Evaluation and Biopsy of Recurrent Rectal Cancer Using Three-Dimensional Endosonography

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PURPOSE: The value of endorectal ultrasonography for postoperative follow-up of rectal cancer is limited by the inability to distinguish recurrent malignancy from benign lesions, *e.g.*, fibrotic tissue. This study was conducted to investigate the role of three-dimensional (3D) endosonography for evaluation and biopsy of recurrent rectal cancer. METHODS: Endorectal ultrasonography was performed in routine follow-up program after resection of rectal cancer. 3D volume scans were recorded using a bifocal multiplane 3D transducer (7.5/10 MHz) with a 100° longitudinal and a 360° transversal scan angle. For transrectal ultrasound-guided biopsy of pararectal lesions, a specially designed targeting device was attached to the endoprobe. RESULTS: Overall pararectal lesions were detected in 28 of 163 patients (17 percent) who were undergoing endorectal ultrasonography for follow-up after resection of rectal cancer. 3D image analysis facilitated assessment of suspicious pararectal lesions by contemporary display of three perpendicular scan planes or volume reconstructions of the scanned area. Ultrasound-guided biopsy was performed in all 28 patients with pararectal lesions identified by endorectal ultrasonography. Biopsy revealed recurrent disease or lymph node metastases in seven and two patients, respectively. Benign lesions explained the endosonographic findings in 17 patients. All patients with benign histology still have no evidence of recurrent disease after a median follow-up of seven months. Nonrepresentative material was obtained in only 2 of 28 patients (accuracy, 93 percent). Histology changed the endosonographic diagnosis in 28 percent of cases. CONCLUSIONS: 3D endosonography with ultrasound-guided biopsy improves the diagnosis of extramural recurrence after curative resection of rectal cancer. 3D image display allows precise control of the position of the biopsy needle within the target. [Key words: Three-dimensional endosonography; Transrectal biopsy; Recurrence; Rectal cancer]

Hünerbein M, Dohmoto M, Haensch W, Schlag PM. Evaluation and biopsy of recurrent rectal cancer using three-dimensional endosonography. Dis Colon Rectum 1996;39: 1373-1378.

Despite apparent curative surgery, local recurrence of rectal cancer is observed in approximately 20 to 30 percent of patients.[1–3] Because of the high incidence and considerable morbidity and mortality caused by local recurrence of rectal cancer, follow-up programs must be aimed at detection of disease at an early and potentially curable stage. Recurrent rectal cancer presents as intramural regrowth of the tumor in the anastomosis or as extramural spread within the pericolic fat, mesentery, and lymph nodes. Whereas recurrence within the bowel lumen is easily accessible to endoscopy, it is often extremely difficult to identify extramural recurrence. Radiologic methods including computed tomography (CT), magnetic resonance imaging (MRI), immunoscintigraphy, and positron emission tomography have been used with limited success for detection of pelvic recurrence of rectal cancer.[4–7]

A sensitivity ranging from 41 to 88 percent has been reported for CT.[5, 8] Generally, lesions smaller than 1.5 cm cannot be visualized accurately because of limited resolution of this technique. Sugarbaker and coworkers[9] observed a rate of false-positives as high as 45 percent. A few authors have claimed that MRI is more accurate than CT, because fibrotic tissue can be distinguished from tumor recurrence by low signal intensity on T2-weighted images.[10, 11] However, others have stated that desmoplastic reactions or inflammatory changes can lead to misinterpretation.[6]

Endorectal ultrasonography with 7.5 or 10 MHz transducers continues to be the most sensitive technique for imaging of the rectal wall and perirectal tissue. Several authors have reported accuracy rates of more than 85 percent in the preoperative assessment of tumor infiltration depth.[12, 13] Accuracy in assessment of lymph node involvement ranges from 53 to 83 percent.[13–16] This technique has also been used for postoperative follow-up after curative resection of rectal cancer.[17–20] However, as with other imaging techniques, endorectal ultrasonography often fails to distinguish between benign and malignant lesions, especially if lymph nodes are considered.[21] The aim of present study was to investigate the value of three-dimensional (3D) endosonography and ultrasound-

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guided transrectal biopsy for diagnosis of recurrent rectal cancer.

