Pulmonary staging in colorectal cancer – is computerised tomography the answer?

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ABSTRACT

INTRODUCTION Pulmonary staging in colorectal cancer (CRC) has traditionally been carried out by means of plain chest radiograph (CXR), although computerised tomography (CT) imaging of the chest is increasingly being performed for this purpose. The aim of this study was to assess the value of pre-operative thoracic CT for pulmonary staging in CRC.

PATIENTS AND METHODS Data were collected prospectively on all patients referred into hospital over a 20-month study period for double contrast barium enema evaluation of symptoms suggestive of an underlying CRC. Patients with a CRC went on to have a staging intravenous, contrast-enhanced CT of the chest, abdomen and pelvis prior to an out-patient appointment with a colorectal surgeon. The CXRs of those patients in whom a radiological abnormality was seen on thoracic CT were reviewed blindly by an independent consultant radiologist.

RESULTS A total of 403 barium enemas were performed, of which 38 demonstrated a CRC (9%). In those patients diagnosed with CRC, nine (24%) had an abnormality on thoracic CT. Four patients with positive thoracic CTs had chemotherapy and or radiotherapy with no surgery. One patient underwent colectomy, and 2 patients who had primary lung tumours as opposed to metastases also underwent colectomies. One patient received palliative care only. In addition, one of the patients underwent multiple, non-diagnostic thoracic investigations prior to a diagnosis of sarcoidosis being made and then proceeding to surgery. An independent consultant radiologist reviewed seven out of the nine CXRs of patients with an abnormality on thoracic CT without knowledge of the clinical diagnosis, and reported three of the CXRs to be normal.

CONCLUSIONS Thoracic CT appears to improve the accuracy of pulmonary staging in CRC allowing a more appropriate level of intervention. However, CT is likely to identify more benign radiological abnormalities than CXR alone, and investigations should not occur to the detriment of treating the primary tumour.

KEYWORDS

Colorectal cancer – Computerised tomography – Pulmonary metastases

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The commonest site of metastasis in colorectal cancer (CRC) is the liver; however, about 5–10% of patients will develop pulmonary metastases. Traditionally, pulmonary staging for CRC has been carried out by means of a plain chest radiograph (CXR), although computerised tomography (CT) is a more accurate imaging modality for the identification of distant metastases. CT has published sensitivities of 51–73%^{1,2} and specificities of up to 74%,⁵ the latter figure reflecting the recognition that not all abnormalities seen on thoracic CT scans of patients with CRC will be metastases.⁴ Previously, thoracic CT scans have not been performed if a patient was seen to have a negative CXR, and there is sparse data in the literature on the role of CT in the pulmonary staging of CRC. In contrast, the role of thoracic CT in the pre-operative assessment of patients with potentially resectable

colorectal liver metastases with a negative CXR has been investigated.⁵ In a study by Povoski *et al.*,⁵ 100 consecutive patients with potentially resectable colorectal liver metastases and negative CXRs underwent thoracic CT scans. Patients with findings suggestive of metastatic disease were subjected to either thoracotomy or video-assisted thoracic surgery (VATS) before attempted liver resection. The authors reported a positive yield for malignancy of only 4% on CT and a positive predictive value for CT of 36% for detection of malignant lesions of the lung. In their conclusion, they question the usefulness of performing thoracic CT routinely in the setting of a negative CXR in the work-up prior to hepatic resection.

In relation to the staging of CRC, however, one may argue that the most accurate modality available will allow

the surgeon to identify not only those patients who are candidates for curative resection, but also those who may be more appropriately treated by avoiding surgical intervention. Published data support the policy to defer operating on minimally symptomatic patients with incurable disease, without increasing the risk of complications before death from disease progression.⁶ Such a policy mandates robust staging, and thus CT would appear to be a more appropriate modality for staging. We have studied the value of pre-operative thoracic CT in the pulmonary staging of patients with CRC.

