Ischemic Colitis Proximal to Obstructing Colonic Carcinoma: Values of CT in Its Detection

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Purpose: To determine the value of the CT scan in distinguishing an ischemic and a tumoral segment in colonic carcinoma complicated by proximal bowel ischemia.

Materials and Methods: CT scans of twenty patients with ischemic colitis proximal to obstructing colonic carcinoma were reviewed retrospectively. The presence of an ischemic segment proximal to colonic carcinoma were pathologically confirmed in 12 patients, and the remaining eight patients showed typical radiologic findings of bowel ischemia on barium enema but on pathologic review showed only colonic carcinoma. CT scans were analyzed for the location, wall thickness, length, and enhancing pattern of both tumoral and ischemic segments in correlation with barium enema or surgico-pathologic results. The results of tumor staging shown on CT scan were compared with those of pathologic findings.

Results: On CT scan a distinction between ischemic and tumoral segments could be made in 15 patients (75%). The ischemic segments were contiguously proximal to the tumoral segment in 18 patients. In two patients, however, there was an intervening segment of normal bowel between the two segments and this was confirmed by pathology. Maximum bowel wall thickness ranged from 0.8 to 4.5 cm (mean, 2.0 cm) in tumoral segments and from 0.6 to 1.5 cm (mean, 1.0 cm) in ischemic segments (p<0.05). Tumoral segments were enhanced heterogeneously in 12 patients (60%) and homogeneously in the remaining eight, while ischemic segments were enhanced homogeneously in 14 patients (70%) and heterogeneously in six. Peripheral rim enhancement was seen only in the ischemic segments of four patients (20%). Comparing TNM tumor staging of the CT scan with that of pathology, CT scan overstaged in two patients (10%) and understaged in one (5%).

Conclusion: CT is a valuable tool for distinguishing an ischemic from a tumoral segment in patients with ischemic colitis proximal to colonic carcinoma. An understanding of this pathologic entity could reduce the possibility of over or understaging in cases of colonic carcinoma.

Index Words: Colitis
Intestines, ischemia
Intestinal neoplasms, CT

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INTRODUCTION

Ulceration and inflammation of the colon may occur proximal to an obstructing colonic carcinoma, and this has been called pseudoulcerative colitis(1), acute necrotizing colitis(2), obstructive colitis(3), colitis or antecedent carcinoma(4), or obstructing carcinoma with acute proximal ulcerative colitis(5).

Without an understanding of this pathologic entity, ischemic colitis proximal to obstructing carcinoma can be confused with extensive colonic carcinoma. On computed tomography (CT), the concomitant presence of an ischemic segment and colonic carcinoma will give the impression of a longer tumoral segment than is actually the case. Secondary congestive changes in the pericolic space may lead to overstaging the tumor. Preoperative detection of this pathologic process will help surgeons to prevent possible postsurgical complications.

The purpose of this paper was to determine the value of CT in distinguishing an ischemic and a tumoral segment in those carcinomas complicated by proximal bowel ischemia.

MATERIALS and METHODS

From January 1990 to March 1995, we experienced twenty patients with ischemic colitis proximal to obstructing colonic carcinoma, and the CT findings were reviewed retrospectively. There were nine male and eleven females ranging from 31 to 85 years of age (mean, 63 years). All patients preoperatively underwent both barium enema and CT scans. The presence of an ischemic segment proximal to a colonic carcinoma was pathologically proved in 12 patients, and the remaining eight showed typical radiologic findings of bowel ischemia on barium enema, but pathologic review showed only colonic carcinoma.

A barium enema was performed using single (n=7) and double (n=13) contrast methods. CT scans were performed on a Somatom Plus - S (Siemens, Erlangen, Germany) or GE 9800SX (GE, Milwaukee, USA). Contiguous scans of slices 8–10 mm thick were obtained in 18 patients at 10 mm intervals from the diaphragm to the symphysis pubis with bolus injection of intravenous ionic contrast material. Two patients underwent spiral CT using the two-phase dynamic technique with bolus injection of nonionic contrast material, and were scanned with 10 mm collimation and a pitch of 1. About 450 ml E-Z cat (E-Z-EM, NY, USA) was orally administered to patients who could tolerate food ingestion. Rectal contrast materials were infused with air inflation or diluted E-Z cat in all patients. The interval between CT scans and barium enema ranged from 0 to 7 days in 13 patients and 8 to 14 days in seven patients. The interval between CT or barium enema and surgery ranged from 1 to 7 days in all patients.

