Limitation of radiological T3 subclassification of rectal cancer due to paucity of mesorectal fat in Chinese patients

Esther MF Wong *, Bill MH Lai, Vincent KP Fung, Hester YS Cheung, WT Ng, Ada LY Law, Alta YT Lai, Jennifer LS Khoo

ABSTRACT

Objectives: To describe the thickness of mesorectal fat in local Chinese population and its impact on rectal cancer staging.

Design: Case series.

Setting: Two local regional hospitals in Hong Kong.

Patients: Consecutive patients referred for multidisciplinary board meetings from January to October 2012 were selected.

Main outcome measures: Reports of cases that had undergone staging magnetic resonance imaging for histologically proven rectal cancer were retrospectively retrieved and reviewed by two radiologists. All magnetic resonance imaging examinations were acquired with 1.5T magnetic resonance imaging. Measurements were made by agreement between the two radiologists. The distance in mm was obtained in the axial plane at levels of 5 cm, 7.5 cm, and 10 cm from the anal verge. Four readings were obtained at each level, namely, anterior, left lateral, posterior, and right lateral positions.

Results: A total of 25 patients (16 males, 9 females) with a median age of 69 (range, 38-84) years were included in the study. Mean thickness of the mesorectal fat at 5 cm, 7.5 cm, and 10 cm from the anal verge was 3.1 mm (standard deviation, 3.0 mm), 9.8 mm (5.3 mm), and 11.8 mm (4.2 mm), respectively. The proportions of patients with mean mesorectal fat thickness of <15 mm were 100%, 84%, and 75% at 5 cm, 7.5 cm, and 10 cm from the anal verge, respectively. The thickness of mesorectal fat was the least anteriorly, and <15 mm at all three arbitrary levels (P<0.001).

Conclusion: The thickness of mesorectal fat was <15 mm in the majority of patients and in most positions. Tumours invading 10 mm beyond the serosa on magnetic resonance imaging may paradoxically threaten the circumferential resection margin in Chinese patients. Use of T3 subclassification of rectal cancer in Chinese patients may be limited.
treatment with curative intent (local failure). The depth of extramural penetration of the tumour has been shown to be an independent prognostic factor. According to the European Society for Medical Oncology guidelines, T3 disease is subclassified into T3a, T3b, T3c, and T3d based on the depth of invasion beyond the muscularis propria (Table 1). Magnetic resonance imaging is also highly accurate in predicting the actual depth of this invasion. Currently, patients with disease more advanced than T3b are recommended to receive induction therapy prior to surgery.

Another factor that potentially affects the disease status is the thickness of the mesorectal fat which, for the sake of this discussion, shall be defined as the distance between the serosa and mesorectal fascia. The word ‘perirectal fat’ is used interchangeably with ‘mesorectal fat’. We are of the opinion that the word ‘mesorectal fat’ better conceptualises compartmentalised fat within the mesorectal fascia and is, thus, selected for use in this article.

In our experience, the mesorectal fat is rather thin in Chinese patients. It is not uncommon to encounter early T3 (T3a/b) disease with threatened CRM as predicted on MRI. The less the mesorectal fat thickness, the less the depth of extramural invasion it takes to infiltrate the CRM.

This study aimed to measure the amount of mesorectal fat in the local population. The use and limitation of T3 subclassification in the Chinese population will be discussed.

Methods

A total of 25 consecutive staging MRIs done for patients referred for rectal carcinoma multidisciplinary meetings at a local regional hospital from January to October 2012 were retrospectively reviewed by two radiologists with special interest in abdominal imaging.

All MRI examinations were acquired with 1.5T MRIs in two local centres using Siemens Magnetom Avanto (Erlangen, Germany) MRI machines. Measurements were made with mutual agreement between the two reviewing radiologists. The thickness of mesorectal fat was defined as the distance from the serosa to the mesorectal fascia in the axial plane. The distance in mm was obtained in the true axial plane at levels of 5 cm, 7.5 cm, and 10 cm from the anal verge. Measurements were performed primarily on T2 sequence, supplemented by T1 sequence if the acquired T2 images were unsatisfactory. As this study involved two hospitals, the scanning parameter was not identical. However, such difference was not assumed to attribute to error.
of any source in terms of calibre measurement.

