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COMPUTERIZED RADIOLOGY OF THE COLON: A POTENTIAL SCREENING TECHNIQUE*

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Abstract—We report here a new technique; computerized radiology of the colon. This technique consists of digital radiography of the colon combined with colon CT utilizing only air as a contrast agent. This technique is capable of detection of very small polyps. It is also useful in the study of diverticulitis of the colon. Comparison between CT and radiographic air contrast barium enema is demonstrated. In one case, a 13-yr-old girl who underwent total colectomy for familial polyposis, the surgical pathologic findings are also shown. Future potential of the technique is discussed including use as a mass screening method.

Colon CT Colon polyps CT Colon cancer CT CT contrast agents Three dimensional CT Diverticulitis

INTRODUCTION

CT scanning has been advocated in evaluation and preoperative staging of rectal and colon carcinoma [1–6]. The use of CT for polyp detection has not been previously described, although this potential use has been suggested [7]. We report here the use of this technique combined with digital radiography utilizing only air as a contrast agent. Use in study of diverticular disease is also shown. Our techniques and representative examples are reported here.

METHOD

A standard barium enema preparation is utilized. The patient is examined in the supine position following rectal inflation of air. This is followed by digital radiography made by the CT scanner. The digital images provide valuable diagnostic information in addition to precise correlation with CT slice position. The colon is scanned by rapid sequential contiguous thick CT sections. Additional thin sections may be obtained if desired. Intravenous glucagon may be utilized to reduce peristalsis. I.V. contrast is generally not needed.

Selected CT sections are magnified and reconstructed from raw data for maximum spatial resolution.† This program provides very fine detail since contrast difference between air and intraluminal polyps is extremely high. In one of our cases, the sections were also reconstructed for three-dimensional display.

Technical factors

GE CT/T 8800 scanner, 120 KVP, 320 mas, 9.6 sec per slice and 10 mm slice thickness. Selected sections were also obtained at 1.5 mm thick. Sections were magnified up to three times and reconstructed with pixel size down to 0.25 mm. These factors provided images of excellent quality, with fine spatial resolution and very adequate contrast between intraluminal polyps and intraluminal gas. Both thin and thick sections were seen to be of excellent quality. Polyps of 1–10 mm were easily resolved by this method (Fig. 2). Proper colon preparation is most desirable; however, retained feces may sometimes be differentiated from tumors by the presence of small amounts of air visible within feces on CT (Fig. 2).

* Presented at the annual meeting of the Radiological Society of North America, 1981.
†ReView program G. E. Milwaukee.

