

Case Report

Solitary Splenic Metastasis from Gastric Adenocarcinoma Treated with Stereotactic Body Radiotherapy using Deep Inspiratory Breath Hold

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ABSTRACT

Splenic metastases are rarely caused by non-hematologic malignancies, and only 6.9% of these metastases have a gastric origin. Stomach cancer splenic metastases are rare and often asymptomatic. The conventional therapy of choice is splenectomy. However, few instances are documented where stereotactic body radiation (SBRT) was used to treat isolated splenic metastases from gastric cancer. We present a case of solitary splenic metastasis from gastric adenocarcinoma treated with SBRT using deep inspiratory breath hold (DIBH). A woman in her fifties, previously treated with subtotal gastrectomy and adjuvant chemotherapy for pT4aN0M0 gastric cancer, presented with a positron emission tomography-avid solitary splenic lesion 2 years later. Following multidisciplinary discussion, SBRT with DIBH (50 Gray/5 fractions) was delivered along with daily cone beam computed tomography. The patient tolerated treatment well, with stable disease and no haematological toxicity. This case highlights SBRT as a non-invasive, feasible option for local control of isolated splenic metastasis from gastric carcinoma.

Keywords: Carcinoma stomach, Deep inspiratory breath hold, Splenic metastasis, Stereotactic body radiotherapy

INTRODUCTION

With 968,784 cases in 2022, gastric cancer ranked fifth amongst all cancers, according to GLOBOCAN.^[1] Most often, the liver (48%), peritoneum (32%), lung (15%) and bone (12%) are the sites involved by gastric cancer.^[2] Splenic metastases from non-haematologic malignancies are infrequent, affecting 0.6–1.1% of carcinoma patients. A weak lymphatic system, unusual immunological milieu and vascular anatomy make spleen metastases uncommon. The most prevalent cancers that cause splenic metastasis include breast, lung, colorectal, ovarian and melanomas.^[3] Gastric cancer accounts for 6.9% of spleen metastases.^[4] Imaging often finds metastases incidentally, since most present asymptotically.^[5] Isolated splenic metastases are indicated by serum carcinoembryonic antigen (CEA) and carbohydrate antigen (CA-19-9) values.^[6] Patients with a history of cancer should initially consider a single splenic lesion a metastasis.^[7] Oligometastatic or oligoprogessive tumours are

often amenable to local therapy. Splenectomy is the preferred modality of treatment for splenic metastases.^[8] Palliative radiotherapy has a well-established role in symptom relief and local control across multiple malignancies. Its role has expanded with advances in precise delivery techniques such as stereotactic body radiotherapy (SBRT). SBRT is now being offered in various oligometastatic or oligoprogessive settings with good local control and limited toxicity.^[9,10]

We present the case of a 55-year-old female with a solitary splenic metastasis from gastric adenocarcinoma, 23 months after treatment for the primary, treated with SBRT with deep inspiratory breath hold (DIBH) technique.

CASE REPORT

A middle-aged female in her fifties presented with progressive symptoms of fatigue, abdominal pain and vomiting for a 2-month duration. No validated tools for symptom assessment were used. The patient had an Eastern Clinical Oncology Group performance status of 2 at presentation.

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No substantial family history of cancer existed. She was pale and had haemoglobin of 3 g/dL on assessment. Upper gastrointestinal endoscopy showed an antral lump. A biopsy from the mass suggested moderately differentiated stomach cancer. A contrast-enhanced computed tomography (CECT) of the thorax, abdomen and pelvis suggested non-metastatic gastric antrum cancer.

She underwent subtotal gastrectomy with D1 lymph node dissection, and post-operative histopathology was pT4aN0M0, with lymphovascular space invasion. There was no perineural invasion; only three lymph nodes were dissected, of which none were positive. Completion lymphadenectomy could not be done as per the opinion of the operating oncosurgeon, considering intraoperative findings and anticipated morbidity. The case was discussed with the multidisciplinary tumour board, where it was decided to give adjuvant chemotherapy. Her adjuvant treatment included six rounds of epirubicin, oxaliplatin and capecitabine. Since D1 dissection, she was recommended adjuvant chemoradiotherapy, but she declined. Nearly 2 years following therapy, a splenic metastasis measuring 1.2 × 1.3 × 1.5 cm (maximum standard uptake value 4.81) was detected using 18-fluorodeoxyglucose positron emission tomography [Figure 1]. With a reference range of 0–5 ng/mL, CEA, a tumour marker, was 9.1. CA-19-9 was 166 (reference range: 0–37 U/mL). Differential diagnoses included lymphoma or neuroendocrine tumours, but clinical history, imaging features and tumour markers supported splenic metastasis from gastric origin. She refused biopsies and surgery and began oral capecitabine. A response assessment CECT scan after 4 months of therapy with capecitabine showed a 1.4 × 1.4 × 1.5 cm lesion in the spleen with no interval change in size. The findings were discussed in the multidisciplinary tumour board, and she was advised local therapy for the splenic metastasis with a choice of surgery or SBRT. SBRT was planned for the patient as she opted for a non-invasive approach.

