

## Helical tomotherapy for duodenal adenocarcinoma in an elderly patient: A case report

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### Abstract

To evaluate the efficacy and feasibility of external beam radiotherapy (EBRT) for duodenal adenocarcinoma in an 84-year-old female who underwent EBRT (2.2 Gy/d for a total dose of 46.2 Gy) using helical tomotherapy (HT). Toxicity was evaluated on the National Cancer Institute's common toxicity criteria (CTCAE 3.0). The patient completed the treatment without G3-G4 toxicity. After 22-mo follow-up, she is alive and well, in complete remission with no late side effects. HT seems to be feasible and effective for duodenal adenocarcinoma in old to very old patients.

**Key words:** The elderly; Duodenal carcinoma; Helical tomotherapy; Toxicity

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**Core tip:** Radiotherapy is now effective and safe for old to very old patients with duodenal adenocarcinoma, thanks to better dose conformity and tissue sparing with helical tomotherapy.

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## INTRODUCTION

Duodenal adenocarcinoma accounts for about 0.3% of gastrointestinal carcinoma<sup>[1]</sup>. Treatment consists of complete surgical resection (segmental resection, pancreatic-duodenectomy and pancreas-preserving duodenal resection)<sup>[2-4]</sup>. As symptoms are often non-specific, the disease is frequently diagnosed at advanced stage when bypass surgery or stenting ± chemotherapy play a palliative role<sup>[2-5]</sup>. When radical surgery is feasible, the role of adjuvant chemotherapy or radio-chemotherapy is unclear since duodenal carcinoma is so rare<sup>[6-8]</sup>. They are recommended for patients at high-risk of recurrence (high grade, nodal metastases, margin positivity, advanced stage disease) as disease recurrence and metastases are common<sup>[9]</sup>. Although external beam radiotherapy (EBRT) was claimed to be unsuitable for duodenal adenocarcinoma as the small bowel poorly tolerates radiation<sup>[10-12]</sup>, it was reported to improve local disease control but not overall survival<sup>[1]</sup>. With advanced radiotherapy techniques like intensity-modulated radiotherapy, volumetric radiotherapy and tomotherapy, dose distribution is now homogeneous and exposure of organs at risk (OARs) to high dose irradiation is now limited, thus decreasing the risk of complications<sup>[13]</sup>.

This case report shows EBRT with helical tomotherapy (HT) was efficacious and safe in an elderly female with duodenal adenocarcinoma who was ineligible for surgery.

## CASE REPORT

An 84-year-old female presented in hospital with abdominal pain, itching and cholestasis.

Clinical examination confirmed abdominal pain. Blood were counts normal with glutamic oxaloacetic transaminase 56UI/L (Normal range (nr) 40-45 U/L), glutamic pyruvic transaminase 46 UI/L (nr 5-35 U/L), alkaline phosphatase 241 UI/L (nr 55-142 U/L), Lactate Dehydrogenase 256Mu/MI (nr 122-222 U/L), total bilirubin 1.48 mg/dL (nr 0.3-1.0 mg/dL).

Endoscopic retrograde cholangiopancreatography (ERCP) revealed a mass involving the entire thickness of the duodenal wall mid-portion with extension of 12 mm without ampulla of Vater involvement. Findings were confirmed by contrast-enhanced computed tomography (CT) which did not detect any nodal metastases. Biopsy findings were duodenal adenocarcinoma which was staged cT3N0M0 (AJCC Cancer Staging Manual 7<sup>th</sup> edition)<sup>[14]</sup>.

**Table 1 Planning target volume coverage**

	HT PTV
D90%	49.27 Gy
D95%	48.76 Gy
D50%	50.61 Gy
D2%	51.5 Gy
V107	0 Gy
HI	0.96

HT: Helical tomotherapy; PTV: Planning target volume; HI: Homogeneity index; Gy: Gray.

As surgery and systemic chemotherapy were excluded because of age and comorbidities (high blood pressure and ischaemic heart disease) the patient was not investigated further. Instead of palliative support we opted for radical treatment with EBRT. To visualize the lesion a CT without contrast medium was performed after having inserted a metal stent and a clip about 0.5 cm below the distal margin during a repeated ERCP.

CT images were acquired with 0.25 cm slice thickness and transmitted to the Pinnacle<sup>3</sup> TPS V9.8. One radiation oncologist (VL) contoured the clinical target volume (CTV), *i.e.*, the diseased duodenal tract. CTV was expanded 5 mm in all directions except for the cranial and caudal which were expanded 7 mm to provide the planning target volume (PTV). The radiation oncologist contoured the liver and kidneys as OARs.

The HT plan was generated using the Tomotherapy HD System commercial planning software. The dose prescription was 46.2 Gy to PTV in 21 fractions.

HT provided good PTV coverage as shown in Table 1. Table 2 showed dosimetric results for the OARs, which were markedly lower than pre-defined dose constraints.

Treatment was associated with G2 acute abdominal toxicity (diarrhoea), as defined by CTCAE 3.0 criteria.

Follow-up included a clinical examination and complete blood work-up every three months, and abdominal ultrasound or CT scans every six months.

