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Local Ablative Treatment of Pulmonary Oligometastases from Rectal Cancer: Surgery or SBRT? A Retrospective Comparative Study

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Abstract **Original Research Article**

Introduction: Pulmonary metastases occur in 10% to 15% of patients with colorectal cancer and represent a frequent site of recurrence for rectal cancer. In the context of oligometastatic disease, local ablative treatment via surgery or stereotactic body radiotherapy (SBRT) is central to the therapeutic strategy. While surgical metastasectomy remains the historical gold standard, SBRT is emerging as an effective, non-invasive alternative, particularly for central lesions or patients at high surgical risk. This study reports our experience in managing pulmonary metastases of rectal origin and defines criteria for selecting between these two modalities. ***Materials and Methods:*** We conducted a retrospective study over a 4-year period, including six patients with histologically confirmed rectal adenocarcinoma whose cases were discussed during a multidisciplinary tumor board (MTB). Data collected included primary tumor characteristics, neoadjuvant and systemic treatments received, and the profile of the metastatic disease (number and location of lesions). Selection criteria between surgical resection and SBRT were based on anatomical (central or peripheral location), functional (respiratory reserve), and oncological parameters. Primary endpoints were local control, progression-free survival, and toxicity. ***Results:*** At initial diagnosis, disease was locally advanced in 83% of patients (T3N1, n=5) and T2N1 in 17% (n=1). The majority (83%) received short-course neoadjuvant radiotherapy (5×5 Gy) followed by primary tumor excision and systemic chemotherapy (XELOX/FOLFOX). At the metastatic stage, disease involved the lungs (50%, n=3) or liver (50%, n=3), with 1 to 3 lesions per patient. Three patients were treated with surgery (peripheral lesions) and three with SBRT (central lesions or surgical contraindication). The local control rate with SBRT was 100%, documented by morphological imaging and PET-CT, with doses ranging from 30 to 54 Gy in 4 to 6 fractions. No grade ≥3 toxicity or perioperative mortality was observed. Systemic progression remained the primary challenge, with two cases of distant recurrence (cerebral and bilateral pulmonary). ***Conclusion:*** This series illustrates the complementarity of surgery and SBRT in the management of pulmonary metastases of rectal origin. Surgery remains the preferred option when complete R0 resection is feasible with acceptable morbidity. SBRT constitutes an effective and welltolerated alternative for unresectable or high-surgical-risk lesions, providing excellent local control. These results underscore the importance of systematic multidisciplinary evaluation and the individualization of therapeutic decisions.

Keywords: Rectal cancer, Pulmonary metastases, Oligometastatic disease, Metastasectomy, Local control.

INTRODUCTION

Colorectal cancer (CRC) is the third most commonly diagnosed cancer worldwide and remains one of the leading causes of cancer-related mortality. Despite advances in screening, systemic treatments and multimodal approaches, metastatic spread remains the main factor limiting patient survival. Around 20–25 per cent of patients have synchronous metastases at the time of diagnosis, whilst nearly a third will develop metastatic disease during the course of their illness [1].

Within this population, the concept of the oligometastatic state, introduced by Hellman and Weichselbaum in 1995, describes an intermediate stage between localised disease and widely disseminated disease, characterised by a limited number of metastatic lesions that may be treatable with local curative therapies [2]. Although the exact definition varies between studies, most guidelines consider that disease involving five or fewer metastatic lesions is consistent with this concept [3]. This new biological perspective has profoundly changed the management of patients with metastatic

colorectal cancer, opening up the possibility of prolonged survival, or even cure, in carefully selected patients.

The lungs are, after the liver, one of the main sites of metastasis for colorectal cancer, particularly for rectal cancers due to their systemic venous drainage. Lung metastases occur in approximately 10–15 per cent of patients and represent a common form of recurrence following curative treatment of the primary tumour [4]. In patients with oligometastatic disease confined to the lung, local control of the lesions has become a major therapeutic objective as part of a multimodal strategy.

