

Thermal Therapies in The Multidisciplinary Management of Peritoneal Metastases

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ABSTRACT

ARTICLE DETAILS

Background: Peritoneal metastases arise from biologically distinct tumors and require treatment to be matched to disease distribution. Radiofrequency ablation, microwave ablation, and high-intensity focused ultrasound are focal procedures, whereas cytoreductive surgery with hyperthermic intraperitoneal chemotherapy is directed at the peritoneal cavity.

Methods: PubMed/MEDLINE was searched from inception to 10 July 2026. Randomized trials, prospective studies, major cohorts, technical consensus documents, and disease-specific guidance were prioritized. Evidence from non-peritoneal abdominal tumors was included only to define the established role and limitations of focal ablation.

Results: Focal ablation may be useful for a targetable visceral metastasis, isolated implant, oligoprogression, or symptom palliation in a patient who also has peritoneal disease; it is not intended to control diffuse peritoneal spread. Cytoreductive surgery with hyperthermic intraperitoneal chemotherapy remains the principal cavity-directed thermal strategy, but its value is tumor- and protocol-specific. Thirty-minute oxaliplatin hyperthermic intraperitoneal chemotherapy did not improve survival after complete cytoreduction in colorectal peritoneal metastases. Randomized gastric-cancer studies, including PERISCOPE II, do not support routine gastrectomy plus cytoreductive surgery and hyperthermic intraperitoneal chemotherapy. The strongest randomized evidence supports cisplatin hyperthermic intraperitoneal chemotherapy during interval cytoreductive surgery for selected stage III epithelial ovarian cancer. Practice in pseudomyxoma peritonei and diffuse malignant peritoneal mesothelioma relies mainly on specialized-center data and consensus.

Conclusions: Thermal modalities should be judged against the clinical task they are designed to perform. Focal ablation is a selective local-control tool; cytoreductive surgery with hyperthermic intraperitoneal chemotherapy is a configurable locoregional platform whose benefit depends on primary tumor, burden, completeness of cytoreduction, regimen, and center expertise.

Abbreviations: CRS, cytoreductive surgery; DMPM, diffuse malignant peritoneal mesothelioma; HIFU, high-intensity focused ultrasound; HIPEC, hyperthermic intraperitoneal chemotherapy; MDT, multidisciplinary team; MWA, microwave ablation; OS, overall survival; PCI, Peritoneal Cancer Index; PFS, progression-free survival; PM, peritoneal metastases; PMP, pseudomyxoma peritonei; RFA, radiofrequency ablation.

KEYWORDS: peritoneal metastases; thermal ablation; hyperthermia; cytoreductive surgery; hyperthermic intraperitoneal chemotherapy; radiofrequency ablation; microwave ablation; high-intensity focused ultrasound

Published On:
14 July 2026

Available on:
<https://ijmir.com>

1. INTRODUCTION

Peritoneal metastases (PM) are not a single biological entity. They arise from tumors with different patterns of spread, sensitivity to systemic therapy, and natural history, yet they share a difficult anatomical compartment. Small deposits are frequently underestimated on cross-sectional imaging, implants may occupy several peritoneal regions, and progression can lead

to ascites, bowel obstruction, malnutrition, and loss of performance status [1-3]. This combination of biological diversity and compartmental disease explains why management usually requires more than one treatment modality.

Heat-based interventions occupy two distinct places in this setting. Radiofrequency ablation (RFA), microwave ablation (MWA), and high-intensity focused ultrasound (HIFU) are lesion-directed procedures: they are used to destroy or palliate a defined target. Cytoreductive surgery (CRS) followed by hyperthermic intraperitoneal chemotherapy (HIPEC) is different. CRS removes visible disease, whereas HIPEC exposes the peritoneal cavity to heated chemotherapy in an attempt to treat microscopic residual deposits. The fact that focal ablation cannot treat diffuse peritoneal spread is therefore not a defect in the evidence or in the technology; it simply reflects a different indication.