After 22-mo follow-up, the patient is alive and well, in complete remission without late side effects.

## DISCUSSION

Radiotherapy was the only option for this patient as surgery and chemotherapy were ruled out on account of age and comorbidities. However, despite the patient's age and advanced stage disease, her performance status was good (80% Karnofsky), she did not have cognitive and/or motor deficits and was compliant with treatment. These positive factors influenced our decision to opt for radical treatment and no palliative support. Even though a 22 mo follow-up is relatively short, our very old patient has achieved a complete response.

A mild hypofractionated schedule seemed appropriate for overcoming duodenal carcinoma's putative radio-resistance. Indeed, duodenal adenocarcinoma may be chemo-radiation-sensitive as neo-adjuvant radio-

**Table 2** Organs at risk dosimetry for helical tomotherapy

	Constraints	HT
Right kidney		
V12 Gy	< 55%	5.6%
V20 Gy	< 32%	1.3%
V23 Gy	< 30%	0.7%
V28 Gy	< 20%	0.2%
Dmean	15-18 Gy	6.10 Gy
Left kidney		
V12 Gy	< 55%	22%
V20 Gy	< 32%	0%
V23 Gy	< 30%	0%
V28 Gy	< 20%	0%
Dmean	15-18 Gy	8.9 Gy
Liver		
V30 Gy	< 30%	0%
Dmean	< 28 Gy	5.32 Gy

HT: Helical tomotherapy; Dmean: Mean dose; Gy: Gray.

chemotherapy was associated with an overall survival benefit in 11 patients with a R0 resection (5-year 83% vs 53%)<sup>[15]</sup>. Onkendi *et al*<sup>[16]</sup> also showed that neoadjuvant chemo- and/or chemoradio-therapy as well as intra-operative radiotherapy could potentially prolong survival.

HT provided good target cover and a homogeneous dose to the target volume. Furthermore, it limited exposure of OARs, keeping the kidney and liver doses as low as possible and circumvented the small bowel's poor tolerance of radiation<sup>[13]</sup>. In fact irradiation of a limited target area, as our patient had no nodal metastases, may have made a major contribution to low toxicity as she was affected by only G2 acute toxicity and suffered no late irradiation-related side effects. Finally, daily imaging-guided radiotherapy with megavoltage CT served to monitor treatment administration. Images were co-registered automatically with planning CT images using the bone and tissue technique and, if needed, the treatment position was adjusted.

Treating duodenal adenocarcinoma with radiotherapy alone, as in this case report, appears to be innovative since we have been unable to find any other reports of this approach. Data deriving from small single-institution, retrospective reports or biased case reports are available on adjuvant radiotherapy with or without chemotherapy but outcomes are divergent. A prospective, randomized European study<sup>[17]</sup> showed no difference in overall survival in patients with pancreatic or peri-ampullary tumours, when compared with surgery alone. It did not, however, distinguish between duodenal cancer and other tumours and did not describe the radiotherapy techniques and doses that were used. On the other hand, Swartz *et al*<sup>[11]</sup> reported local control rates of 93% and longer median survival (41 vs 21 mo) in 14 patients who received concurrent fluorouracil-based chemotherapy, a median of 50 Gy radiotherapy and maintenance chemotherapy compared with a control group who underwent only surgery. Confirming these findings, Overman *et al*<sup>[18]</sup> showed that adjuvant

chemo-radiotherapy improved disease-free survival and overall survival in patients at high-risk of relapse.

The present study has the usual case report limitations. It does, however, propose an option for the management of duodenal adenocarcinoma when surgery and chemotherapy are precluded and offers hope that surgery is no longer the only means of cure, particularly in old to very old patients<sup>[10]</sup>. Given the rarity of duodenal adenocarcinoma, future studies are needed to establish the most suitable treatment.

## COMMENTS

### Case characteristics

An 84-year-old female presented abdominal pain, itching and cholestasis.

### Clinical diagnosis

Clinical examination confirmed abdominal pain.

### Differential diagnosis

Ampullary carcinoma or other duodenum disease.

### Laboratory diagnosis

Blood counts with glutamic oxaloacetic transaminase, glutamic pyruvic transaminase, alkaline phosphatase, LDH, total bilirubin.

### Imaging diagnosis

The patient underwent to the endoscopic retrograde cholangiopancreatography, contrast-enhanced computed tomography.

### Pathological diagnosis

Biopsy findings were duodenal adenocarcinoma.

### Treatment

The patient was treated with external beam radiotherapy. The dose prescription was 46.2 Gy to PTV in 21 fractions.

### Related reports

Radiotherapy can be an option for the management of duodenal adenocarcinoma when surgery and chemotherapy are precluded.

### Term explanation

Helical tomotherapy provided a homogeneous dose distribution and limited exposure of organs at risk to high dose irradiation.

### Experiences and lessons

Given the rarity of duodenal adenocarcinoma, future studies are needed to establish the most suitable treatment.

### Peer-review

This manuscript provides very important clinical information of effectiveness of helical tomotherapy of duodenal cancer in the elderly. This may certainly be of use for treatment of duodenal cancer. The case presentation and discussions are well described and organized. The conclusion derived is consistent and sound.

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