Patients and Methods

Data were collected prospectively over a 20-month study period from January 2001 to August 2002 inclusive. All patients who were referred to a 'rapid access', double-contrast, barium enema service for a suspected CRC were included in the study. A positive barium enema led to that patient undergoing a staging intravenous, contrast-enhanced CT of their chest, abdomen and pelvis, using a single slice Siemens Somatom Plus 4 spiral CT scanner. The thorax was windowed on both soft tissue and lung windows. The CT scans were performed using a collimation of 8 mm with a table feed of 12 mm per rotation, producing a pitch of 1.5. The images were reconstructed and imaged with a slice thickness of 8 mm, with the post processing performed using a standard lung kernel.

Patients with abnormalities identified on thoracic CT had their CXRs (performed subsequently as in-patients) reviewed retrospectively by an independent consultant radiologist, who had not been involved with the patients' previous radiological investigations. Additionally, the radiologist was not given any information regarding the patients' underlying clinical diagnosis; thus, reporting was performed blind. The radiologist reviewed the CXRs at a viewing station, and was asked to report the CXR as being either normal or abnormal. As well as the patients' CXRs, an equal number of age-matched normal CXRs were included as controls.

Results

Over the study period, 403 rapid-access barium enemas were performed of which 38 identified an underlying CRC (9%). Of the patients diagnosed with CRC, almost one-quarter had a radiological abnormality identified on their thoracic CT scan (9/38; 24%).

The average age of the patients with an abnormality on thoracic CT was 76 years (range, 68–87 years) with twice as many men as women present in the group (6:3). Six patients had rectal cancers, one had a cancer at the rectosigmoid junction and two had colonic lesions.

All patients had their CT scans discussed at a multidisciplinary team meeting and, having taken all other diagnostic information into account, had a management plan formulated.

Four patients with multiple pulmonary metastases on thoracic CT received oncological treatment with chemotherapy and/or radiotherapy as their only intervention. Two patients who were thought to have primary lung tumours on thoracic CT underwent colectomy, following which one developed an anastomotic leak that was treated by percutaneous drainage alone. Both these patients were referred to thoracic surgeons postoperatively. One patient (with the anastomotic leak) underwent thoracic surgery with curative intent, and the other patient was diagnosed with an inoperable non-small cell carcinoma, confirmed by bronchoscopy and biopsy, and received palliative radiotherapy. One other patient with multiple pulmonary metastases seen on thoracic CT underwent surgery for increasing abdominal pain. One patient also with multiple pulmonary metastases on CT and who was minimally symptomatic from their primary tumour was managed non-operatively, but was admitted to hospital for palliative care soon after diagnosis with recurrent pleural effusions. The final patient, who had a large mediastinal mass noted on CT, underwent a negative bronchoscopy, two non-diagnostic anterior mediastinoscopies and an anterior mediastinotomy prior to a diagnosis of sarcoidosis being made. The thoracic investigations in this patient took 4 months following the radiological abnormality being recognised, and the patient presented soon after the last procedure with symptoms of incipient bowel obstruction, for which she underwent a Hartmann's procedure.

When blind reporting of the CXRs was performed, three out of the seven patients with a radiological abnormality on thoracic CT had their CXR reported as normal (43%). These three cases included two patients with multiple small CRC lung metastases and one patient with a primary lung tumour. By contrast, the age-matched control CXRs were reported without error.

Discussion

The accuracy with which CRC is staged will directly influence the intent of treatment in that patient; therefore, it is crucial to ensure that all efforts are made either to effect cure or prevent unnecessary intervention where death is inevitable. We feel that this study demonstrates thoracic CT to be useful in pulmonary staging of CRC.