CT scans were retrospectively reviewed by two radiologists, and specifically focused on the location, wall thickness, length, enhancement pattern of the tumoral and ischemic segments, and the presence of pericolic congestion or tumor infiltration in correlation with surgical-pathologic results. Contrast enhancement patterns were classified into homogeneous and heterogeneous: in heterogeneous cases the presence of peripheral rim-enhancement (double halo sign) was also noted. The attenuation of the involved bowel wall was compared to that of the abdominal muscle. Pericolic vascular engorgement or congestion indicated the presence of increased linear or round shadows with enhancement in the pericolic space with or without regional fluid collection. Pericolic tumor infiltration was suggested when ill-defined linear or reticular shadows were present in the pericolic spaces.

In these patients, one experienced radiologist who had not been informed of surgical or pathologic results staged the tumor on CT scan on the basis of TNM classification, and its results were compared with those obtained pathologically. Statistical analysis was performed using the Student t-test on Excel 5.0 program.

RESULTS

Tumoral segments were most commonly located in the rectosigmoid colon (n=12) and transverse colon...
Ischemic segments, however, were most commonly located in the rectosigmoid colon (n=10), ascending colon (n=5), descending colon (n=3), and transverse colon (n=2) in order of frequency (Table 1). Schematic drawings of patterns of both tumoral and ischemic segments on barium enema are shown in Figure 1. The ischemic segments showed thumbprinting, transverse ridging, and/or ulceration on barium enema (Figs. 2, 3), and were contiguously proximal to the tumoral segment in 18 patients (90%) (Fig. 2); in two patients, however, there were intervening segments of normal bowel between the ischemic and tumoral segments (Fig. 3). In these two cases, pathology revealed that the intervening segment of normal bowel ranged from 14 to 22 cm. Colonic dilatation proximal to the obstructing tumoral segment was noted in 16 patients (80%); it was high grade in eight (Fig. 4) and low grade in eight.

Contrast enhancement patterns of thickened bowel wall on CT scan and length of tumoral or ischemic segments are shown in Table 2. The involved bowel

| Table 2. Comparison of the Length, Thickness, and Contrast Enhancement Patterns of Involved Bowels on CT between Tumoral and Ischemic Segments |
|---------------------------------|-----------------|-----------------|----------|
| Tumoral segment | Ischemic segment | P value |
| Length (mean) | 4.0–11.0 (5.9) cm | 3.0–33.0 (10.1) cm | P < 0.05 |
| Bowel wall thickness (mean) | 0.8–4.5 (2.0) cm | 0.6–1.5 (1.0) cm | P < 0.05 |
| Enhancing pattern | | |
| Homogeneous | 8 | 14 |
| Heterogeneous | 12 | 6 |
| (Double halo sign) | 0 | 4 |

Fig. 2. A rectal cancer with proximal ischemia.

a. Contrast-enhanced CT shows concentric thickening of the rectum with diffuse perirectal tumor infiltration and vascular engorgement (arrows).

b. Contrast-enhanced CT at 4 cm cephalad level shows diffuse thickening of the ischemic segment in the sigmoid colon (open arrows). In this case, there is a difficulty in separating tumoral from ischemic segment on CT alone.

c. Barium enema more easily separates tumoral (curved arrows) from ischemic segments (open arrows); ischemic segment shows edematous thickening of the mucosal folds with spastic configuration.
Fig. 3. An example of descending colon cancer with proximal ischemic colitis who have intervening normal segment.

a. Barium enema shows an apple-cored cancer (*) in the descending colon and thumbprinting appearance (arrows) in the ischemic segment of the distal transverse colon. Two segments are separated by normal colonic mucosa.

b. Arterial dominant phase of dynamic CT scan shows dense contrast enhancement (*) in the tumoral segment in contrast to the ischemic segment (open arrows).

c. CT scan at delayed phase shows peripheral rim enhancement (arrows) in the ischemic segment of the distal transverse colon.

d. Resected specimen of another patient shows an encircling ulcerolungating mass (*) in the rectosigmoid colon and diffusely scattered hemorrhagic ulceration (open arrows) with submucosal edema(*)along the ischemic segment of the proximal colon.

Table 3. Comparison of TNM Staging between CT and Pathology in 20 Patients

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lengths ranged from 4.0 to 11.0 cm (mean, 5.9 cm) in tumoral segments, but from 3.0 to 33.0 cm (mean, 10.1 cm) in ischemic segments (p<0.05). Maximal thickness of the bowel wall differed between tumoral and ischemic segments; it ranged from 0.8 to 4.5 cm (mean, 2.0 cm) in tumoral segments, but from 0.6 to 1.5 cm (mean, 1.0 cm) in ischemic segments (p<0.05).