MATERIALS AND METHODS

After resection, colorectal cancer patients were subjected to a standard follow-up program comprising digital rectal palpation, laboratory tests including carcinoembryonic antigen, abdominopelvic ultrasonography, colonoscopy, and endosonography; CT was performed in selected patients. In the first two years after the operation, examinations were scheduled every three months and every six months thereafter.

Before endorectal ultrasonography, the rectum was cleaned by phosphate enema. All patients underwent rectosigmoidoscopy with a rigid instrument in the genucubital position to exclude intraluminal recurrence and determine height of the anastomosis. For creation of an acoustic interface between the transducer and rectum wall, a latex balloon was attached to the transducer and filled with 50 ml of deaerated water. Then the rigid 3D ultrasound probe (VRW, Kretztechnik, Austria) was introduced blindly into the rectum.

This instrument is equipped with a bifocal multiplane transducer, tunable between 7.5 and 10 MHz that provides a 360° transversal and 100° longitudinal scan angle. The radial scan plane of the transducer delivers a conventional 360° display of the rectal wall and adjacent tissues. Volume scanning is performed by recording a multitude of serial longitudinal scan planes in a defined region of interest, which results in a pyramid shape of the scanned volume. 3D data were stored and processed using a Combison 530 workstation (Kretztechnik, Austria).

For endosonography-guided biopsy, a special targeting device was attached to the endoprobe (Fig. 1). This device allows passage of needles with a maximum diameter of 1 mm. The needle is guided precisely through the scan volume, thus warranting visualization of the full length of the needle within the pararectal tissue. All patients underwent a conventional endosonography using the 360° display. If a pararectal lesion was detected, the endoprobe was rotated until the lesion presented in the longitudinal scan plane. Then, the 18-gauge, 20-cm-long spring-loaded core biopsy needle was advanced into the lesion along a programed guidance line. Before the biopsy was taken, a volume scan was recorded to verify the correct position of the needle. Biopsies were subjected to routine histologic analysis. If histology revealed benign tissue, repeat biopsies were taken two to four weeks later to confirm results.

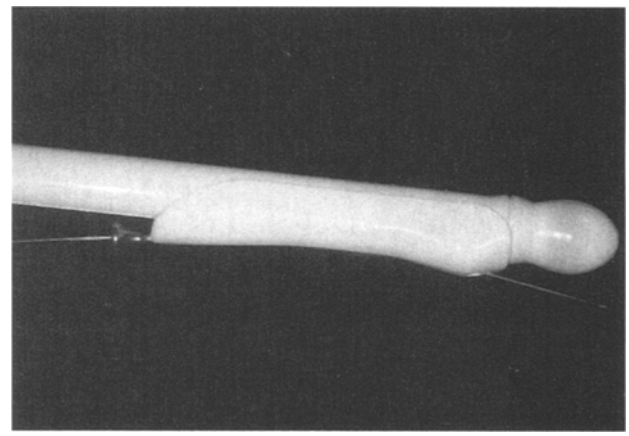

Figure 1. Targeting device attached to probe guides needle through scan volume.

Generally, two to five biopsies were taken of all pararectal nodular structures displayed on endosonography, regardless of echomorphology. Irregularly shaped lesions with low echogenicity were considered suspicious for malignancy. In contrast, lesions containing echo-free areas (fluid) were assessed as postoperative residua, *e.g.*, seroma, hematoma.

Round or oval hypoechoic structures in the pararectal tissue were classified as lymph nodes. Benign enlargement of lymph nodes was characterized by a hyperechoic pattern and indistinctly demarcated boundaries. Metastatic involvement of lymph nodes was indicated by a hypoechoic pattern and clearly defined boundaries.

RESULTS

Endosonography was performed in 163 patients for postoperative follow-up after resection of rectal cancer. Suspicious pararectal lesions were displayed in 28 patients who had undergone anterior resection (n = 25) or transanal excision (n = 3) for adenocarcinoma of the rectum. Lesions were located 3 to 15 cm from the anal verge. Median diameter of the pararectal lesions was 2.2 (range, 1–5) cm. Median diameter of lymph nodes was 0.9 (range, 0.4–1.5) cm. 3D examination including biopsy took approximately 15 to 20 minutes. All examinations were performed on an outpatient basis without sedation or anesthesia. No complications were observed related to endosonography or transrectal biopsy.