This distinction matters in everyday multidisciplinary practice. A patient with PM may also have a small liver metastasis, a solitary resistant deposit, or a painful mass that remains technically targetable after systemic therapy. In that situation, focal ablation can serve a rational local-control objective even though it does not address the entire peritoneal compartment. Conversely, cavity-directed treatment is unlikely to succeed when complete macroscopic cytoreduction is impossible. The present review examines thermal therapies according to the disease compartment they are designed to treat, the clinical objective they can realistically achieve, and the quality of evidence supporting that use.

2. LITERATURE SEARCH AND REVIEW SCOPE

A structured PubMed/MEDLINE search was updated on 10 July 2026. Search terms covered peritoneal metastasis, peritoneal carcinomatosis, pseudomyxoma peritonei, peritoneal mesothelioma, hyperthermia, thermal ablation, radiofrequency ablation, microwave ablation, focused ultrasound, cytoreductive surgery, and HIPEC. Reference lists of pivotal trials, consensus statements, and major reviews were screened to identify additional studies.

Randomized trials, prospective studies, large comparative cohorts, technical consensus documents, and disease-specific guidelines were prioritized. For RFA, MWA, and HIFU, evidence from hepatic or other abdominal tumors was retained because these studies define the technologies' established lesion-directed role, technical limits, and expected outcomes. Such data were not used as proof that focal ablation controls diffuse PM. Owing to marked heterogeneity in tumor origin, procedural technique, systemic therapy, and endpoints, the evidence was synthesized narratively rather than pooled.

3. BIOLOGICAL BASIS OF THERMAL TREATMENT

3.1 Temperature, exposure time, and direct injury

Thermal effect depends on more than a nominal temperature. Duration of exposure, tissue perfusion, spatial coverage, and the sequence of heat with other therapies all influence biological response. Mild hyperthermia, commonly delivered at approximately 40-43 degrees C, acts mainly as a sensitizer. Ablation uses substantially higher temperatures to produce irreversible cell injury and coagulative necrosis [4-6]. Conflating these temperature ranges leads to misleading comparisons because their therapeutic objectives are not the same.

At ablative temperatures, protein denaturation, membrane disruption, mitochondrial damage, and microvascular thrombosis contribute to cell death. Mild heating, by contrast, can increase perfusion and oxygenation in some tumors and may reduce hypoxia-mediated resistance to radiation [7,8]. The response is not uniform: excessive heating may collapse microvessels and lower perfusion, while heterogeneous tissue composition can leave a viable rim at the treatment margin.

3.2 Drug transport and DNA repair

Hyperthermia can alter membrane permeability and drug transport, thereby increasing the cytotoxicity of selected agents. It also suppresses homologous recombination through BRCA2 degradation and affects several other DNA-repair pathways [9,10]. These findings support combinations with radiation, platinum compounds, and DNA-damaging therapy, but a plausible mechanism is not equivalent to clinical efficacy. The target must receive an adequate and reproducible thermal dose, and the drug must reach the relevant tissue at the appropriate time.

3.3 Immune consequences of heating and ablation

Thermal stress changes antigen release, heat-shock protein expression, vascular adhesion, and lymphocyte trafficking. Ablative injury may provide an in situ source of tumor antigens, while non-ablative heating may alter the local immune microenvironment [11-13]. The direction and magnitude of the immune response depend on thermal dose and tissue context. Complete coagulation can destroy resident immune cells and vessels; sublethal heating may preserve a better platform for immune priming. These observations justify translational studies, but no heat-immunotherapy combination is currently an established treatment for PM.

3.4 Delivery is the central technical problem

The peritoneal cavity is not a homogeneous container. Adhesions, recesses, tumor nodules, bowel motion, and uneven fluid circulation produce variations in temperature and drug exposure. Focal ablation has a different set of constraints: safe access,

bowel proximity, respiratory movement, heat-sink effects, and the ability to create an adequate margin. In both settings, the practical question is the same: can the intended dose be delivered to the intended tissue without unacceptable injury?