Pulmonary metastasectomy has historically been the standard of care when metastases are technically resectable and complete resection (R0) can be achieved whilst preserving satisfactory respiratory function. Several retrospective studies and meta-analyses have shown that surgery achieves high rates of local control as well as long-term survival in rigorously selected patients [5,6]. The main prognostic factors associated with improved survival include the possibility of an R0 resection, a prolonged disease-free interval, a limited number of metastases and the absence of mediastinal lymph node involvement [5–7].

Over the past decade, stereotactic body radiotherapy (SBRT) has established itself as a particularly attractive non-invasive ablative alternative. By delivering high biologically effective doses with millimetre-level precision, this technique achieves local control rates of over 80–90 per cent, whilst significantly limiting the exposure of healthy tissue to radiation and treatment-related toxicity [8,9]. SBRT therefore appears particularly suitable for patients with surgical contraindications, limited respiratory reserve or lesions located in anatomically complex sites.

However, despite advances in local treatments, the choice between pulmonary metastasectomy and SBRT remains a matter of debate. In the absence of large-scale randomised trials directly comparing these two approaches, the treatment decision is based primarily on a multidisciplinary assessment incorporating the anatomical characteristics of the lesions, the patient's general condition, comorbidities, tumour biology and previous systemic treatments [3,8,9].

In this context, we report on our institution's experience in the management of lung metastases of rectal origin in patients with oligometastatic disease. The main objective of this study is to compare the outcomes of surgical metastasisectomy and SBRT in terms of local control, survival and tolerability, in order to better define the criteria guiding treatment selection within a personalised multidisciplinary strategy.

MATERIALS AND METHODS

This retrospective study was conducted over a period from January 2022 to January 2025 at our institution. It included six patients treated for histologically confirmed rectal adenocarcinoma, whose treatment strategies were systematically approved during multidisciplinary team (MDT) meetings.

The clinical and paraclinical data collected for each patient included:

- **Characteristics of the primary tumour:** clinical stage, tumour site and TNM classification.
- **Treatment management:** details of neoadjuvant treatment regimens and the lines of systemic chemotherapy administered.
- **The profile of the metastatic disease**: number of lesions, their location and whether they were synchronous or metachronous with the primary tumour.

The treatment decision regarding the local management of metastatic lesions choosing between surgical resection and stereotactic body radiotherapy (SBRT) was made on an individualised basis following a multidisciplinary consultation meeting. This decision was based on a rigorous multi-criteria assessment:

- **Anatomical parameters:** location of the lesion (in particular, whether the lung metastases were central or peripheral).
- **Functional parameters:** assessment of respiratory reserve and the patient's general condition; a respiratory function test was requested to assess FEV_1
- **Oncological parameters:** tumour volume, disease progression and number of metastatic sites.

SBRT (Stereotactic Body Radiation Therapy) protocol For patients eligible for SBRT, treatment planning was based on a 4D CT simulation to account for respiratory motion. The target volumes (GTV, CTV, PTV) were defined by fusing CT scans with MRI and/or PET-CT scans. The dose was prescribed in accordance with dose constraints for surrounding organs at risk and the tumour volume, using a volume-modulated arc therapy (VMAT) technique to optimise the dose gradient.

Inclusion and exclusion criteria

Patients were eligible for the study if they met the following inclusion criteria:

- Rectal adenocarcinoma confirmed by histology.
- Presence of oligometastatic disease (defined as five or fewer metastatic lesions).
- Primary tumour controlled or treated, whether by partial or complete response.

- Local management carried out either by surgical metastasectomy or by stereotactic body radiotherapy (SBRT).

Conversely, the exclusion criteria were:

- The presence of more than five metastatic lesions.
- Inadequate control of, or absence of treatment for, the primary tumour.

Treatment modalities and follow-up

Local treatment modalities were selected according to the chosen strategy:

- **Surgical metastasisectomy:** Patients underwent complete surgical resection of all detectable metastatic lesions, with the aim of cure. Surgical approaches were tailored to the location of the lesions, including liver or lung resections.
- **Stereotactic Body Radiotherapy (SBRT):** SBRT treatment was administered using image-guided radiotherapy systems. The treatment protocol consisted of 1 to 5 fractions, with a total dose ranging from 30 to 60 Gy, adjusted according to the size and location of the lesion.

