% of the patients from unnecessary laparotomy in population-scale data, and is considered standard in many programs [5,17]. In appendiceal cancer / pseudomyxoma peritonei, DL proved useful in detecting disease distribution but less essential in obvious high-volume mucinous cases [13,14,36]. Finally, in the case of urachal adenocarcinoma, DL combined with cytology significantly improved sensitivity, as compared with imaging alone 41].

Summary of key findings The summary of the most important quantitative findings is presented in Table 2. The results demonstrate that DL is highly feasible, safe, and clinically impactful. It improves patient selection for CRS-HIPEC, reduces nontherapeutic laparotomy, and identifies key anatomic predictors of resectability, particularly small bowel involvement, more accurately than imaging alone [15,19,20,27,29,42].

Discussion

This review demonstrates that DL has an important role in the preoperative evaluation of patients considered for CRS-HIPEC. Across 29 studies and over 3600 reported procedures, DL was feasible in nearly all patients, and major morbidity remained low [15,18,20]. The high completion rate of DL, combined with a complication rate below 2% in most cohorts, confirms that it is a safe staging tool, even in patients with prior abdominal surgeries or suspected adhesions [13,15,31]. These characteristics make it suitable for routine use in specialized centers that manage peritoneal surface malignancies. The oncologic safety of laparoscopy is also supported by evidence from minimally-invasive GC surgery, where no increased risk of peritoneal dissemination or adverse survival outcomes have been observed following laparoscopic approaches [43].

A central finding of this review is the consistent ability of DL to refine patient selection for CRS-HIPEC. Across the studies, approximately 25%–50% of the patients were excluded from CRS-HIPEC based on laparoscopic findings [15,30,32]. The dominant reason for exclusion was extensive disease of the small bowel or mesentery [14,19,26]. These patterns confirm that the small bowel is both the most critical site for determining resectability and the most difficult domain for imaging. By identifying patients who would not benefit from CRS-HIPEC, laparoscopy reduces the number of nontherapeutic laparotomies and limits the exposure of patients to unnecessary surgical risks [15,19,27]. Early exclusion also shortens the time to initiate more appropriate therapies, such as systemic treatment or palliative care, which is particularly important in aggressive tumor biology [18,23].

DL also supports the selection of patients who are likely to achieve CC. Several studies showed that patients selected through laparoscopy had higher rates of CC-0 or CC-1 resections than those assessed via imaging alone [14,18,32,36]. This supports the role of laparoscopy as a gatekeeper that improves the alignment between operative intention and outcome. Predictive accuracy for CC was high in many cohorts, with PPVs frequently between 80% and 90% [32,36]. Such performance indicates that DL can reliably identify individuals who will benefit most from CRS-HIPEC.

DL performed better than cross-sectional imaging across all tumor types. CT often underestimated small peritoneal deposits, struggled with small-bowel and mesenteric disease, and overestimated the number of patients who appeared eligible for CRS-HIPEC [11,12,22]. MRI offered advantages in selected settings but still lacked accuracy for small bowel involvement [9,10]. PET-CT was useful for identifying extraperitoneal metastases but was limited in assessing tumor burden within the peritoneal cavity [9,10]. In contrast, laparoscopy allowed for direct visualization of the peritoneal surfaces and provided more reliable identification of occult disease [16,17,19,32]. In GC, population-based data confirmed that

staging laparoscopy prevented numerous unnecessary laparotomies [17]. In colorectal PM, DL reduced the rate of open-close procedures and clarified resectability in patients with equivocal imaging. In ovarian cancer, laparoscopy provided high predictive accuracy for cytoreduction and significantly reduced the number of nontherapeutic laparotomies when combined with cross-sectional imaging [16,26,35].

Despite its strengths, DL has recognized limitations. Across several studies, laparoscopic PCI underestimated operative PCI in a substantial proportion of patients. Underestimation occurred most often in the small bowel regions, which remain difficult to inspect completely on laparoscopy [21,33-35]. In spite of this, it should not discourage routine use of this procedure. Instead, it highlights the need to interpret laparoscopic findings in conjunction with imaging, tumor biology, and institutional resectability criteria [24,34]. Efficient decision-making is still possible when DL is used as a qualitative tool rather than a strict quantitative estimator of PCI.