4. LESION-DIRECTED THERMAL ABLATION IN PATIENTS WITH PERITONEAL METASTASES

RFA, MWA, and HIFU should be assessed as focal treatments. Their inclusion in a review of PM is clinically relevant because PM often coexists with targetable visceral metastases or oligoprogressive lesions. The appropriate endpoint is local control of the treated target, symptom relief, or delay of a more morbid procedure, not eradication of diffuse peritoneal disease.

4.1 Radiofrequency ablation

RFA delivers alternating electrical current through an electrode, producing ionic agitation and frictional heat. Its performance depends on lesion size, electrode geometry, tissue conductivity, blood flow, and the achieved ablative margin. RFA is mature in liver-directed oncology, but it remains vulnerable to heat-sink effects near large vessels and to incomplete treatment when the lesion is large or irregular [14-16]. Adjacent bowel, stomach, biliary structures, and ureters may narrow the safety margin in abdominal or peritoneal targets.

Large liver-metastasis series show that local tumor progression is strongly related to lesion size, margin, and proximity to vessels [17,18]. Randomized and comparative studies in colorectal and gastric liver metastases support RFA as part of a local-treatment strategy in selected patients, usually alongside systemic therapy [19,20]. These results are useful when a patient with PM also has a limited visceral target. They should not be converted into a claim that RFA treats the peritoneal cavity.

Direct ablation of a peritoneal implant is occasionally feasible, particularly when the lesion is solitary, well visualized, separated from bowel, and accessible with image guidance. In practice, such cases require hydrodissection or other protective maneuvers more often than routine liver ablation. The decision should be framed around a specific objective: control of an isolated resistant focus, palliation of pain, or avoidance of a more invasive operation.

4.2 Microwave ablation

MWA produces dielectric heating through oscillation of polar molecules in an electromagnetic field. Compared with RFA, it can heat tissue more rapidly, generate higher intratumoral temperatures, create larger active heating zones, and show less sensitivity to heat sink. Randomized liver-tumor studies and surgical series confirm that both techniques can achieve high technical success, although differences in local progression vary with device, tumor type, and operator experience [21-23].

MWA has been used for lesions that are relatively large, close to vessels, or treated with multiple simultaneous antennas. Retrospective and randomized studies nevertheless show that technical advantage does not remove the need for adequate margins, careful trajectory planning, and post-ablation imaging [24,25]. For a patient with PM, MWA is most defensible when the target is discrete and its control is expected to alter symptoms or the course of multimodal treatment.

The broader liver-metastasis literature supports a selective role for percutaneous RFA or MWA, and recent reviews emphasize standardization of margin assessment and outcome reporting [26,27]. Published experience with direct peritoneal MWA is limited largely to technical reports and case-level evidence [27,28]. That scarcity does not make the procedure conceptually invalid; it means that the indication should be individualized and that outcomes should be described as focal rather than peritoneal-compartment control.

4.3 High-intensity focused ultrasound

HIFU concentrates externally generated ultrasound energy at a focal point, creating thermal coagulation and, depending on parameters, mechanical effects such as cavitation. It avoids needle placement and may be repeated, but its success depends on a clear acoustic window and stable visualization of the target [29,30]. Bowel gas, bone, depth, respiratory motion, and intervening scar tissue are particularly relevant in peritoneal disease.

Clinical experience in pancreatic and hepatic tumors suggests that HIFU can provide local control or symptom palliation without an incision [31-33]. These studies help define feasibility in abdominal oncology but do not establish a role in diffuse PM. The technique is most plausible for a clearly visible mass that can be reached without exposing bowel or other critical structures to unsafe energy.

Prospective and comparative series in difficult liver metastases have reported acceptable feasibility when resection and percutaneous ablation were unsuitable [34,35]. Such observations are relevant to multidisciplinary salvage decisions, especially when the objective is control of one lesion rather than conversion of the entire disease state.

Focused ultrasound also has a non-thermal research trajectory. Mechanical disruption can modify the tumor microenvironment and improve checkpoint-blockade responses in preclinical models, while thermal HIFU may increase antigen release and immune sensitization [36-38]. This field is promising, but evidence remains translational and should not be presented as a current PM indication.