With a thoracoabdominal thermoplastic mould and knee rest in DIBH, the patient was simulated for SBRT supine with arms over her head. A CECT was taken in the same position, and SBRT planning was done using standard planning aims and dosimetric constraints [Table 1].^[11] SBRT using DIBH approach was delivered to a dose of 50 Gray in 5 fractions (50 Gy/5 Fr) as 10 Gy per fraction on alternate days [Figure 2]. The fractionation of 50 Gy/5 Fr was selected based on extrapolation from liver SBRT regimens, as there is limited published data for splenic SBRT. The schedule achieves a high biologically effective dose while respecting normal tissue constraints.

The patient tolerated the treatment well without any treatment interruptions. She experienced mild fatigue with nausea, vomiting or diarrhoea. She also received two cycles of capecitabine after radiotherapy. Three months after SBRT,

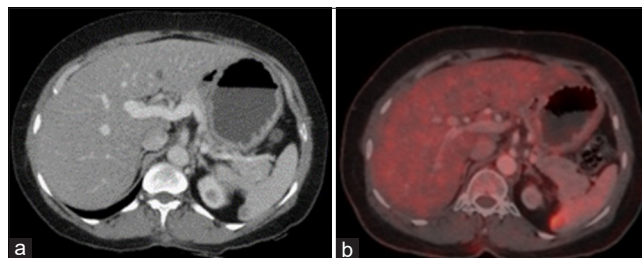


Figure 1: (a) Axial section of the contrast enhanced computed tomography scan depicting a splenic metastasis after two years of subtotal gastrectomy. (b) Corresponding 18 fluorodeoxyglucose positron emission tomography image.

Table 1: Dosimetric parameters of the stereotactic body radiotherapy treatment plan for a prescription of 50 Gy in 5 fractions, respecting the constraints according to UK 2022 consensus for stereotactic ablative body radiotherapy.

Target volume/Organ	Parameter	Constraints	Achieved dose
PTV	V95	≥95%	98.15%
	V107	-	46.84%
	V110	-	6.69%
GTV	V95	≥100%	98.89%
	V107	-	0%
	V110	-	0%
Spinal canal	D _{max}	25.3 Gy	9.26 Gy
Left kidney	D _{mean}	10 Gy	7.3 Gy
Spleen	D _{mean}	-	15 Gy
Chest wall	D _{max}	43 Gy	48.33 Gy
Duodenum	D0.1cc	35 Gy	10.47 Gy
Bowel	D0.1cc	35 Gy	9.4 Gy
Stomach	D0.1cc	35 Gy	14.11 Gy

PTV: Planning target volume, GTV: Gross tumour volume

reassessment imaging showed no new lesions, and the lesion was stable with a mild increase in enhancement, suggestive of post-radiotherapy changes and no distant metastases [Figure 3].

The patient was kept on follow-up. A reassessment imaging, at 7 months, revealed no evidence of local recurrence. However, there was a nodular enhancing soft tissue lesion in the midline anterior abdominal wall at the supraumbilical region of 2.5 × 3.1 × 2.6 cm in size. Palliative radiotherapy was delivered to a dose of 20 Gy/5 Fr to the anterior abdominal wall soft tissue lesion. Palliative re-irradiation of the anterior abdominal wall was guided by institutional protocols, considering cumulative dose constraints and normal tissue tolerance. We reviewed the SBRT plan and chose to treat this lesion with electrons as it was superficial and had very minimal overlap with the previous plan. The dose prescribed

(20 Gy/5 Fr) adhered to safe re-irradiation practices using electrons. There was a negligible dose to the underlying organs. She did not develop any haematological toxicity