Endpoints and statistical analysis

The endpoints of the study were defined as follows:

- **Primary endpoints**: overall survival (OS) and local control (LC).
- **Secondary endpoint**: progression-free survival (PFS).

The statistical analysis was carried out as follows:

- Survival curves were estimated using the Kaplan-Meier method.
- Comparisons between groups were performed using the log-rank test.
- A multivariate analysis was conducted using Cox proportional hazards models.
- A p-value of < 0.05 was considered statistically significant

RESULTS

Population characteristics and initial management

The study involved a cohort of 6 patients with locally advanced disease at diagnosis. The majority, namely 5 patients (83.3%), were at stage T3N1, whilst one patient (16.7%) was at stage T2N1. The standard treatment strategy, administered to 5 patients (83.3%), consisted of short-course neoadjuvant radiotherapy (5 × 5 Gy) combined with chemotherapy (XELOX or FOLFOX), followed by tumour resection.

Metastatic profile and local treatment strategies

Metastatic assessment revealed liver involvement in 3 patients (50 per cent) and lung involvement in 3 patients (50 per cent), with a lesion burden of between 1 and 3 lesions per patient.

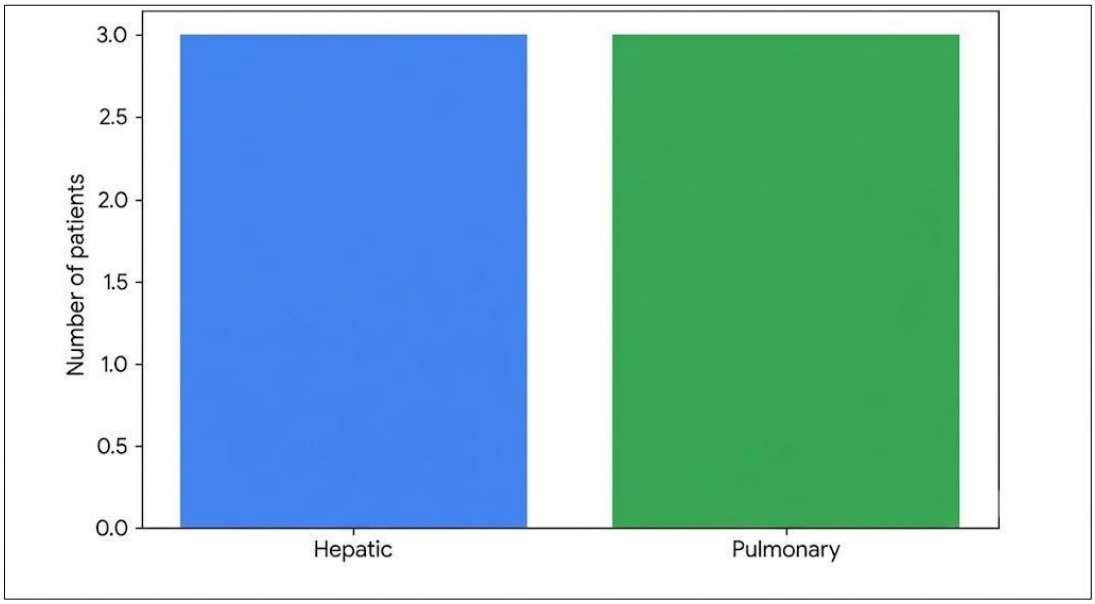

Figure 1: Distribution of metastatic profile in the cohort (n=6). This bar chart illustrates the distribution of metastatic sites within the study population:

Blue bar: 3 patients (50%) with hepatic metastases, green bar: 3 patients (50%) with pulmonary metastases

The management of metastases was tailored according to their location:

