Abstract. Anorectal gastrointestinal stromal tumours (GISTs) are uncommon mesenchymal neoplasms. The objective of this report was to demonstrate the value of sliding multislice (SMS) as an upcoming method of continuously moving table MRI, providing detailed abdominal staging of rectal GISTs. Integration of SMS into a high-resolution pelvic MR imaging protocol allows for both detailed assessment of rectal GISTs and depiction of the entire abdomen with high image quality. The staging of liver, malignant lymph nodes and bone metastases is now possible, prolonging pelvic MRI for only one minute.

Gastrointestinal stromal tumours (GISTs) are smooth muscle mesenchymal alimentary tract tumours of variable malignancy. GISTs are more common than previously believed, with about 4,500-6,000 new cases in the USA each year (1). Fifty to seventy percent of GISTs arise in the stomach, 20-30% in the small bowel, 7% in the anorectum and 5% in both the colon and oesophagus, respectively. A small number of GISTs are found in the appendix, gallbladder and pancreas. Extra-gastrointestinal GISTs may be found within the mesentery, omentum, retroperitoneum, or pelvis (2). The most important prognostic factors are believed to be tumour size and mitotic count. Small lesions of less than 2 cm are rarely symptomatic and are usually benign. However, all GISTs have at least some potential for aggressive clinical behaviour, especially when mucosal ulceration is present (3). Larger tumours may stimulate bleeding, abdominal pain, anaemia, abdominal distension or abdominal mass. Because of their submucosal position and lack of infiltrative growth, GISTs tend to reach considerable size before clinical complaints become apparent. Luminal obstruction is rarely seen. GISTs tend to metastasize to the liver and mesentrium, whereas lymph node metastases are usually not encountered (4). For curative therapy, complete and wide excision of the tumour is recommended. Since lymph node involvement in GIST is not common, formal lymphadenectomy is not indicated. With the development of the specific, highly effective, chemotherapeutic agent Imatinib (Glivec, Novartis, Basel, Switzerland) the management of malignant GISTs has been revolutionized.

The imaging criteria of GISTs have been described previously with a predominance of CT methodology (5-12). However, MRI is known to be an excellent imaging tool for pelvic tumour assessment allowing the resolution of various tissue contrasts. It would be favourable to combine a dedicated pelvic MRI study with a staging examination of the whole abdomen for detection of potential liver, lymph node and mesenteric metastases. Here, we present the value of sliding multislice (SMS), an upcoming continuously moving table MRI technique with extended volume coverage for assessment of liver, lymph node, mesenteric and bone metastases in combination with a dedicated pelvic MRI in rectal gastrointestinal stromal tumours. This is the first report of detailed pelvic MRI in combination with abdominal MRI staging using the SMS technique in rectal GIST.

Materials and Methods

Between September 2005 and January 2007 three male patients (57, 68, and 70 years, mean 65 years) with rectal GIST as validated by histology including immunohistochemical staining, were referred to our department for detailed MRI diagnosis, surgical planning and staging. In addition to a dedicated pelvic MRI, a continuously moving table MRI using SMS was acquired in all patients for combined abdominal staging purposes.

The SMS technique minimizes the required axial field of view (FoV) without compromising image quality (13). Basically, SMS
uses a segmented multislice acquisition pattern, which samples the same phase-encoding steps of any anatomical slice at the same spatial position in the scanner’s axial FoV. Discontinuities between the images along the slice axis, for example, gradient non-linearity, are avoided since all z-dependent scan properties are encoded identically for all slices. The full k-space data of any slice is collected while the slice moves through the scanner from one scan position to the next. Simultaneous acquisition of multiple slices is possible by shifting the acquisition trajectories of different slices in time. A T1-weighted contrast-enhanced fast low angle shot (FLASH) gradient echo sequence is acquired. The initial breath-hold phase of 20 seconds ensures artefact-free imaging of the liver before the rest of the abdomen is scanned during free breathing. For scanning in this study, the table speed was 1 cm per second and total acquisition time of the SMS FLASH sequence was 60 seconds. The sequence parameters were: TR/TE 102/2.03 ms, slice thickness 5 mm, matrix 320x224, FoV 350x263 mm², flip angle 70°, spatial resolution 1.4x1.1x5 mm³, parallel imaging with an accelerating factor of 2 and GRAPPA reconstruction.