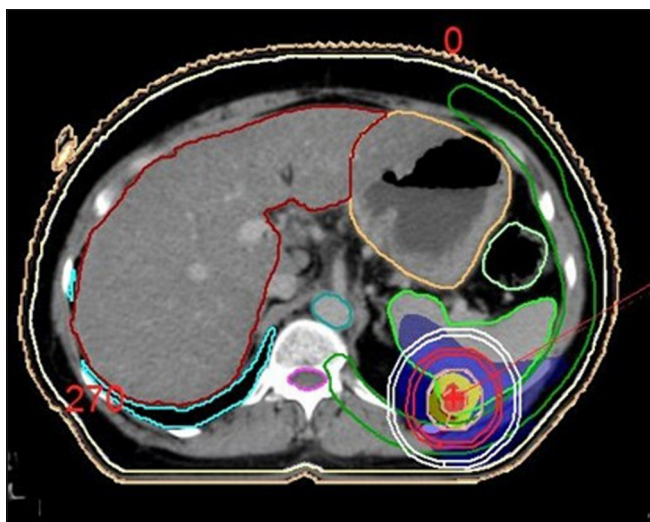


Figure 2: Axial section of the treatment planning computed tomography scan with delineation of the target volumes and organs at risk (Maroon: Liver, Cyan: Right lung, Olive green: Chest wall, Light green: Spleen, Aorta: Teal, Purple: Spinal canal, Yellow: Skin, Ochre: Stomach) and dose wash for stereotactic body radiotherapy.



Figure 3: Axial section of the contrast-enhanced computed tomography scan for response assessment after 3 months of stereotactic body radiotherapy, showing post-radiotherapy changes and no evidence of disease.

during the follow-up period. After 1 year of Tegafur-based palliative chemotherapy, the patient is clinically managed.

DISCUSSION

Splenic metastasis from solid malignancies is relatively rare, and isolated occurrences are even rarer. In an epidemiologic review of 6137 malignant patients, only 59 had splenic metastasis, and only three patients had isolated splenic metastasis.^[12] Hence, because of its rarity, there is not enough evidence in the literature to establish one particular treatment modality as the standard of care.

Isolated gastric cancer splenic metastases were the subject of case studies by Zhu *et al.* and Yamanouchi *et al.* that demonstrated extended disease-free life after splenectomy; however, these investigations did not address post-operative complications.^[13,14] Li *et al.*'s meta-analysis found a rise in post-operative splenectomy sequelae such as abscesses, fistulas and anastomotic leaks but no improvement in 5-year overall survival or recurrence rates.^[15] However, splenectomy is associated with side effects, such as bleeding, opportunistic infections by encapsulated organisms, especially pneumococci, meningococci, thromboembolism, abscess, reduced immunity and lymphopenia.^[16] These infections may be fatal, especially amongst the young and those with underlying malignancy.^[17,18]

SBRT is ablative with high accuracy, precision and high dosage while preserving normal tissues.^[19] It is useful in treating abdominal metastases, including liver, pancreas, adrenals and kidney.^[20-23] Extrapolating data from other abdominal locations while following normal tissue limits allows us to address the paucity of large-scale published data on SBRT for splenic metastases.

Only a few case reports demonstrate a favourable response and no toxicity. Hughes *et al.* successfully treated solitary ovarian cancer splenic metastases with SBRT (50 Gy/10 Fr).^[24] Another case report by Kim *et al.* showed an oligoprogressive non-small cell lung carcinoma with splenic metastases that responded well to SBRT at 50 Gy/5 Fr and remained disease-free for 20 months.^[25] Similarly, in the present case, the patient was disease-free in the spleen till the last follow-up and did not develop any haematological toxicity. Table 2 provides a comparative summary of reported splenic metastasis cases with this case.

DIBH reduces abdominal organ movement and spares healthy tissues during radiation treatment.^[26,27] In this,

Table 2: Comparative summary of reported splenic metastasis cases.

Study	Primary cancer	Treatment	Dose	Outcome
Hughes <i>et al.</i> ^[24]	Ovarian	SBRT	50 Gy/10 Fr	Disease-free at 12 months post-treatment
Kim <i>et al.</i> ^[25]	NSCLC	SBRT	50 Gy/5 Fr	Disease-free at 20 months post-treatment
Present case	Gastric	SBRT	50 Gy/5 Fr	Stable disease at 7 months

SBRT: Stereotactic body radiotherapy treatment, NSCLC: Non-small cell lung cancer

patients take a deep breath and hold it, causing the diaphragm to move downwards and reduce target motion. The patient in our study experienced no symptomatic toxicity even 14 months post-SBRT, which further supports the safety of the chosen fractionation and dose constraints. Using DIBH with SBRT allowed for increased precision in targeting splenic metastasis while minimising radiation exposure to surrounding structures such as the normal spleen, bowel and kidneys.

CONCLUSION

SBRT for a single splenic metastasis in a patient with oligometastatic gastric adenocarcinoma resulted in little treatment-related toxicity and good local control.

SBRT is a promising non-invasive, feasible and safe alternative to splenectomy in patients who do not want to undergo an invasive approach or are not surgical candidates. Given the rarity of spleen metastases, reports like these lend some evidence for its use and safety.

Ethical approval: The research/study was approved by the Institutional Ethical Committee with approval number IEC 1-227/2025, dated 21st May 2025.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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