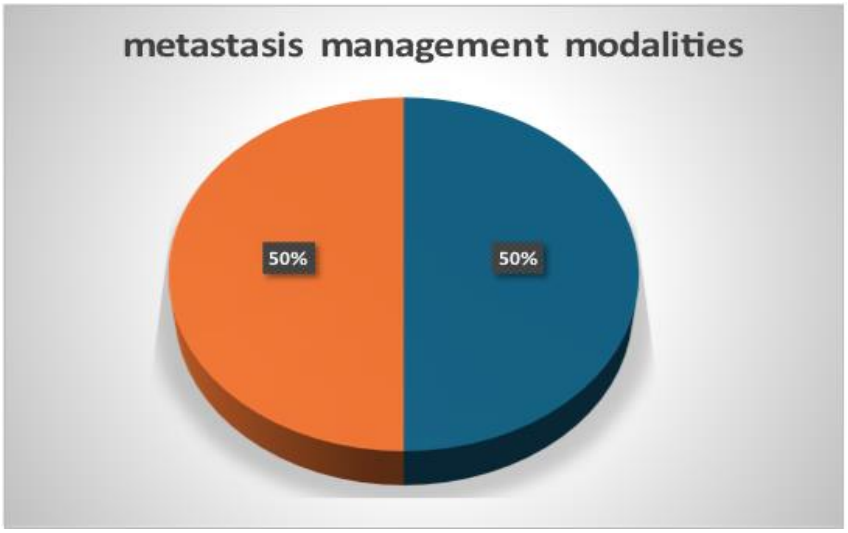

Figure 2: Distribution of metastasis management modalities (n=6): This pie chart illustrates the distribution of treatments administered to the cohort of 6 patients based on lesion location and clinical criteria

Surgery (Orange sector): Performed for 3 patients (50%).
SBRT (Blue sector): Applied for 3 patients (50%).

- **Surgery:** Performed for peripheral lesions in 3 patients (50 %).
- **Stereotactic radiotherapy (SBRT):** Administered for central lesions or in cases where surgery was contraindicated in 3 patients (50 %).
- SBRT demonstrated optimal efficacy with a local control (LC) rate of 100 %, documented by morphological imaging and PET scans, with doses delivered ranging from 30 to 54 Gy in 4 to 6 fractions.
- The tolerability profile was excellent, with no grade ≥ 3 toxicity or perioperative mortality.

Analysis of survival and disease progression

The endpoints (Overall Survival, Local Control and Progression-Free Survival) were assessed over a median follow-up of 36 months, using the Kaplan-Meier method, the log-rank test and Cox proportional hazards models ($p < 0.05$ considered statistically significant).

- **Overall Survival (OS):** The median overall survival was 64 months for the group treated with surgery and 52 months for the group treated with SBRT.
- **Clinical response and progression:**
  - A complete response was observed in 2 patients (33.3%).
  - Systemic progression remains the major challenge, with progression noted in 1 patient (16.7%) and persistent disease in 1 patient (16.7%).
  - A distant recurrence in the form of brain metastases occurred in 1 patient (16.7 %) after 3 years

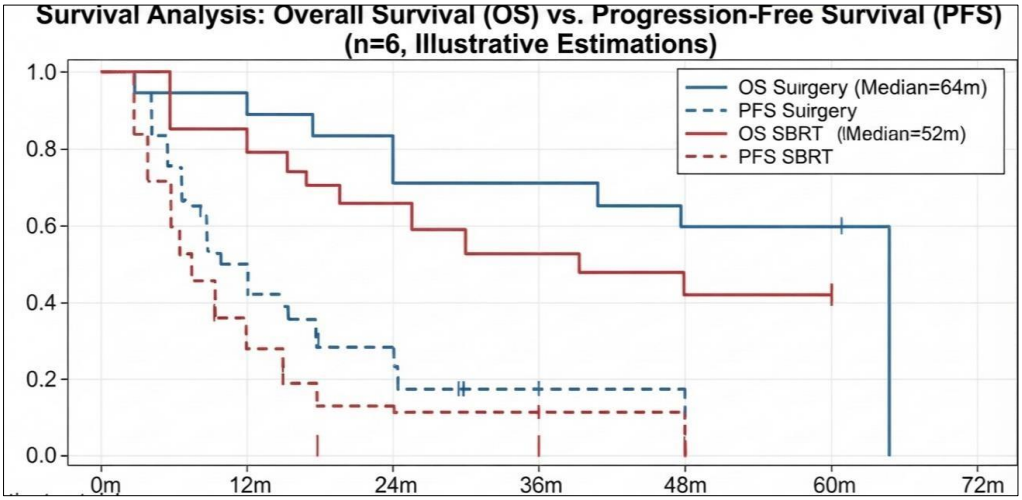

Figure 3: Kaplan-Meier survival curves for Overall Survival (OS) and Progression-Free Survival (PFS)