3D image analysis using two display modes facilitated assessment of pararectal lesions and increased

the diagnostic confidence of the investigator. The section mode allowed simultaneous display of three perpendicular planes (Fig. 2). This was especially useful for delineation of small isoechogenic lesions. The volume mode provided a spatially oriented display, which improved understanding of the anatomy (Fig. 3).

In 25 of 28 patients (89 percent), endosonography was the first diagnostic method that suggested the presence of local recurrence of malignancy. In addition to endosonography, 19 patients were evaluated with CT. However, CT showed suspicious lesions in only 12 patients; among these were three false-positive (25 percent). On the other hand, CT failed to visualize the lesion in 7 of 19 patients (41 percent).

3D ultrasound-guided transrectal biopsy of all lesions was performed to obtain material for histopathologic analysis. 3D endosonography proved to be extremely valuable in visualizing the correct position of the needle (Fig. 4). Representative material was collected in 26 of 28 lesions (93 percent). Extramural recurrence of rectal adenocarcinoma was identified in seven pararectal lesions and two lymph nodes. Benign tissue such as lymphoid or fibrotic tissue explained the endosonographic findings in 17 patients (Table 1). After repeat biopsies and a median follow-up of seven months, all of these patients have no evidence of recurrent disease.

Results of endosonography-guided biopsy changed the endosonographic diagnosis in 8 of 28 patients (28 percent) by exclusion of extraluminal recurrence (n = 4) and lymph node metastases (n = 4). Transrectal biopsy confirmed the diagnosis of recurrent malignancy suggested by endosonography findings in 7 of 11 patients (Table 2). Metastatic involvement was established in two of six patients with suspicious lymph nodes. In 11 patients, pararectal lesions were correctly classified as benign lymph nodes or postoperative residua, *e.g.*, seroma, hematoma.

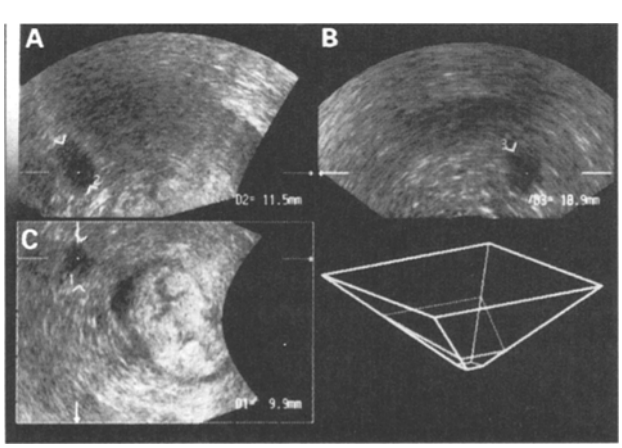

Figure 2. Section display shows a suspicious pararectal lymph node in three perpendicular scan planes (A = longitudinal; B = transverse; C = frontal).

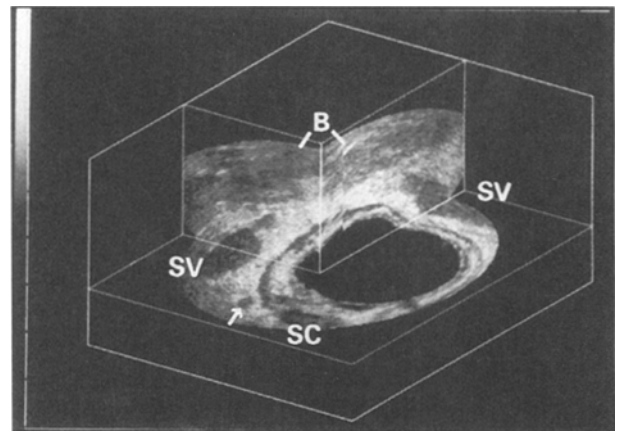

Figure 3. Three-dimensional display after transanal excision of rectal cancer resembles true anatomy: arrow = lymph node; SC = scar; B = bladder; SV = seminal vesicle.

In one patients with suspected recurrence of rectal cancer, biopsy revealed the presence of a secondary tumor. Histology demonstrated a lymph node metastasis of a prostatic carcinoma. The patient was treated with hormonal treatment.

The six patients with biopsy-proven locally recurrent rectal cancer underwent preoperative radiochemotherapy. Complete remission was achieved in one patient with a small lesion of 1.5 cm in size. Because of progressive disease, surgery was abandoned in the other five patients.