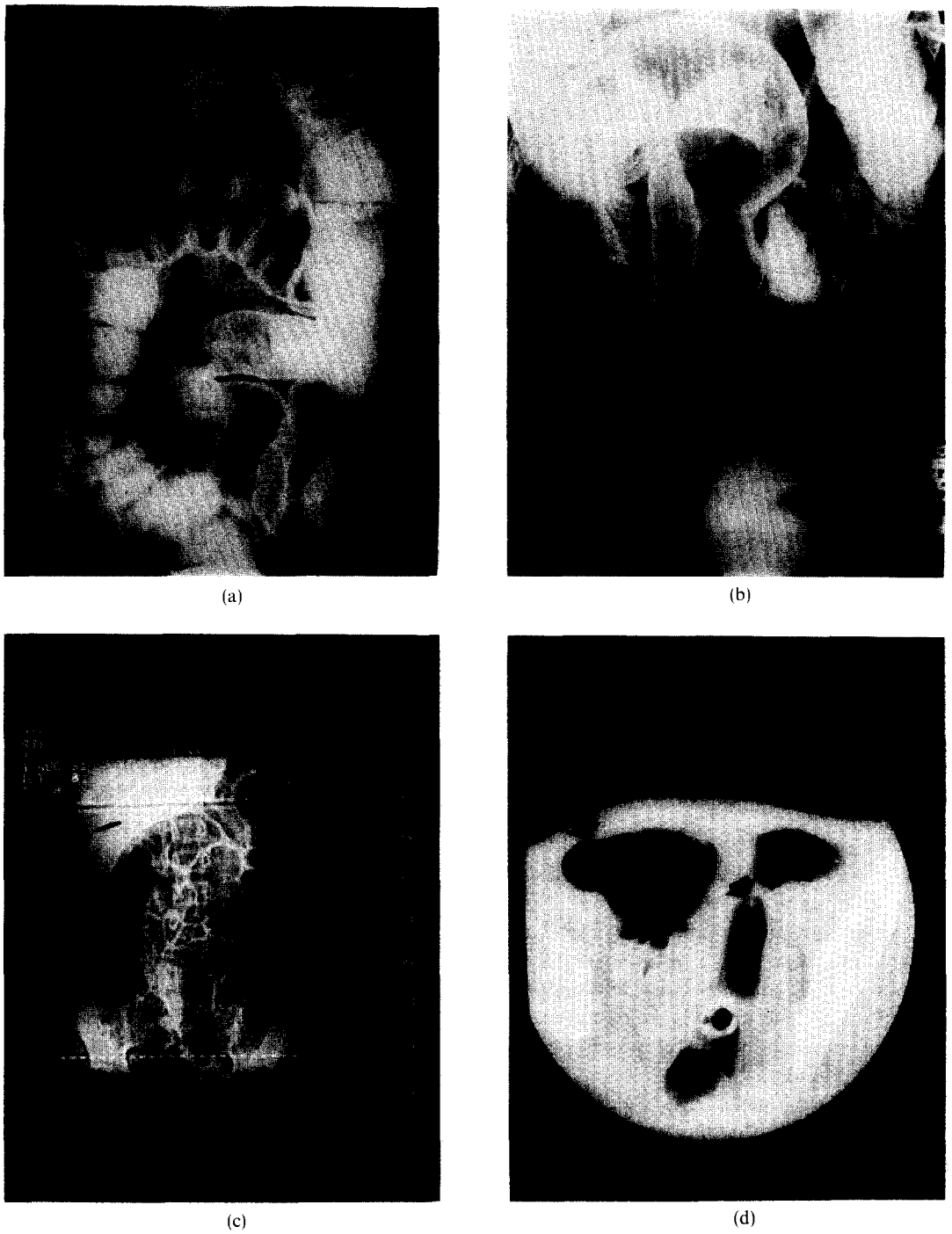


Fig. 1. Case 1: conventional air contrast barium enema (a,b) shows small filling defects in the sigmoid colon (arrows). Digital radiograph (c) outlines the colon distended with air. White line indicates the level of CT section (d). Multiple small polyps are demonstrated (arrows).

CASE REPORTS

Case 1

An asymptomatic 9-yr-old female was examined after adenocarcinoma and multiple colon polyps were found in a 23-yr-old brother. Representative images from a radiographic double contrast study of the colon and air contrast CT of the colon are shown demonstrating small intraluminal polypoid filling defects (Fig. 1). Sigmoidoscopy confirmed the presence of multiple polyps. The clinical diagnosis of familial polyposis was confirmed.

Case 2

An asymptomatic 13-yr-old girl, the sister of the patient in Case 1, was examined by barium enema with air contrast study and by air contrast CT and digital radiography of the colon (Fig. 2). These studies both demonstrate multiple small polyps. Representative photographs of the colectomy specimen are shown (Fig. 2). There was excellent correlation between the studies. CT sections from this study were also reconstructed in a three-dimensional format [8] (Fig. 2), providing the ability to view the entire colon from any perspective.

Case 3

A 51-yr-old male presented symptoms of bright red rectal bleeding. Sigmoidoscopic examination revealed two polyps which were removed. The base of one was extensively fulgurated since it appeared agressive. Barium enema and air contrast study shows an ulcerated lesion at the rectosigmoid junction (Fig. 3a). Characteristics of this lesion are also demonstrated well by air contrast CT (Fig. 3b,c).

Case 4. Sigmoid diverticulitis

This is the case of a 63-yr-old male who was having vague lower abdominal pain and tenderness. In this case, examination consisted of digital radiography (not illustrated) and air contrast CT with intravenous contrast material. This study shows conclusive evidence of sigmoid diverticulitis (Fig. 4).