4.4 Practical positioning of focal ablation

A focal procedure is most likely to add value when disease is otherwise controlled, the number of relevant targets is small, the lesion is technically accessible, and local failure would have a meaningful consequence. The procedure is less persuasive when rapid diffuse progression, uncontrolled extra-peritoneal disease, or multiple bowel-adjacent implants make repeated focal treatment unlikely to change outcome. A clear pre-procedure statement of intent-durable local control, symptom relief, or treatment of oligoprogression-prevents the modality from being judged against an endpoint it was never designed to meet.

5. CYTOREDUCTIVE SURGERY AND HYPERTHERMIC INTRAPERITONEAL CHEMOTHERAPY

5.1 Pharmacological rationale

HIPEC is delivered after surgical cytoreduction, when visible disease has been removed as completely as possible. Intraperitoneal administration creates a concentration gradient between the peritoneal cavity and plasma, allowing selected drugs to achieve high local exposure with slower systemic absorption [39-41]. Heat may enhance cytotoxicity, membrane transport, and DNA damage, but the magnitude of enhancement varies by drug and temperature.

Agent selection cannot be separated from thermal conditions. Mitomycin C, oxaliplatin, cisplatin, and other compounds differ in pharmacokinetics, heat synergy, exposure time, and organ toxicity [42-44]. A regimen should therefore be described as a package that includes drug, dose, carrier solution, target temperature, duration, flow, and technique. Calling all of these packages simply 'HIPEC' obscures clinically important differences.

Drug penetration from the peritoneal surface is shallow, generally measured in millimeters rather than centimeters. Surface exposure also becomes uneven when adhesions, bulky nodules, or incomplete fluid circulation are present [45,46]. HIPEC cannot compensate for substantial residual macroscopic disease; the biological rationale is strongest after complete or near-complete cytoreduction.

5.2 Patient selection and procedural quality

Selection begins with primary tumor biology, extent and distribution of PM, response to systemic therapy, extra-peritoneal disease, performance status, nutritional reserve, renal function, and the probability of complete cytoreduction. The Peritoneal Cancer Index is useful, but the same numerical score does not carry identical meaning across tumor types, particularly when the small bowel and mesentery are involved [47,48]. The relevant question is not merely whether the operation can be performed, but whether it can be completed with an acceptable balance of morbidity, oncological benefit, and recovery time.

Center experience matters because CRS-HIPEC combines complex peritonectomy, multivisceral resection, reconstruction, anesthesia, temperature control, and perioperative oncology. Quality reporting should include completeness of cytoreduction, drug and dose, inflow and outflow temperatures, duration, open or closed technique, major morbidity, readmission, reoperation, renal toxicity, and the interval to resumption of systemic treatment.

5.3 Colorectal peritoneal metastases

The historical randomized comparison by Verwaal and colleagues established that an aggressive locoregional strategy could improve outcome over the systemic therapy available at that time [49,50]. Interpretation changed after PRODIGE 7, in which adding 30-minute oxaliplatin HIPEC to complete CRS did not improve overall survival and increased late postoperative complications. The trial did not show that cytoreduction lacks value; it showed that this particular HIPEC regimen should not be assumed to add benefit after successful CRS.

Contemporary consensus therefore separates the role of CRS from the choice of HIPEC protocol. The 2022 PSOGI consensus did not support the short-duration high-dose oxaliplatin regimen used in PRODIGE 7 and favored investigation or conditional use of selected mitomycin C regimens [51-53]. The CAIRO6 program further examined perioperative systemic therapy around CRS-HIPEC. Its phase 2 work demonstrated feasibility, while the phase 3 results did not justify automatic perioperative treatment for every patient with resectable peritoneal-only disease.

Current pathways emphasize early referral to a peritoneal surface malignancy center, disease biology, and careful sequencing rather than an operation-first rule. Large observational data sets also show substantial treatment-selection effects, which limit simple comparisons between chemotherapy and surgery [54,55]. For colorectal PM, the defensible conclusion is that complete CRS remains central in selected patients; the additional contribution of HIPEC depends on the regimen and has not been established as uniform.