Solid lines represent Overall Survival (OS), and dashed lines represent Progression-Free Survival (PFS) for both treatment groups (Surgery in blue, SBRT in red). Median OS was 64 months for the surgery group and 52 months for the SBRT group. Vertical tick marks (+) indicate censored data. Drops in the PFS curves reflect the systemic disease progression (1 patient), disease persistence (1 patient), and distant re currence (1 patient) documented within the cohort.

DISCUSSION

The management of colorectal lung metastases has changed significantly over the last two decades. Whilst metastatic disease was historically regarded as a purely palliative condition, the emergence of the concept of oligometastasis has paved the way for curative treatment strategies in carefully selected patients. Introduced by Hellman and Weichselbaum in 1995, this concept is based on the hypothesis that a subgroup of patients has limited metastatic potential, characterised by a small number of lesions that can be controlled long-term through local ablative treatments [2].

Since then, this concept has evolved considerably, and the recent ESTRO/EORTC consensus [10] has refined the definition of oligometastatic disease by distinguishing between de novo oligometastatic disease, oligorecurrence, oligopersistence and oligoprogression, emphasising that these entities differ in terms of prognosis and therapeutic management [2,3]. At the same time, the latest ESMO clinical practice guidelines recommend that any patient with technically curable oligometastatic colorectal cancer should be assessed by a multidisciplinary team to determine whether complete eradication of all metastatic lesions can be achieved through surgery, SBRT or other ablative techniques [4].

Since this initial description, numerous clinical and biological studies have confirmed that the oligometastatic state represents an intermediate stage between localised disease and widespread dissemination, justifying an individualised multimodal approach [3,9,11].

In rectal cancer, the lungs are the second most common site of metastasis after the liver, due to the systemic venous drainage of the lower rectum, which facilitates haematogenous spread to the lungs. In patients with a limited number of lung metastases, local treatments now play a key role in the overall therapeutic strategy, complementing systemic treatments. International guidelines now emphasise the need for a multidisciplinary assessment incorporating clinical, radiological, surgical and biological data in order to identify patients likely to benefit from a curative approach [3,9].

Our study is part of this evolving clinical practice. Despite the small sample size of our cohort, the results obtained show that local treatments – whether pulmonary metastasectomy or stereotactic body radiotherapy (SBRT) – enable excellent local control to be achieved in patients with oligometastatic disease selected during a multidisciplinary team meeting. These findings confirm that management should no longer be guided solely by the presence of metastases, but also by their number, location, resectability, tumour biology, disease-free interval and the patient's general condition [3]. This approach is fully in line with current ESMO guidelines [12], which recommend individualised treatment planning based on anatomical resectability, the biology of the disease and the patient's general health [4].

In our cohort, the treatment strategy was based on rigorous patient selection. Technically resectable peripheral lesions were primarily managed with metastasectomy, whilst SBRT was offered to patients with central lesions, significant comorbidities or insufficient respiratory reserve. This approach is fully consistent with current guidelines, which regard surgery and SBRT as two complementary rather than competing modalities. The choice of treatment is therefore no longer based on a dichotomy between these techniques, but on which is best suited to each patient's clinical profile [3,9].

Our results show a higher median overall survival in the group treated with surgery. Although this difference should be interpreted with caution given the limited size of our sample and the absence of randomisation, it is consistent with the data in the literature. Several retrospective series report five-year survival rates of between 40 per cent and 70 per cent following complete pulmonary metastasectomy in selected patients [5,6]. This improvement in survival is mainly attributed to the possibility of achieving an R0 resection, which remains the primary modifiable prognostic factor.

Nevertheless, the evidence supporting pulmonary metastasisectomy remains limited. The PulMiCC randomised trial challenged the assumption that surgery consistently improves survival, by demonstrating significantly smaller differences between operated and nonoperated patients than previous retrospective studies had suggested [9]. Although lacking statistical power due to insufficient recruitment, the PulMiCC study highlighted the importance of rigorous patient selection and reinforced the need for prospective comparative studies.