The observation of contrast enhancement patterns of the involved bowels was helpful in separating the two segments; tumoral segments were enhanced heterogeneously in 12 patients (60%) and homogeneous in the remaining eight, while ischemic segments were enhanced homogeneously in 14 patients (70%) and heterogeneously in six (Figs. 2, 3, 4). Peripheral rim enhancement was not seen in any tumoral segments, but only in ischemic segments in four patients (20%) (Figs. 3, 4). Tumoral segments were hyperattenuate in 13 patients, isoattenuate in six and hypoattenuate in one, while ischemic segments were hyperattenuate in five.
isoattenuate in 11, and hypoattenuate in four. Through differences of bowel thickness or contrast enhancement patterns, CT scan could distinguish an ischemic and a tumoral segment in 15 patients (75%). Pericolic vascular engorgement or congestion was present in 19 patients (95%) (Figs. 2, 5) and pericolic tumor infiltration was present in 17 (75%).

Comparing TNM tumor staging of the CT scan with that of pathology, the former correctly staged in 17 patients, but overstaged in two (10%) (Fig. 5) and understaged in one (5%) (Table 3).

**DISCUSSION**

The incidence of ischemic colitis coexisting with colonic carcinoma is unclear. Rutledge(1) and Ganchrow (6) reviewed this syndrome, and stated that it occurs in about 1% of cases of colonic carcinoma, but Toner(7) identified proximal obstructive colitis in 7% of colonic resections due to an obstructive lesion in the colon.

The characteristic gross pathological features of ischemic colitis proximal to the colonic lesions are a dilated bowel with marked congestion, focal mucosal hemorrhage, and ulceration(6–12). Obstructing lesions in the distal segment can be caused by colonic carcinoma, volvulus, diverticulitis, fecal impaction, postoperative stricture, or incarcerated hernia(7, 9). This range of diseases indicates that colitis is a consequence of mechanical obstruction rather than a paraneoplastic effect of carcinoma. The distention of the bowel undoubtedly plays a major role in the pathogenesis of this complication. Distended colonic lumen may produce local hemodynamic disturbances and focal circulatory insufficiency. Boley et al. (13) have clearly demonstrated the reduction of intestinal (especially mucosal) blood flow and its secondary effect on arteriovenous oxygen difference when intraluminal pressure is raised due to bowel distention. In certain cases, proliferation of bacteria due to the stagnation of bowel contents above the stricture(2, 7) or mechanical vascular occlusion(6, 7, 9) may contribute to ischemic colitis.

Detection of ischemic change proximal to colonic carcinoma is important in two aspects. First, understanding this disease entity will help the surgeon to prevent possible postsurgical complications, since up to 25% of cases of proximal ischemic colitis have been reported to cause postoperative complications such as suture-line disruption(2, 4, 6, 7). Second, without a knowledge of this disease entity, the concomitant presence of an ischemic segment in colonic carcinoma may give a false impression regarding tumor length or depth of tumor invasion: indeed, in our study, the tumor was overstaged on CT scan in two patients who showed pericolic vascular engorgement.

As demonstrated by other researchers, our study showed that there was a normal-appearing segment of colon between the colonic carcinoma and the proximal ischemic colitis(7, 8, 14). This finding can be explained by the law of Laplace, i.e., tension in the bowel wall increases both with increasing intraluminal pressure and with increasing diameter of the obstructed bowel (7). Ischemia can therefore develop at sites remote from the obstructing lesion. Our study showed that in 75% of cases CT could distinguish an ischemic from a tumoral segment because of different bowel wall thick-
Fig. 5. An ascending colon cancer in whom CT scan overstaged the tumor.

a. Barium enema shows a long segment cancer(*) in the ascending colon with proximal ischemic change (arrowheads).  
b. Contrast-enhanced CT scan shows marked enhancement of tumoral segment in the ascending colon (*).  
c. Contrast-enhanced CT scans at 3 cm caudad level shows thickened bowel wall in the ischemic segment (arrowheads) with contrast enhancement lesser than tumoral segment. Fluid collection in the pericolic fat plane (open arrows) was misinterpreted as diffuse tumor infiltration, but histopathologic examination confirmed that the tumor confined to the muscularis mucosae without pericolic infiltration.