DISCUSSION

Approximately 100,000 new cases of colonic cancer occur annually in the United States and accounted for almost 50,000 deaths in 1974 [9]. Five-year survival of localized disease approaches 79%. Early detection has the greatest promise for reduction of mortality from this malignancy. Colonoscopy and double contrast barium enema examinations represent the most accurate methods presently available for this purpose. Each of these methods, properly performed, is capable of detecting very small polyps and colon cancer at an early stage [10–13]. Both methods, however excellent in accuracy, suffer from limitations making them of questionable utility for mass screening. CT of the colon also has some drawbacks as a possible screening technique. These include the expense of the equipment and relatively slow speed of the present CT scanners. These do not appear to be formidable limitations in view of technologic improvements either now available or in progress. Fast scan time coupled with rapid table incrementations potentially can increase the productivity of the scanner reducing time and cost of examination. Our studies indicate a potential accuracy of polyp detection comparable to or superior to that of air contrast colon examination. Advantages of the CT study include absence of need for barium, examination in supine position only (oblique and horizontal beam positions are not required) and better patient tolerance with less patient cooperation required. Further comparison studies are in progress. These preliminary studies are promising.

SUMMARY

Digital radiography combined with air contrast is a promising new technique for colon examination. The ability of air contrast CT to accurately and easily demonstrate the presence of small polyps of the colon has been shown. Diverticulitis and other inflammatory lesions are also demonstrable by this method. Minor changes in presently available equipment including faster scan times and rapid table incrementation will make this technique even more useful. An accurate mass survey method for detection of colon polyps and early carcinoma is a worthwhile goal that may be achievable using this technique with proper equipment.

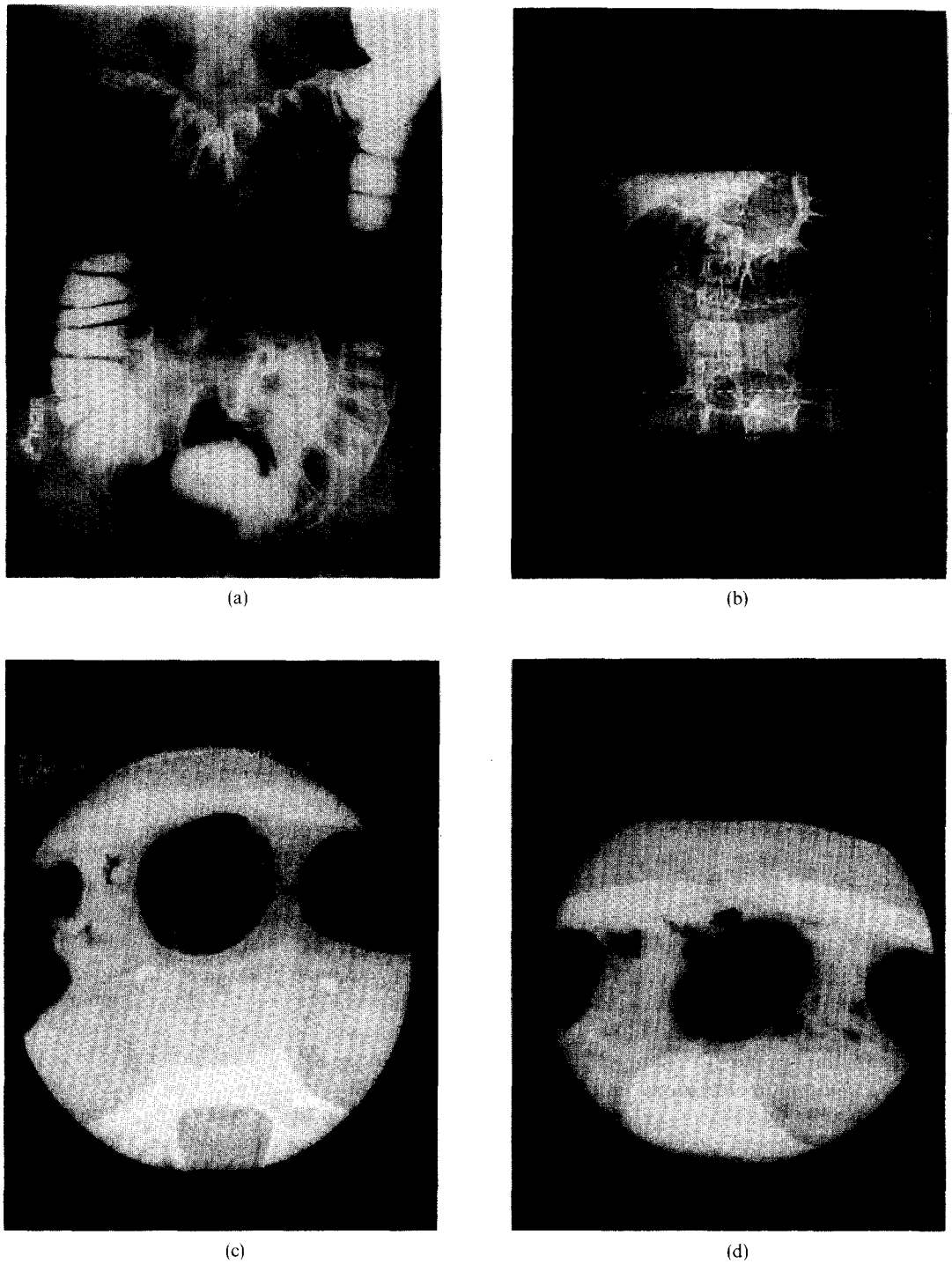
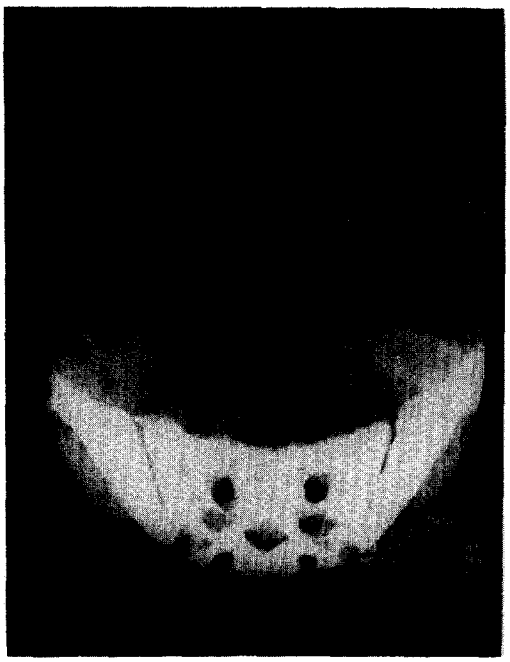