**Results**

In all three patients, the exact extent of the rectal GIST could be successfully determined with the largest tumour diameters ranging from 6.5-17 cm (Figure 1). The large tumour size resulted in compression of the surrounding organs in two patients. In two patients, all rectal wall layers were infiltrated by the GIST, whereas in one patient a sharp delineation between the rectum and the mesorectal GIST could be demonstrated. Moreover, infiltration of prostate and seminal vesicles was observed in one patient and confirmed by the pathologist, although a tumour capsula was distinguishable in all the cases. With the use of the SMS technique, a staging examination of the entire abdomen within one minute could be added to the dedicated high-resolution pelvic MRI. In all the cases, the SMS rendered excellent image quality for assessment of possible liver, lymph node, mesenteric and bone metastases. Additionally, in one patient, a lung metastasis was detected in the right lower lobe (Figure 2). No malignant abdominal lymph nodes or liver metastases were encountered in any of the patients.

**Discussion**

Pelvic MRI is considered the current gold standard of local staging of rectal cancer (14). Recent advances in scanner and sequence technology such as parallel imaging, multiple matrix coils and receiver channels have opened the door for high-resolution MRI with extended volume coverage which...
is utilized by continuously moving table acquisition. Within one examination, information from organ systems distant from the primary region of interest can be gained. By performing SMS, a one-step staging of hepatic, mesenteric, retroperitoneal lymph node and bone metastases was achieved in addition to the dedicated pelvic MRI examination with excellent diagnostic quality. Using this technique, a lung metastasis was seen in one of the presented cases (Figure 2A). This is an uncommon finding since GISTs tend to predominantly metastasize to the liver and mesentery as documented in a series of 31 patients where GIST metastatic disease was revealed in the liver (38.7%), mesentery (38.7%), omentum (12.9%), and ovary (9.7%) but no lung metastases were found (15). The differential diagnosis of a leiomyosarcoma, which is more likely to metastasize to the lung, should be considered. However, in this particular case, histology revealed the diagnosis of a rectal GIST rather than a rectal leiomyosarcoma. The majority of GISTs show exophytic growth with tumour size larger than 5 cm (15). This corresponds well to our findings with the size of exophytic tumors ranging from 6.5-17 cm. As in our cases, GISTs typically occur in elderly male patients (6).

State-of-the-art MR imaging has the ability to directly visualize the relationship between the tumour and the resection margin. To overcome step-by-step staging of cancer patients using different imaging modalities, SMS-MRI has been integrated into a high-resolution imaging protocol for initial work-up and surveillance. The presence of liver metastases, mesenteric, retroperitoneal lymph nodes and bone metastases can be assessed utilizing an axial breath-hold contrast-enhanced T1-weighted FLASH-2D sequence in a portal dominant phase, which covers the entire abdomen.

We conclude that the SMS technique using continuously moving table MRI allows detailed assessment of the extent of rectal GISTs as well as depiction of the entire abdomen with high image quality and within a one minute scan. In all cases, the tumour could be assessed in great detail. Even infiltration of adjacent organs could be predicted. Neither liver metastases nor lymph node or bone metastases were encountered. In one case, a lung metastasis was additionally detected.

**Figure 2.** A 56-year old male with rectal GIST. Extended FoV imaging with sliding multislice moving table examination as adjunct to high-resolution pelvic MRI. A) Axial contrast-enhanced SMS-FLASH 2D clearly shows a lung metastasis in the right lower lobe (arrow). B) No liver metastasis was evident. C, D) Iliac and inguinal lymph node metastasis could be excluded.
References


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