Four readings were obtained at each level, namely, anterior, left lateral, posterior, and right lateral positions (Fig 1).

Patients with bulky primary or secondary pelvic tumours (>3 cm in diameter) were excluded from the study, as these might cause significant distortion of the anatomy and configuration of the mesorectum.

Statistical analysis was performed with the Statistical Package for the Social Sciences (Windows version 15.0; SPSS Inc, Chicago [IL], US). One-sample Student’s t test was performed for analysis of mean thickness.

**Results**

A total of 25 patients (16 males, 9 females) with a median age of 69 (range, 38-84) years were included in the study. The rectosigmoid junctions were reached at the level of 10 cm above the anal verge for four patients and were, thus, excluded from calculation for the respective level.

Mean thicknesses of mesorectal fat at 5 cm, 7.5 cm, and 10 cm from the anal verge were 3.1 (standard deviation [SD]=3.0) mm, 9.8 (SD=5.3) mm, and 11.8 (SD=4.2) mm, respectively. Details of the mean mesorectal fat thickness are shown in Table 2. In brief, the proportions of patients with mean mesorectal fat thickness of <15 mm were 100%, 84%, and 75% at 5 cm, 7.5 cm, and 10 cm from the anal verge, respectively.

The mesorectal fat was noted to be the least thick in the anterior position for all three arbitrary levels (Table 2; Fig 2). At 5 cm and 7.5 cm from the

<table>
<thead>
<tr>
<th>Position</th>
<th>Levels (distance from anal verge)</th>
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<tbody>
<tr>
<td></td>
<td>5 cm</td>
</tr>
<tr>
<td>Mean thickness of mesorectal fat (mm)</td>
<td></td>
</tr>
<tr>
<td>Anterior</td>
<td>1.0</td>
</tr>
<tr>
<td>Left lateral</td>
<td>3.9</td>
</tr>
<tr>
<td>Posterior</td>
<td>2.6</td>
</tr>
<tr>
<td>Right lateral</td>
<td>4.9</td>
</tr>
<tr>
<td>Average (anterior + left lateral + posterior + right lateral / 4)</td>
<td>3.1</td>
</tr>
<tr>
<td>Patients with mean thickness &lt;5 mm</td>
<td>80% (n=20)</td>
</tr>
<tr>
<td>Patients with mean thickness &lt;15 mm</td>
<td>100% (n=25)</td>
</tr>
</tbody>
</table>

**TABLE 3. Thickness of anterior mesorectal fat with respective P values**

<table>
<thead>
<tr>
<th>Distance from anal verge</th>
<th>Proportion of patients with thickness &lt;5 mm</th>
<th>P value*</th>
<th>Proportion of patients with thickness &lt;15 mm</th>
<th>P value†</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 cm</td>
<td>96%</td>
<td>&lt;0.001</td>
<td>100%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>7.5 cm</td>
<td>88%</td>
<td>0.01</td>
<td>100%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>10 cm</td>
<td>71%</td>
<td>0.15</td>
<td>95%</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

* P<0.05 indicates mean anterior mesorectal thickness significantly <5 mm
† P<0.05 indicates mean anterior mesorectal thickness significantly <15 mm

![FIG 2. A patient with marked paucity of mesorectal fat. T2 axial images obtained at (a) 5 cm, (b) 7.5 cm, and (c) 10 cm from the anal verge. The mesorectal fat is thinnest at its anterior aspect at all levels](image)
anal verge, proportions of patients with mesorectal fat thickness of <5 mm were 96% and 88%, respectively. The figure reached up to 100% if 15 mm was taken as the cutoff level. At 10 cm from the anal verge, 95% of patients showed mesorectal fat thickness of <15 mm. \( t \) Tests showed that the anterior mesorectal fat thickness was significantly <15 mm at all three levels (P<0.001) and <5 mm at both 5 cm (P<0.001) and 7.5 cm (P=0.01) from the anal verge (Table 3).

There was a tendency for the lateral aspects to be more spacious than the anterior and posterior aspects, and for the left side to be larger than the right side. However, these findings were not statistically significant.