Fig. 2. Case 2: radiographic air contrast barium enema (a) and digital radiograph of the colon (b) indicate the presence of multiple small intraluminal filling defects. CT sections (c,d) confirm multiple small polyps (arrows). Larger filling defect in the rectosigmoid (e) contains a small amount of air on CT section (arrow); therefore is feces. Surgical colectomy specimen (f,g) confirms polyposis. Three-dimensional display of CT data is shown (h).



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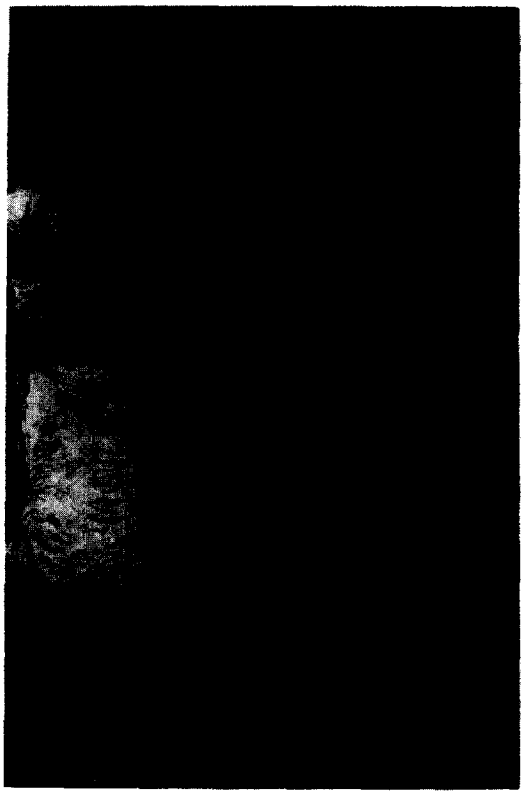