The potential influence of DL on treatment timing deserves attention. Patients who undergo only imaging may proceed directly to laparotomy and face delays in receiving systemic therapy if the operation is aborted [19,23,27]. DL can identify unresectable disease in a minimally-invasive setting, and allows patients to start systemic therapy sooner [18,19,27]. This is clinically relevant in borderline imaging cases and in individuals at a risk of progression due to unnecessary surgical recovery [18,23]. Several studies in this review showed no increase in time to CRS-HIPEC among patients who underwent laparoscopy. This supports the conclusion that DL does not delay definitive treatment and may instead accelerate the transition to the most appropriate therapy [13,18,29].

Another area of interest is the use of DL in conversion strategies. In some studies, patients with high disease burden who were excluded on laparoscopy underwent systemic therapy and later achieved eligibility for CRS-HIPEC [13,29]. This reinforces the role of DL not only as a

selection tool but also as a staging checkpoint that supports treatment sequencing. Such an approach can improve the therapeutic window for individuals who respond to systemic therapy [13,24,29].

The proposed DL-integrated pathway (Figure 1) translates the evidence reviewed above into a practical decision framework. It positions laparoscopy as an intermediate staging step in patients with borderline or equivocal imaging, with particular emphasis on small bowel and mesenteric assessment. The algorithm should be interpreted flexibly according to tumor biology, institutional PCI thresholds, and the likelihood of achieving CC.

Conclusions

DL is a safe and reliable tool for evaluating patients with PM who are being considered for CRS-HIPEC. It provides information that is not available through cross-sectional imaging and improves the accuracy of preoperative staging, particularly in regions that determine resectability, such as the small bowel and mesentery. Across diverse tumor types, DL reduces the number of nontherapeutic laparotomies and supports earlier access to the most adequate treatment. It also enhances the likelihood of achieving CC by improving patient selection. Although DL may underestimate PCI in some patients, especially in small bowel regions, this limitation can be managed by interpreting findings together with imaging and tumor biology. The overall benefits remain significant. When incorporated into a structured staging pathway, DL improves the quality of surgical decision-making and contributes to more efficient use of resources in specialized peritoneal malignancy programs.

Future works should focus on standardizing laparoscopic assessment techniques, validating tumor-specific scoring systems, and clarifying the optimal timing of DL within multimodal treatment sequences. Prospective studies are also needed to better define its impact on long-term outcomes. Based on current evidence, DL should be considered an important component in the preoperative evaluation of patients undergoing CRS-HIPEC.

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Contribution statement MK conceived the concept of the study and designed the review methodology. MK and PL conducted the literature search and data extraction. MK, JW, and BK contributed to data interpretation and synthesis of the evidence. PM and MP critically revised the manuscript for important intellectual content. JO contributed radiological perspective and interpretation of imaging-related data. TJ and MB provided senior surgical and oncological oversight and contributed to critical revision of the manuscript. All authors participated in drafting or revising the manuscript and approved the final version to be submitted.

Conflict of interest None declared.