Discussion

To the best of our knowledge, this is the first Chinese study and the first study in Asian subjects on mesorectal fat thickness. The majority of published literature on MRI staging of carcinoma of rectum are based, predominantly, on data from western/Caucasian populations. It has been well known that variations in body build, lean mass, and fat composition do occur across ethnic groups.\textsuperscript{10} Chinese or Asian patients have a smaller body build. Whether the amount of fat in the mesorectum is the same in Chinese and Caucasian population remains largely unknown.

In recent decades, total mesorectal excision has revolutionised rectal cancer surgery.\textsuperscript{11} Patients with relatively early tumours (ie T3b or below, lymph node--negative) are usually streamlined to total mesorectal excision without preoperative neoadjuvant therapy. The rationale behind this is that early, mid- and low-rectal tumours with their whole lymphatic drainage are contained within the mesorectal fascia. Total mesorectal excision allows en-bloc removal of the tumour together with its intact mesorectal fascia. A low local recurrence rate of only 4% has been reported.\textsuperscript{12}

An involved CRM is an independent disease prognostic indicator.\textsuperscript{13} It is defined pathologically as identifying tumour cells within 1 mm of the surgically created margin. Beets-Tan et al\textsuperscript{14} postulated that, on MRI, a distance of 6 mm from the outer edge of the tumour to the mesorectal fascia predicted a tumour distance of 2 mm on histology with 97% confidence, and a distance of 5 mm could predict a crucial distance of 1 mm on histology with high confidence. A study using 1 mm as cutoff showed data with satisfactory accuracy but with a lower sensitivity.\textsuperscript{15} For practical purposes, we have adopted a cutoff of 5 mm as the predictor of clear CRM.

Given a certain depth of tumour invasion, CRM is more likely to be threatened for patients with thinner mesorectal fat (Fig 3). The mean thickness of mesorectal fat is <15 mm for the majority of patients at all arbitrarily measured levels. Taking into account the margin of 5 mm on MRI, a tumour invading 10 mm beyond the serosa on MRI fulfils the criteria for threatened CRM in the majority of patients. Whether Chinese patients present with later-stage disease or have worse disease prognosis is largely unknown. However, caution has to be taken that T3a/b disease in Chinese populations does not equal, or even imply, early-stage disease.

The position of the tumour may also affect the chance of mesorectal fat infiltration. The anterior aspect of the mesorectal fat was found to be thinnest for patients with thinner mesorectal fat (Fig 3). The mean thickness of mesorectal fat is <15 mm for the majority of patients at all arbitrarily measured levels. Taking into account the margin of 5 mm on MRI, a tumour invading 10 mm beyond the serosa on MRI fulfils the criteria for threatened CRM in the majority of patients. Whether Chinese patients present with later-stage disease or have worse disease prognosis is largely unknown. However, caution has to be taken that T3a/b disease in Chinese populations does not equal, or even imply, early-stage disease.

The mesorectal fat is thinnest inferiorly as it approaches the anal verge. Low rectal cancer (<5 cm from the anal verge) has overall worse prognosis. Higher local recurrence rate with higher chances of CRM involvement has been reported.\textsuperscript{17} This may be partly explained by the fact that the amount of mesorectal fat is thinner in low rectum. Low rectal tumours also deserve special surgical attention.\textsuperscript{18}

One major weakness of this study was that body mass index (BMI) was not taken into account. However, a study in the UK\textsuperscript{19} has shown that BMI does not affect the thickness or volume of mesorectal
fat. However, the measurement method employed in that study was different from that in our study, rendering direct comparison difficult. Whether the paucity of mesorectal fat in Chinese patients is due to body build or genetic factors is unknown. Further multicentre studies with collection of BMI data and ethnic information and using standardised measurement methods are needed for better comparison.

**Conclusion**

Thickness of mesorectal fat is shown to be <15 mm in the majority of patients in most positions and at most levels. It was <5 mm for low rectal position. T3a/b tumours may paradoxically infiltrate the mesorectal fascia in the study population. In staging of Chinese rectal cancer patients, T3a/b tumours may threaten the CRM in the majority of locations and patients. Thus, the status of T3a/b alone should not be taken as an indicator of early-stage disease.

**Acknowledgements**

We would like to acknowledge Dr John KW Chan and St Paul's Hospital for courtesy of MRI images.

**References**