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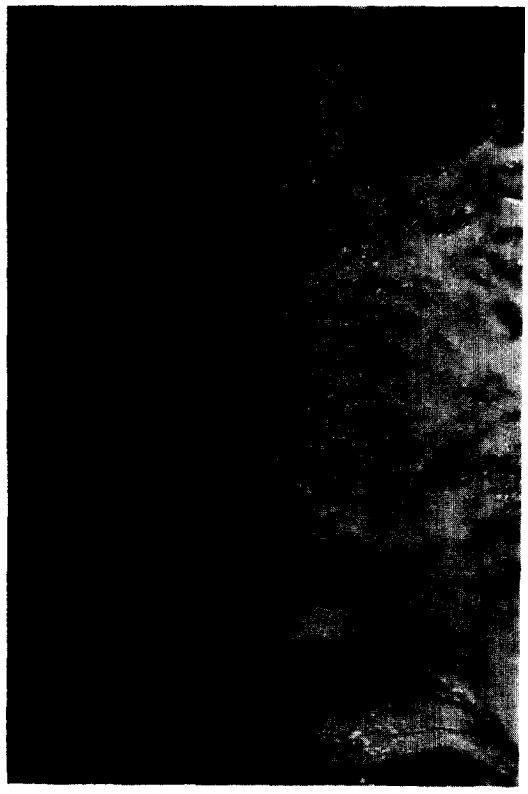

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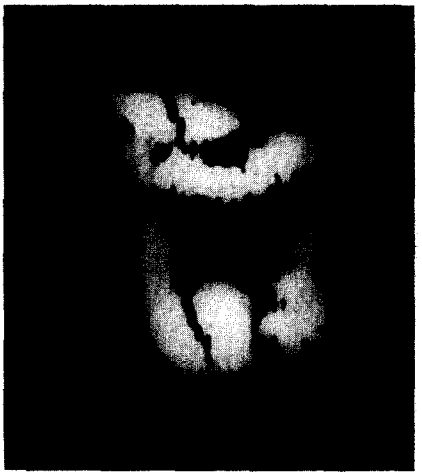
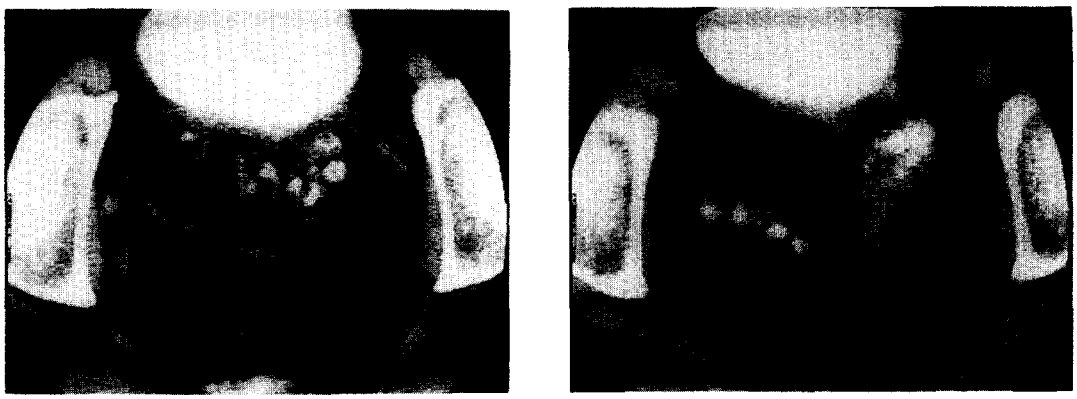


Fig. 2.

(a) (b)

(c) (d)

Fig. 3. Case 3: air contrast barium enema (a) demonstrates an ulcerating lesion in the distal sigmoid (arrow). CT (b) shows annular thickening of the bowel wall at this level (arrow) and in (c) air (lower arrow) that is submucosal. Normal thin wall of the rectum (d) is shown for comparison.



(a) (b)

Fig. 4. Case 4; sigmoid diverticulitis is shown by air contrast CT (a,b). Diverticuli (arrows) deeply penetrate the thick inflamed sigmoid wall.

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