Research by Borasio *et al.,* has shown that complete resection of lung metastases is associated with a significant improvement in long-term survival, regardless of the patient's age or the number of resections performed [5]. More recently, Davini *et al.,* demonstrated that the quality of surgical margins directly influences local control and overall survival,

emphasising the importance of anatomically adapted surgery that allows for complete resection whilst preserving functional lung parenchyma [6]. These results reinforce the role of metastasisectomy as the standard of care where anatomical and functional conditions permit.

However, it is now recognised that the technical feasibility of surgery is no longer the sole criterion for decision-making. An understanding of tumour biology has significantly altered the indications for local treatments. Several studies have shown that parameters such as disease-free interval, carcinoembryonic antigen (CEA) levels, the number of metastases, their size, and mutations in the RAS and BRAF genes strongly influence the risk of recurrence following local treatment [3,10]. Thus, two patients with the same number of metastases may have very different prognoses depending on the molecular profile of their tumour.

The selection of candidates for an ablative strategy must therefore be based on a multidimensional approach incorporating anatomical, clinical and biological criteria. In this context, the multidisciplinary consultation meeting is an essential step. It not only allows for discussion of the resectability of the lesions, but also enables the integration of data from functional imaging, molecular biology and previous systemic treatments in order to propose the most appropriate strategy for each patient. This personalised approach is now considered one of the key factors in improving oncological outcomes in oligometastatic disease [3,9].

The role of SBRT in the management of lung metastases

Over the past fifteen years, stereotactic body radiotherapy (SBRT) has gradually established itself as an essential ablative treatment for oligometastatic lung metastases. Advances in imaging, dosimetric planning, respiratory motion control and image-guided irradiation techniques now make it possible to deliver very high biological doses with millimetre precision, whilst minimising exposure to at-risk organs. This technological advancement explains the excellent local control rates reported in the literature, which are often above 85 per cent at three years for small-volume lung metastases [11,12].

In our series, patients treated with SBRT mainly presented with central lesions or contraindications to surgical resection. Despite this initially less favourable patient population, the local control achieved was excellent and no severe toxicity of grade ≥ 3 was observed. These results are consistent with those of Kobiela et al., whose systematic review reports local control rates ranging from 70% to 95% depending on the biologically effective dose (BED) delivered [11]. Similarly, the meta-analysis by Cao et al., involving several hundred patients with colorectal lung metastases, confirms that SBRT is a safe and effective ablative strategy, with excellent tolerability and a very low incidence of major complications [12].

Although the SABR-COMET study [14] examined several types of primary tumours, it was the first randomised trial to demonstrate that stereotactic ablative radiotherapy could significantly improve both progression-free survival and overall survival when combined with standard systemic treatment in patients with oligometastatic disease [14]. These results have considerably strengthened the case for incorporating SBRT into multimodal treatment strategies

The efficacy of SBRT relies primarily on the delivery of high ablative doses in a limited number of fractions. Several studies have shown that tumour control is directly correlated with the delivered effective dose (ED). As colorectal metastases are considered to be relatively radioresistant compared with metastases from other solid tumours, several authors recommend an effective dose in excess of 100–120 Gy, where dosimetric constraints permit, in order to optimise local control [16]. This concept is particularly important for lung lesions of rectal origin, whose biological behaviour may differ from that observed in other cancers.

Beyond its direct cytotoxic effect, SBRT induces complex changes in the tumour microenvironment. High per-fraction doses promote immunogenic cell death, with the release of tumour antigens and the activation of dendritic cells, which may stimulate a systemic antitumour immune response. This phenomenon, known as the ‘abscopal’ effect, remains rare in clinical practice but represents a particularly promising area of research, particularly in strategies combining SBRT and immunotherapy [9]. Although this synergy has not yet demonstrated a definitive clinical benefit in colorectal cancer, several prospective trials are currently underway.