DISCUSSION

Most local recurrences of rectal cancer are isolated and are not accompanied by disseminated disease. It has been demonstrated that a curative reoperation may be feasible in approximately 50 percent of patients with isolated local recurrence if the disease is diagnosed at an early stage.[22, 23] Pollard *et al.*[23] achieved a five-year survival rate of 29 percent of patients if radical resection of the tumor was possible. There is also some evidence that patients with isolated pelvic recurrence of rectal cancer benefit from radiotherapy or a combined modality approach.[24–26] Clearly, success of any treatment is dependent on early detection of disease, and several follow-up programs have been developed to achieve this aim.[27, 28]

It has been reported that endorectal ultrasonogra-

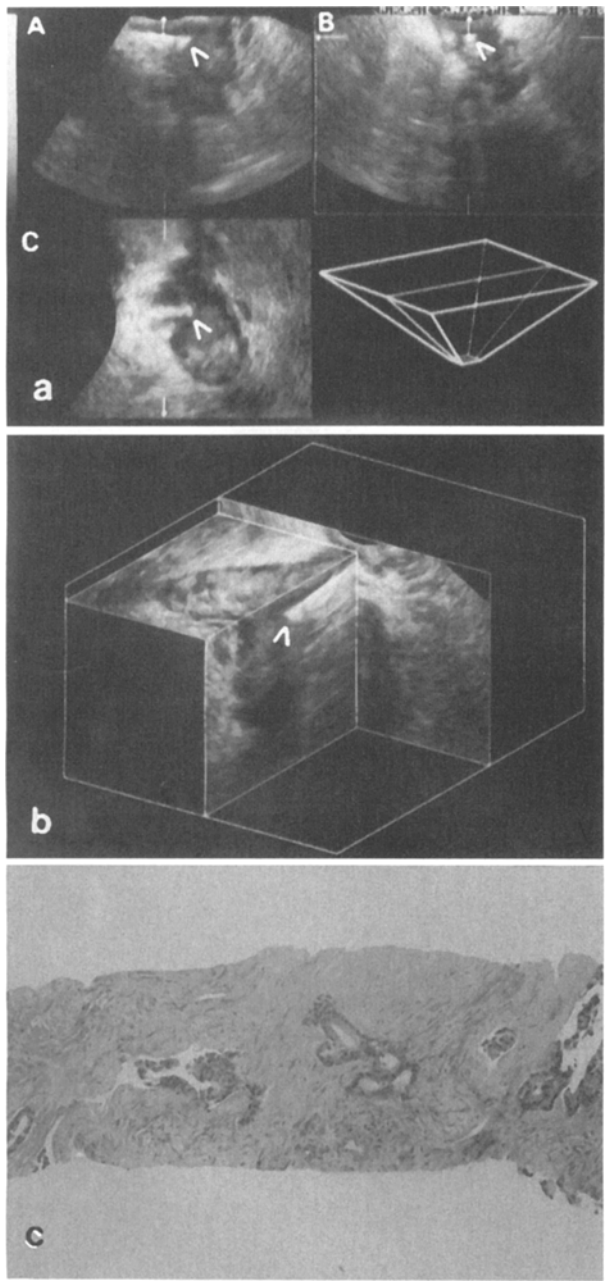

Figure 4. Three-dimensional endosonography-guided transrectal biopsy. a. Section display—biopsy needle (arrow) is placed correctly in a hypoechoic pararectal lesion. b. Volume display—position of needle within target is visualized three-dimensionally. c. Histology reveals recurrent rectal carcinoma and fibrotic tissue.

Table 1.
Transrectal Ultrasound-Guided Biopsy: Histology of Biopsy Specimen of Pararectal Lesions (n = 28)

	n	%
Recurrent adenocarcinoma	7*	25
Lymph node metastasis	2	7
Benign tissue (*e.g.*, lymphoid or fibrotic material)	17	61
Nonrepresentative material (*e.g.*, blood, fat)	2	7

* Includes one prostatic carcinoma.