5.4 Gastric cancer with peritoneal metastases

Gastric PM has a more aggressive natural history and a narrower therapeutic window. Earlier randomized and propensity-adjusted studies suggested that CRS-HIPEC might improve disease control in patients with limited peritoneal burden and complete cytoreduction [56,57]. These studies were influential but were conducted in selected populations and with heterogeneous systemic treatment.

More recent randomized evidence has been sobering. GASTRIPEC-I did not improve overall survival, although progression-free and metastasis-free survival favored HIPEC. PHOENIX-GC, which tested intraperitoneal paclitaxel rather than intraoperative HIPEC, also illustrates the difficulty of demonstrating a survival advantage in this disease [58,59]. Together, these trials argue against treating all forms of intraperitoneal therapy as interchangeable.

PERISCOPE I established feasibility in a highly selected setting, but PERISCOPE II found no survival benefit from gastrectomy plus CRS-HIPEC over continued systemic therapy for limited PM or positive cytology after initial treatment; serious morbidity and treatment-related deaths were higher in the surgical arm [60,61]. Routine CRS-HIPEC cannot therefore be recommended for this population outside a trial or exceptionally selected multidisciplinary practice.

5.5 Epithelial ovarian cancer

The strongest randomized support for a defined HIPEC indication comes from OVHIPEC-1. In patients with stage III epithelial ovarian cancer who had received neoadjuvant chemotherapy and underwent interval cytoreductive surgery, cisplatin HIPEC improved recurrence-free and overall survival, and the advantage persisted on long-term follow-up [62,63]. This evidence is specific to interval surgery after neoadjuvant treatment and should not be generalized automatically to primary debulking, recurrent disease, or different regimens.

A separate randomized trial that included primary and interval cytoreduction was negative overall, with a benefit signal confined to the interval-surgery subgroup. International consensus consequently gives the clearest support to cisplatin-based HIPEC at interval CRS, together with nephroprotection and standardized delivery [64,65]. Questions remain about histological subtype, homologous recombination status, maintenance therapy, and the interaction between HIPEC and modern targeted agents.

5.6 Appendiceal tumors and pseudomyxoma peritonei

For appendiceal tumors and pseudomyxoma peritonei (PMP), CRS with intraperitoneal chemotherapy has become established in expert centers despite the absence of conventional randomized trials. The disease is biologically distinct from gastrointestinal adenocarcinoma: mucin distribution, grade, cellularity, and completeness of cytoreduction strongly influence outcome [66-68]. Registry analyses and consensus documents support CRS-HIPEC as a standard platform for operable PMP, while acknowledging uncertainty about the optimal drug and protocol.

5.7 Diffuse malignant peritoneal mesothelioma

Diffuse malignant peritoneal mesothelioma is rare, making randomized trials difficult. Disease-specific consensus recommends CRS-HIPEC for carefully selected patients in experienced centers, although certainty of evidence remains low [69,70]. Histology, nodal status, PCI, completeness of cytoreduction, and patient fitness are central to selection. The strength of the recommendation reflects both the long survival observed in selected cohorts and the limited effectiveness of systemic therapy alone.

6. COMBINATION STRATEGIES AND EMERGING DIRECTIONS

Thermal therapy is increasingly considered as one component of a sequence rather than a stand-alone intervention. For focal ablation, the most immediate combinations are with systemic therapy for oligoprogression, with surgery for parenchymal preservation, and with radiotherapy when lesions have different anatomical constraints [14-16]. The key research need is not to show that combinations are technically possible, but to identify whether they improve a patient-centered endpoint over the best single-modality alternative.

For HIPEC, future studies should separate the contribution of cytoreduction, heat, and intraperitoneal drug exposure. Trials that use different drugs, temperatures, and durations under one label make pooled interpretation unreliable [42-44]. Pharmacokinetic sampling, real-time temperature mapping, and protocol-specific toxicity reporting would make negative and positive studies more informative.

Biomarkers may refine selection, but no single marker is ready to replace clinical judgment. Circulating tumor DNA is attractive for postoperative risk assessment, yet low shedding from isolated peritoneal disease may reduce sensitivity. Ascites cytology, radiomics, molecular subtype, immune infiltration, and pharmacogenomic measures are likely to be most useful when combined with burden, resectability, and treatment-response data [54,55].