Surgery versus SBRT: a contrast that is becoming less and less relevant

There is growing interest in comparing surgery with SBRT, but the available data remain largely retrospective. To date, no randomised trial has demonstrated the superiority of one approach over the other in patients with oligometastatic lung metastases of colorectal origin. This lack of high-quality evidence explains why guidelines favour an individualised approach, based on patient and disease characteristics rather than a strict hierarchy of treatments [3,9].

In our study, overall survival appeared to be higher among patients treated surgically. However, this observation must be interpreted with caution due to the small sample size and the selection bias inherent in retrospective studies. Patients who underwent surgery generally had peripheral lesions that were more easily resectable and were in better general health, whereas patients referred for SBRT were often inoperable or had

anatomically complex lesions. These differences in baseline characteristics may largely explain the observed differences in survival.

The published data show that, when patients are carefully selected, the oncological outcomes of the two approaches are relatively similar. Whilst surgery retains a potential advantage in terms of overall survival in the most favourable patients, several studies show that the local control achieved with SBRT is comparable, with significantly lower morbidity [11,12]. This observation is particularly important in elderly or frail patients, for whom preserving quality of life is a major therapeutic objective.

Prognostic factors and patient selection

The success of an ablative strategy depends first and foremost on rigorous patient selection. Multivariate analyses published in recent years show that several parameters independently influence the prognosis following local treatment of lung metastases.

Among these factors, the disease-free interval is one of the most robust prognostic markers. A prolonged interval between treatment of the primary tumour and the onset of metastases generally indicates a less aggressive tumour biology and is associated with a significant improvement in survival [10]. Similarly, a limited number of metastases, a small tumour size, a normal carcinoembryonic antigen (CEA) level and the absence of mediastinal lymph node involvement are consistently associated with a better prognosis [5,10].

Beyond traditional clinical criteria, advances in molecular biology are opening up new avenues for selecting candidates for local treatments. Mutations in the KRAS, NRAS and BRAF genes, as well as microsatellite instability (MSI) status, appear to be predictive markers of tumour aggressiveness and could help to refine the indications for surgery or SBRT in the coming years [3]. The incorporation of these biomarkers into decision-making algorithms is likely to be one of the major developments in the management of oligometastatic colorectal cancer.

Tolerability and quality of life

One of the main advantages of SBRT is its excellent tolerability profile. In our series, no severe adverse events were observed, which is consistent with the results of major metaanalyses [12]. The reported toxicities are generally limited to transient fatigue, a moderate cough or low-grade radiation pneumonitis, the incidence of which remains low when dosimetric constraints are adhered to.

Lung surgery has also seen considerable progress thanks to the development of minimally invasive techniques, notably video-assisted thoracoscopic surgery (VATS). However, it remains associated with a longer hospital stay, a non-negligible anaesthetic risk and a transient impairment of respiratory function. In this context, SBRT represents a particularly attractive alternative for patients with significant comorbidities or limited pulmonary reserve.

Thus, the choice between surgery and SBRT should no longer be viewed as a choice between two competing strategies, but rather as the selection of the treatment modality best suited to each patient's clinical, anatomical and biological profile. This personalised approach, based on multidisciplinary consultation, is now the main determinant of the quality of care for patients with oligometastatic colorectal cancer.

Limitations of the study

Several limitations must be taken into account when interpreting our results. The first relates to the retrospective nature of this study, which inevitably introduces selection bias. Indeed, the decision to proceed with surgery or SBRT was not randomised but was based on a multidisciplinary decision taking into account the anatomical characteristics of the lesions, comorbidities, respiratory reserve and patient preferences. Consequently, patients who underwent surgery generally had a more favourable profile than those treated with SBRT, which may influence comparisons of survival.

The second limitation lies in the small sample size of our cohort. This limited size does not allow for robust multivariate statistical analyses or the definitive identification of independent prognostic factors. Nevertheless, this study reflects the daily practice of a specialist centre and illustrates the feasibility of individualised management for patients with oligometastatic rectal cancer.

Furthermore, the heterogeneity of the systemic treatments administered, the sites of metastases and the SBRT doses also constitutes a potential confounding factor. However, this variability reflects the rapid evolution of therapeutic practices and the ongoing adaptation of treatments to the specific characteristics of each patient.