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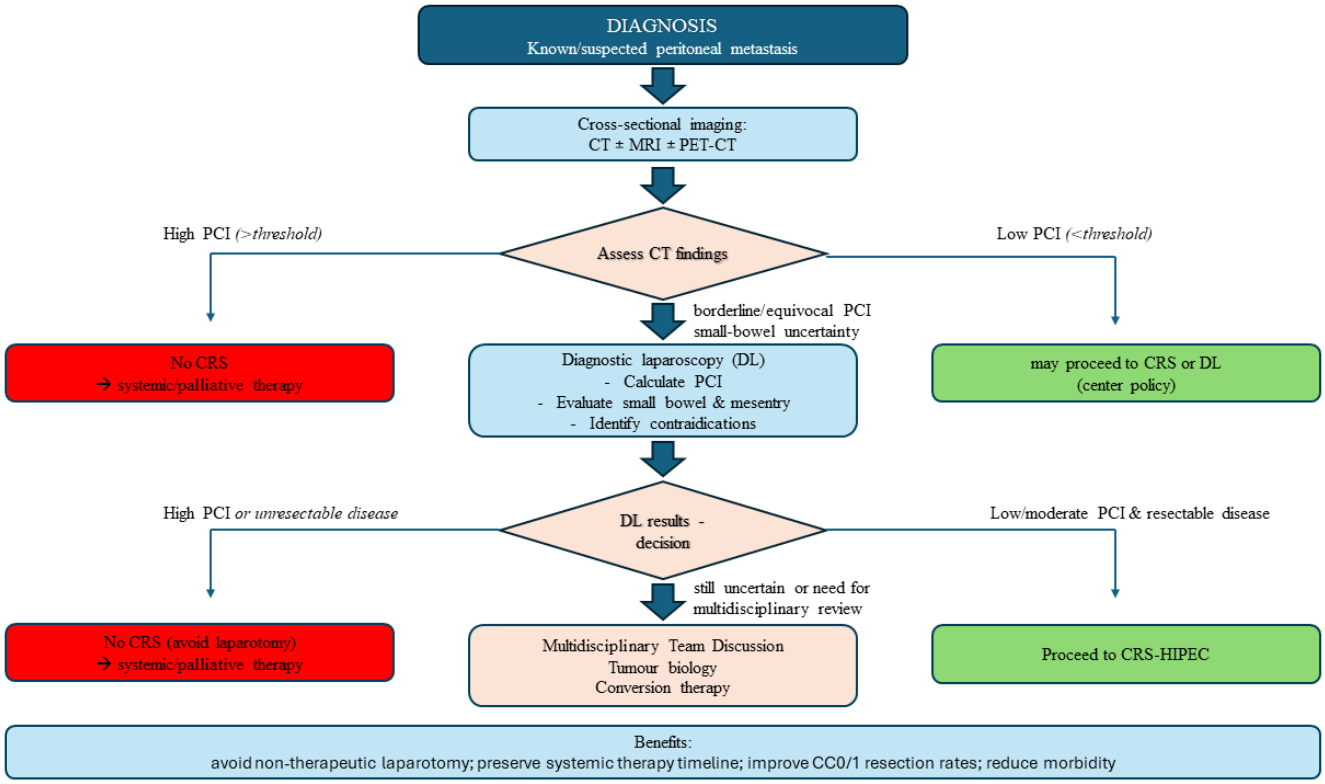

Figure 1 Proposed diagnostic laparoscopy–integrated staging pathway for patients with peritoneal metastasis considered for CRS-HIPEC; algorithm integrating diagnostic laparoscopy after cross-sectional imaging in patients with borderline / equivocal findings, emphasizing assessment of small bowel / mesenteric involvement, avoidance of nontherapeutic laparotomy, and optimization of selection for CRS-HIPEC; adaptable to tumor type and institutional PCI thresholds

Abbreviations: CRS-HIPEC, cytoreductive surgery combined with hyperthermic intraperitoneal chemotherapy; CT, computed tomography; MRI, magnetic resonance imaging; PET, positron emission tomography; others, see Table 1

Table 1 Characteristics of the studies evaluating diagnostic laparoscopy before cytoreductive surgery combined with hyperthermic intraperitoneal chemotherapy

No	Author, year	Country	Study type	Tumor type	Sample size, n	DL success rate, %	Excluded on DL, %
1	Federici et al, [15] 2019	Italy	Retrospective	Mixed (GI, gynecological, and PMP)	744	99.73	50.3
2	Acs et al, [24] 2022	Germany	Review	Mixed PM	–	NA	NA
3	Hanna et al, [18] 2022	United States	Retrospective	Appendix, CRC, and mesothelioma	68	100	Not evaluated
4	Bravo et al, [32] 2018	United States	Retrospective	Appendix, CRC, and GC	31	100	54.8
5	Iversen et al, [14] 2013	Denmark	Prospective	CRC, appendix, and PMP	45	96	40
6	Garofalo et al, [28] 2009	Italy	Retrospective	Mixed PM	197	99.49	34
7	Karanicolas et al ,[17] 2011	United States	Retrospective	GC	506	No data	30
8	Valle et al, [37] 2012	Italy	Review + cohort	Mixed PM	351	99.7	29.6
9	Leimkühler et al, [19] 2020	Netherlands	Retrospective	Colorectal cancer	112	96	12
10	Tabrizian et al, [29] 2015	United States	Multi-institutional	Mixed PM	217	92.6	31.3