7. UNRESOLVED PROBLEMS AND RESEARCH PRIORITIES

First, the field needs precise terminology. Focal ablation, mild regional hyperthermia, and HIPEC should not be grouped as though they deliver the same dose to the same compartment. Second, procedural studies should report technical quality, not only survival. Ablative margin, local tumor progression, thermal coverage, completeness of cytoreduction, perfusion parameters, and postoperative recovery are necessary to understand why a treatment succeeded or failed [16,44].

Third, disease-specific trial design is essential. Colorectal, gastric, ovarian, appendiceal, and mesothelial disease should not be merged into a generic PM population. Even within one primary tumor, PCI distribution, histology, systemic response, and extra-peritoneal disease can alter the expected value of locoregional treatment [47,48].

Fourth, endpoints should reflect the treatment objective. Overall survival remains important, but symptom control, ascites, bowel function, time without systemic therapy, local progression, quality of life, readmission, and return to work may be more sensitive to a focal or palliative intervention. A well-chosen endpoint is particularly important for RFA, MWA, and HIFU, because their purpose is often control of a specific lesion rather than treatment of the entire metastatic compartment.

Finally, centralization should be treated as part of the intervention. Complex CRS-HIPEC and challenging abdominal ablation depend on case volume, imaging expertise, anesthesia, critical care, interventional radiology, surgical oncology, and medical oncology. Multicenter trials should measure center-level quality and use shared technical definitions; otherwise, procedural variation may overwhelm the biological question.

8. LIMITATIONS

This is a narrative review rather than a systematic review or meta-analysis. It does not include a prespecified risk-of-bias instrument, and the evidence spans different primary tumors, treatment eras, and procedural platforms. Direct PM-specific evidence for RFA, MWA, and HIFU remains limited; their discussion is intentionally based on their established focal role in abdominal oncology and on the clinical situations in which patients with PM may also require lesion-directed treatment. Several HIPEC indications rely on consensus or specialized-center cohorts rather than randomized evidence.

9. CONCLUSION

Thermal treatment in PM is best understood as a set of tools with different targets. RFA, MWA, and HIFU are focal modalities. They can be useful for a targetable visceral metastasis, an isolated peritoneal implant, oligoprogression, or symptom palliation, but they are not intended to treat diffuse peritoneal spread. Their value should be judged by local control and by whether controlling that lesion changes the patient's broader treatment course.

CRS-HIPEC is a cavity-directed strategy whose success depends first on patient selection and complete macroscopic cytoreduction, and then on the drug, thermal protocol, and center expertise. Evidence is disease-specific: short-duration oxaliplatin HIPEC has not improved survival after CRS for colorectal PM; randomized gastric data do not support routine CRS-HIPEC; cisplatin HIPEC at interval cytoreduction has the strongest trial support in ovarian cancer; and treatment of PMP and peritoneal mesothelioma remains concentrated in specialized centers. Progress will come from better technical reporting, biologically informed selection, and trials that compare each thermal intervention with the correct alternative for the clinical problem it is meant to solve.

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TABLES

Table 1. Clinical positioning of thermal modalities in peritoneal metastases.

Modality	Primary target and purpose	Potential role in a patient with PM	Principal constraints	Evidence interpretation
RFA	One discrete lesion; coagulative ablation	Small liver metastasis, isolated implant, or oligoprogressive focus	Heat sink, bowel proximity, lesion size, margin uncertainty	Established focal therapy in selected visceral tumors; not a treatment for diffuse PM [17,18]
MWA	One or several discrete lesions; rapid thermal ablation	Target near a vessel, larger focal lesion, or lesion requiring multiple antennas	Bowel injury, antenna trajectory, margin assessment, device variability	Technical advantages over RFA in some settings; PM evidence is limited to focal use [21,22]
HIFU	Non-invasive focal thermal or mechanical treatment	Clearly visualized mass with a safe acoustic window or palliative objective	Bowel gas, bone, motion, depth, uncertain margins	Feasible for selected abdominal tumors; investigational for PM targets [32,34]
CRS-HIPEC	Removal of macroscopic disease followed by cavity-wide heated chemotherapy	Disease-specific curative-intent or consolidative treatment after complete/near-complete cytoreduction	Major morbidity, shallow drug penetration, protocol heterogeneity	Best-established cavity-directed platform; benefit varies by tumor and regimen [44,46]

Table 2. Representative lesion-directed ablation evidence relevant to multidisciplinary management.