Outlook

Recent advances in oncology are opening up particularly promising prospects for the treatment of oligometastatic colorectal cancer. Improvements in functional imaging techniques, notably 18F-FDG PET/CT and diffusion-weighted MRI, enable better detection of subclinical lesions and more precise selection of candidates for ablative treatments.

At the same time, advances in molecular biology are gradually transforming clinical decisionmaking. Mutations in the RAS and BRAF genes, MSI status and circulating tumour DNA (ctDNA) may soon complement conventional radiological criteria to identify patients likely to benefit from an aggressive local treatment strategy.

The combination of SBRT and immunotherapy also represents a particularly promising avenue of research. Preclinical data suggest that hypofractionated radiotherapy promotes antigen presentation and stimulates lymphocyte activation, thereby potentially enhancing the efficacy of immune checkpoint inhibitors. Although microsatellite-stable colorectal cancers remain relatively insensitive to immunotherapy, several clinical trials are currently evaluating this therapeutic combination [19].

Finally, the integration of artificial intelligence, radiomics and predictive models represents a major development. Automated image analysis could enable a more precise assessment of tumour aggressiveness, predict radiosensitivity and optimise the selection of patients suitable for surgery or SBRT.

Clinical implications

The results of our study confirm that the management of lung metastases of rectal origin should be considered as part of a personalised treatment strategy. Surgery remains the standard of care when complete resection (R0) is technically feasible with acceptable morbidity. However, SBRT now represents a mature ablative alternative, offering excellent local control, low toxicity and optimal preservation of quality of life.

These two treatment modalities should no longer be regarded as competing but as complementary. Their optimal use depends on a multidisciplinary assessment that takes into account the anatomical characteristics of the lesions, functional parameters, tumour biology, previous treatments and the patient's expectations. This personalised approach is likely to be the main factor in improving the prognosis for patients with oligometastatic colorectal cancer

CONCLUSION OF THE DISCUSSION

In conclusion, our experience confirms that local treatments play a central role in the therapeutic strategy for lung metastases of rectal origin. Pulmonary metastasectomy remains the gold standard when surgical conditions permit complete resection. SBRT, meanwhile, is an effective and safe alternative for inoperable patients or those with anatomically complex lesions, with local control rates comparable to those reported in major international series.

Whilst our results should be interpreted with caution given the methodological limitations inherent in this retrospective study, they nevertheless reinforce the evidence in the literature in favour of an individualised multimodal strategy. Prospective, multicentre studies incorporating molecular biomarkers and new combination approaches will be necessary to better define the respective indications for surgery and SBRT in this patient population.

CONCLUSION

The management of oligometastatic rectal cancer has evolved considerably with the growing integration of local ablative therapies into multimodal treatment strategies. In our singlecenter retrospective experience, both pulmonary metastasectomy and stereotactic body radiotherapy (SBRT) achieved satisfactory local disease control in carefully selected patients discussed within a multidisciplinary tumor board. Although surgical resection remained associated with longer overall survival, SBRT provided excellent local control with minimal treatment-related toxicity, confirming its role as a safe and effective alternative for patients who are medically inoperable or unsuitable for surgery.

These findings support the concept that surgery and SBRT should not be viewed as competing therapeutic options but rather as complementary modalities within a personalized treatment strategy. Treatment selection should be guided by a comprehensive assessment of disease burden, anatomical feasibility, pulmonary reserve, patient comorbidities, tumor biology, and individual preferences. Such a multidisciplinary approach is essential to maximize oncological outcomes while preserving quality of life.

The interpretation of our results should nevertheless take into account the inherent limitations of this study, including its retrospective design, the small sample size, and the potential selection bias related to treatment allocation. Consequently, our findings should be considered hypothesis-generating rather than definitive.

Future prospective multicenter studies with larger patient cohorts are warranted to better define the respective roles of surgery and SBRT in the management of pulmonary oligometastases from rectal cancer. The integration of molecular biomarkers, circulating tumor DNA, advanced imaging techniques, radiomics, and artificial intelligence into clinical decision-making may further improve patient selection and contribute to the development of increasingly personalized therapeutic strategies.

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