Table 2.
Correlation of Three-Dimensional Endosonography and Histopathology in 28 Patients with Pararectal Lesions

Endosonographic Diagnosis	Histology	
	Malignant	Benign
Extraluminal recurrence	7*	4
Benign extraluminal lesion (*e.g.*, seroma)	0	9
Lymph node metastasis	2	4
Benign lymph node enlargement	0	2

* Includes one prostatic carcinoma.

phy can improve early diagnosis of recurrent rectal cancer. Beynon *et al.*[16] identified recurrent disease in 3 of 22 patients exclusively by endosonography. In another study, endorectal ultrasonography revealed extramural recurrence of rectal cancer in 12 patients, 4 of whom could not be visualized by CT.[29] The major problem of all imaging techniques is that the morphology of early recurrence may be indistinguishable from fibrotic tissue or postoperative residua. Interpretation of endosonography findings after surgery can be difficult because the endosonographic anatomy of the pelvis may alter following surgery. Scar tissue and prolapsed organs such as the uterus or the small bowel may be mistaken for recurrent malignancy. Usually if no definitive diagnosis can be made by endosonography, a repeat examination is performed after four to six weeks. If the lesion has increased in size, it is most likely to be a tumor; if it has not increased in size, further examinations are mandatory within short intervals. This procedure results in considerable discomfort for the patient and can also delay treatment of disease. Consequently, definitive histologic information regarding hypoechoic pararectal lesions could be extremely valuable for therapeutic decisions.

A transperineal approach to the biopsy of pararectal lesions using a 360° radial scanner has been described.[16] However, a major disadvantage of this technique is that the examiner cannot observe the pathway of the needle, because only a transverse section through the lesion is available. The procedure is difficult to perform, and biopsy material is often nonspecific. Recently, Milsom *et al.*[30] investigated the feasibility of preoperative biopsy of pararectal lymph

nodes in rectal cancer using a longitudinally oriented endorectal ultrasound probe. This probe allowed advance of the biopsy needle precisely into the lymph node under real-time guidance. Representative material was obtained in only 18 of 26 patients. Because the longitudinal scan plane is not suitable for accurate diagnostic evaluation, a second examination had to performed with a conventional radial scanner.

In contrast, 3D endosonography using a multiplane transducer permits display of the tumor in longitudinal and transversal scan planes. Furthermore, scanning of a volume of up 3.5 liters is possible. 3D image processing allows examination of the lesion using deliberately chosen scan planes. Previously not available scan planes can be used to improve interpretation of ultrasonography images. 3D image processing enables display of recorded volume data in three perpendicular planes (section display) or as 3D volume image (volume display). The former facilitates delineation of small pararectal lesions such as lymph nodes, because these can be easily distinguished from vessels or artifacts. The latter is very useful in enhancing the understanding of the anatomy and defining the spatial relationship of the tumor with normal structures, *e.g.*, bladder, seminal vesicles. However, despite improved imaging facilities, differentiation of benign and malignant lesions remains difficult. This fact emphasizes the need for a safe and accurate technique for endosonography-guided biopsy of pararectal lesions.

The 3D technique provides the possibility of ultrasonography-guided transrectal biopsy using a special targeting device. This device guides the needle through the scan volume of the transducer. The needle can be visualized in the entire length while it is advanced into the target. Furthermore, a volume scan can be recorded to verify the correct position of the needle. Image processing of the volume scan allows display of the needle simultaneously in three orthogonal planes or in a reconstructed 3D image. Both modes accurately document the definitive position of the needle. In our experience, the 3D technique enabled precise biopsy of structures as small as 0.5 cm. Representative material was obtained in 93 percent of biopsies. Endorectal ultrasound-guided biopsy had a considerable impact on the diagnostic accuracy of endorectal ultrasonography. Overall endosonographic diagnosis was changed in 28 percent of patients. Notably, transrectal biopsy disclosed benign lesions in eight patients who were considered to have recurrent disease on the basis of endosonography findings. On the other hand, transrectal biopsy revealed recurrent rectal cancer in eight patients and a prostatic carcinoma in one patient with suspicious pararectal lesions.

CONCLUSIONS

3D endorectal ultrasonography including transrectal biopsy appears to be extremely valuable in evaluating recurrent rectal cancer. This technique is capable of providing a quick and accurate diagnosis, thus avoiding inadequate and timely diagnostic efforts. Consequently, overtreatment can be avoided in patients with benign lesions, whereas appropriate treatment can be initiated promptly after histologic confirmation of malignancy.

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