Modality/study	Population	Main observation	Relevance to patients with PM
RFA: Shady et al.; Ruers et al. [18,19]	Colorectal liver metastases	Local control and survival depend on selection, lesion size, and integration with systemic therapy	Supports treatment of a limited visceral target, not diffuse peritoneal disease
MWA versus RFA trials [21,22]	Primary and metastatic liver malignancies	Both modalities achieved high technical success; ablation-zone geometry and local progression differed by study	Choice should be based on target anatomy, device, and operator expertise
MWA metastasis reviews/series [26,27]	Liver metastases from colorectal and other primaries	Local control is feasible, but data are heterogeneous and largely non-randomized	Useful for an oligometastatic or oligoproliferative lesion within a broader plan
HIFU abdominal series [31-33]	Pancreatic cancer and primary/metastatic liver tumors	Non-invasive local treatment may improve symptoms or achieve local control in selected patients	Requires a safe acoustic window and a defined focal objective
HIFU difficult liver metastases [34,35]	Colorectal liver metastases unsuitable for resection/RFA	Feasibility demonstrated in selected patients	Potential salvage option for a targetable lesion; no cavity-wide effect

Table 3. Disease-specific interpretation of CRS-HIPEC evidence.

Disease	Key evidence	Current interpretation
Colorectal PM	PRODIGE 7 and PSOGI consensus [50,51]	Complete CRS remains central in selected patients. The 30-minute high-dose oxaliplatin regimen should not be used as a routine generic addition; regimen-specific trials are needed.
Gastric PM	GASTRIPEC-I and PERISCOPE II [58,61]	No established overall-survival benefit for routine CRS-HIPEC. Any use should be trial-based or exceptionally selected.
Epithelial ovarian cancer	OVHIPEC-1 and long-term follow-up [62,63]	Cisplatin HIPEC at interval cytoreductive surgery after neoadjuvant chemotherapy has the strongest randomized support.
PMP/appendiceal tumors	Guideline and registry evidence [66,67]	CRS-HIPEC is an established expert-center platform for operable disease, although the optimal regimen remains uncertain.
DMPM	Disease-specific and multisocietal consensus [69,70]	Recommended for carefully selected patients in specialized centers despite low certainty from non-randomized evidence.

Table 4. Multidisciplinary checklist before a thermal intervention.

Domain	Questions to resolve	Why it matters
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Domain	Questions to resolve	Why it matters
Therapeutic objective	Is the goal cure, consolidation, focal local control, symptom relief, or delay of another treatment?	Defines the correct comparator and endpoint.
Disease distribution	Is disease diffuse, oligometastatic, or dominated by one resistant lesion?	Determines whether a focal or cavity-directed treatment is logical.
Tumor biology	What are the histology, grade, molecular features, tempo, and response to systemic therapy?	The same procedure has different value across tumor types.
Technical feasibility	Can an adequate ablation margin or complete cytoreduction be achieved safely?	Incomplete local treatment may add morbidity without durable benefit.
Extra-peritoneal disease	Is it absent, controlled, or progressing?	Uncontrolled systemic disease reduces the value of major locoregional intervention.
Patient reserve	Performance status, frailty, nutrition, renal function, comorbidity, and patient preference?	Predicts toxicity, recovery, and ability to resume systemic therapy.
Center capability	Are imaging, interventional oncology, peritoneal surgery, anesthesia, and critical care experienced with the procedure?	Technical quality and complication management are part of the intervention.
Outcome plan	How will local progression, morbidity, quality of life, and systemic-treatment interval be measured?	Prevents judging a focal treatment only by an inappropriate survival endpoint.