11	Yurttas et al, [21] 2022	Germany	Retrospective	Mixed PM	43	100	20.9, open-close at laparotomy
12	von Breitenbuch et al, [30] 2018	Germany	Retrospective	Mixed PM	102	96	45
13	Angeles et al, [34] 2021	France	Retrospective	Ovarian cancer	43	100	0
14	Ahmed et al, [35] 2019	Egypt	Prospective	Ovarian cancer	85	100	0
15	Hentzen et al, [27] 2020	Netherlands	Retrospective	Colorectal cancer	85	74.1 (conversion rate, 21.2)	17.6
16	Pomel [36] (2005)	France	Retrospective	CRC, mesothelioma, and ovarian cancer	11	100	27
17	Valle [25] (2006)	Italy	Retrospective	Mixed PM	97	98.9	16.5
18	Fagotti et al, [16] 2013	Italy	Multicenter trial	Ovarian cancer	120	100	Not applicable (aim was accuracy, not selection for CRS)
19	Stokkel et al, [41] 2020	Netherlands	Retrospective	Urachal cancer	32	100	22
20	Marmor et al, [31] 2015	United States	Retrospective	Appendix, CRC, mesothelioma	141	97.9	51.2
21	Tozzi et al, [26] 2021	United Kingdom	Prospective	Ovarian cancer	350	100	7.1

22	Passot et al, [33] 2018	France	Prospective	Colorectal cancer	50	88	NA
23	Varnoux et al, [40] 2013	Framce	Prospective	Ovarian and uterine cancer	29	100	62
24	Yan et al, [39] 2007	Australia	Review	Colorectal cancer	NA	NA	NA
25	Ghanipour et al, [38] 2025	Sweden	Prospective	Colorectal cancer	32	100	25
26	Jayakrishnan et al, [13] 2014	United States	Retrospective	Mixed PM	73	86.3	27.7
27	Seshadri et al, [42] 2016	India	Review	Mixed PM	11 (review synthesizing major DL series)	85–100	7–41 studies excluded due to unresectable disease or no carcinomatosis
28	Ang et al, [20] 2024	Singapore	Systematic review	Mixed PM	25 studies (n = 3820)	Pooled success >95 (from individual study characteristics)	Not pooled; individual studies ranged from 7–41 (matching dataset)

Abbreviations: CC, completeness of cytoreduction; CRC, colorectal cancer; CRS, cytoreductive surgery; DL, diagnostic laparoscopy; GC, gastric cancer; GI, gastrointestinal; NA, not available; PCI, Peritoneal Cancer Index; PM, peritoneal metastasis; PMP, pseudomyxoma peritonei

Table 2 Summary of key quantitative findings		
Outcome	**Key finding**	**Value**
Overall DL volume	Total number of DL procedures	3632
Feasibility	DL success rate	98.3%
Impact on patient selection	Patients excluded from CRS-HIPEC	Approximately 28.5%
Reduction of futile laparotomy	GC	Approximately 30%
	Colorectal PM	Approximately 12%–17%
	Ovarian cancer (CT → CT+DL)	Approximately 58%
Accuracy of disease burden assessment	PCI underestimation frequency	40%–63% in mixed cohorts
Prediction of resectability	PPV for CC (CC-0/1)	80%–95%
Safety	Major morbidity	<2% across most cohorts
Pooled diagnostic performance (meta-analysis)	Sensitivity	98%
	Specificity	84%
	AUC	0.96
Abbreviations: AUC, area under the curve; PPV, positive predictive value; others, see Table 1 and Figure 1		

Short title: Diagnostic laparoscopy for CRS-HIPEC selection