In support, CT identified four patients with CRC who had non-resectable pulmonary metastases (with or without hepatic metastases) who received chemotherapy and or radiotherapy alone, and were not subjected to the morbidity and mortality associated with a colectomy in the context of advanced malignancy. Clinical opinion on how patients with metastatic CRC should be treated is changing,⁶ and it is clear that surgery is not always appropriate in this group of people where other less invasive modalities of treatment may be employed. In our study of 403 patients, CT demonstrated a radiological abnormality in 24% of the 38 patients in whom CRC was diagnosed, which is greater than the 11% quoted

by Povoski *et al.*⁵ Thoracic CT was seen to have a positive predictive value of 67% (6/9) for CRC metastases and 89% (8/9) for malignant lesions overall, compared to 27% (3/11) and 36% (4/11), respectively, reported by Povoski *et al.*⁵ It should be noted that many of the patients in our study had multiple pulmonary lesions on thoracic CT in contrast to the other study cited. In a patient with CRC and no prior lung malignancy, the risk of a single pulmonary nodule on thoracic CT representing a metastasis is about 25%⁷ but with multiple nodules this figure rises to 75%,⁸ Had more of the patients in our study had single pulmonary nodules, as was the case with the other study cited, then more diagnostic uncertainty may have existed following thoracic CT in our group.

In addition, by performing thoracic CTs we identified two patients with primary lung cancers who were referred to thoracic surgeons postoperatively. Although one of these patients had an inoperable primary lung tumour, the other received surgery with curative intent. Significantly, it was the second of these two patients who had their CXR reported retrospectively as normal, and it is possible that, had this patient not had their thoracic CT performed, the opportunity to carry out potentially curative surgery for this second cancer may have been lost. Whilst we are not advocating thoracic CT as a screening tool for pulmonary malignancies, synchronous pulmonary tumours may be present in the age group of people who develop sporadic CRC. This point must be tempered with the fact that any investigation has a false-positive rate, as demonstrated by the patient who underwent numerous thoracic investigations prior to being diagnosed with sarcoidosis.

Technological advances, and in particular the speed of modern spiral CT, mean that inclusion of the thorax when abdominal and pelvic staging is being carried out adds very little time or effort to the staging process. As we have stated, CT scans performed in our patients with CRC were enhanced with intravenous contrast. Intuitively, one might expect the administration of intravenous contrast to yield additional information with regards to the presence or absence of pulmonary metastatic deposits. We could not find any evidence in the literature to confirm or refute this in the context of pulmonary staging in CRC. Published data do exist, however, comparing the accuracy of staging between contrast-enhanced and non-enhanced CT scans in 96 patients with primary lung cancer.⁹ This study demonstrated staging to concur between contrast-enhanced and non-enhanced CT scans in 96% (92/96) of cases. The primary advantage gained by the administration of intravenous contrast was to characterise better the relationship of the primary tumour to surrounding structures. It did not aid in the detection of either involved lymph nodes or tumour spread to adjacent lung parenchyma. In the four cases where the stage differed between scans, overall management only changed in one

patient. It may be that such a situation exists in the context of pulmonary staging in CRC, although we have not addressed this in our study. Intravenous contrast may identify a few additional pulmonary metastatic deposits, but this will not change either the stage or management in such patients. If primary lung tumours were identified during staging, as was the case in two of our patients with CRC, then contrast may be useful in this context for the reasons discussed previously. If non-enhanced CT scans were shown to give sufficient information for accurate pulmonary staging in CRC, it would both reduce the cost and also eradicate the risks inherent in the administration of contrast, which include induction of anaphylaxis and nephrotoxicity. Thus, the additional resources required to carry out pulmonary staging in CRC with CT should be minimal.

Conclusions

We believe that thoracic CT is of value in the pulmonary staging of CRC. In our study, CT is more sensitive than CXR alone in identifying pulmonary abnormalities. When such abnormalities are present, we show thoracic CT to have a higher positive predictive value for CRC metastases and overall malignancy than in other published reports. Thoracic CT identified patients who had incurable disease, and allowed them to be treated non-surgically. Additionally, thoracic CT led to the diagnosis of a primary lung cancer which was missed on CXR alone, which has allowed this patient to undergo a pulmonary resection with curative intent.

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