Although overlapped in some instances, the bowel wall was homogeneously and concentrically thickened in the ischemic segment, but inhomogeneously and irregularly thickened in the tumoral segment. However, the peripheral rim enhancement (double halo sign) seen in 20% of the ischemic segment appeared to be the most specific sign for the diagnosis of colonic ischemia.

The barium enema findings of ischemic colitis proximal to obstructing colonic carcinoma are similar to those of general ischemic colitis from other causes such as thumbprinting, transverse ridging, spasm, ulceration, and stricture. Although CT was the only modality for detecting a proximal ischemic segment in the presence of high-grade colonic obstruction, barium enema also showed a high sensitivity similar to that of CT in low-grade obstructing colonic carcinoma. Careful study of the colonic segment proximal to a cancer is therefore necessary during barium enema in order to detect the characteristic findings of ischemia (e.g., thumbprinting). In addition, observation of the proximal end of the tumoral segment is important; even in the absence of thumbprinting, loss of abrupt transition with prominent transverse ridging raises the possibility of proximal ischemic change.

In conclusion, CT is a valuable tool for distinguishing an ischemic from a tumoral segment in patients with ischemic colitis proximal to colonic carcinoma. An understanding of this pathologic entity could reduce the possibility of over or understaging in cases of colonic carcinoma.

REFERENCES

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10. 우성구, 임재훈, 김순용, 안치열 대장암에 동반된 괴사성 대장염 대한 방사선의학회지 1982; 18: 543-548

대한방사선의학회지 1996; 35(2): 229-235

목 적: 대장암의 근위부에 허혈성 장염이 합병된 경우에 단층촬영이 종양부위와 허혈부위의 구분에 유용한가 알아보고자 하였다.

대상 및 방법: 대장암과 근위부의 합병된 허혈성 장염이 수술과 병리적으로 확정된 12명의 환자와 대장조영술상 전형적인 대장암과 근위부의 허혈성 장염 소견이 보였으나 병리적으로는 대장암만 확인된 8예의 환자를 대상으로 하였다. 단층촬영에서 종양부위와 허혈부위 각각의 위치, 침범된 길이, 장관벽의 두께, 조영증강의 형태를 대장조영상 및 병리 소견과 비교하여 분석하였다. 단층촬영과 병리 소견의 결과를 TNM 종양 병기 판정 방법으로 비교하였다.

결과: 단층촬영상 15명 (75%) 의 환자에서 종양부위와 허혈부위의 구분이 가능하였다. 허혈부위는 18예에서는 종양부위와 연속적으로 근위부에서 위치하였으나, 2예에서는 허혈부위와 종양부위 사이에 정상 점막 조직이 존재하되며 병리적으로 확인되었다. 장관벽의 두께는 종양부위에서 0.8-4.5cm (평균, 2.0cm), 허혈부위에서 0.6-1.5cm (평균, 1.0cm) 로 유의한 차이가 있었다 (p<0.05). 조영증강 형태는 종양부위에서 불균질한 조영증강이 12예 (60%), 균질한 조영증강이 8예인데 비하여 허혈부위는 균질한 조영증강이 6예, 균질한 조영증강이 14예 (70%) 었다. 특히, 음상의 범위를 조영증강은 허혈부위에서만 4예 (20%) 었다. 종양 병기 판정은 단층촬영상 2예에서 병리 소견보다 과도한 결과를 보였고, 1예에서는 병리 소견보다 낮은 병기 판정을 하였다.

결론: 단층촬영은 대장암의 근위부에 허혈성 장염이 합병된 경우 두 부위를 구분하는데 유용하며, 이러한 합병된 질환을 이해함으로써 단층촬영에서 잘못된 병기 판정을 방지하는데 도움을 줄 수 있을 것으로 사료된다.
진단방사선과 전문의시험 경향 안내

1. 전문의 시험 분야별 출제비율

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2. 핵의학 분야의 수련은 현행대로 2개월 이상 의무적으로 수련해야 하며 전문의 시험에도 핵의학을 현행 비율대로 계속 출제 할 것임.

3. 동위원소 취급 특수면허 취득을 위한 교육이나 동 면허취득으로 상기 2항의 수련 의무를 대신하지 못함.

4. 상기 출제 비율은 당해연도 문제 선택위원의 성향 또는 문제은행의 문제 성향 등에 따라 증감될 수 있음.

5. 전공의의 전문의시험 응시자격을 위한 논문은 응시서류 제출시 별책을 제1저자 원저1편과 공저자 2편을 제출하여야 함(단, 증례보고와 논문게재 확인 증명서는 안됨).