undetectable antibody concentrations to determine whether they are protected.

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Requests for reprints should be sent to JEB.

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Indium-111 autologous leucocyte scanning: comparison with radiology for imaging the colon in inflammatory bowel disease

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Abstract

Indium-111 autologous leucocyte scanning was compared with barium enema for assessing the extent of colonic disease in Crohn's colitis and ulcerative colitis. Scanning was shown to be as accurate as conventional radiology in colitis, reliably distinguishing active from inactive disease.

The results suggest that ¹¹¹In-leucocyte scanning is an accurate, non-invasive, alternative technique for imaging the extent of disease in colitis.

Introduction

A rapid and effective isotopic method of visualising inflamed bowel might offer advantages over conventional radiological techniques in medical and surgical gastroenterology. Initial promising results with ^{99m}Tc-diethylenetriamine penta-acetic acid could not be repeated in later studies.^{1,2} Though ⁶⁷Ga-citrate has been used successfully in ulcerative colitis,^{3,4} its value appears to be both limited⁴ and unpredictable⁵ in Crohn's

disease. Indium-111-labelled leucocyte scanning is now established as an effective method of locating sepsis,⁶⁻⁹ and in preliminary studies we and others have shown that it can image inflamed bowel.^{10,11} We have therefore examined the imaging potential of ¹¹¹In-leucocyte scanning in ulcerative colitis and Crohn's colitis as compared with radiology.

Patients and methods

We studied 20 patients with colitis (see table). In all cases the diagnosis was confirmed histologically. Spread to the small bowel in patients with Crohn's disease was excluded by barium follow-through. From clinical and histological assessment, 17 patients had active colitis and three inactive disease. Colonoscopy was available within two weeks of the scan in six patients (three with active and all three with inactive disease). Nine patients were receiving treatment in the form of steroids or sulphasalazine at the time of the scan.

Radiology—Double-contrast barium enema was performed in 19 patients. The remaining patient was considered too ill for the procedure and the extent of disease was assessed by late barium follow-through films and confirmed by surgery. The extent of colitis was assessed by the radiologist performing the barium study (who was unaware of the result of the leucocyte scan) and classified according to regional disease, regions 1, 2, and 3 corresponding to descending, transverse, and ascending colon, respectively. Radiology was performed within two weeks of the leucocyte scan in 17 patients. In the remaining three barium enema was performed three to four months before the scan.

Scanning—Leucocytes were labelled either in saline with ¹¹¹In-acetylacetate (eight patients)¹² or in plasma with ¹¹¹In-tropolone (12 patients).¹³ Abdominal scans were performed within four

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hours of reinjection of the labelled cells with a gamma camera (IGE 400T) fitted with a medium-energy parallel-hole collimator and assessed by an experienced nuclear physician, who was unaware of the clinical details or radiological assessment. The extent of abnormal activity in early scans corresponding to regions 1, 2, and 3 was determined for each patient.

Results

The table gives the clinical details and extent of colitis as assessed by radiology, colonoscopy, surgery, and early leucocyte scans. All patients with inactive colitis had negative scans (fig 1). Early scans were abnormal, showing colonic localisation in all cases of active colitis (figs 2-4). Later scans showed disappearance of activity from

the initial site of localisation. Steroids and sulphasalazine did not prevent localisation.

There was complete agreement between radiology and scan in 17 of the 20 patients. In three patients the scan disagreed with the extent of disease as assessed by barium enema. In case 7 the scan showed colitis confined to transverse and descending colon, whereas radiology indicated pancolitis. Colonoscopy 10 days after steroid treatment showed disease in the transverse and descending colon. In case 12 both scan and barium enema showed colitis in the descending colon. Additionally, however, radiology showed a skip lesion affecting the midtransverse colon. The skip lesion was missed in the scan on initial assessment but was visible in retrospect. In the third patient (case 8) scanning suggested pancolitis, whereas barium enema indicated disease of ascending and transverse colon only. Colonoscopy showed active pancolitis.

Clinical details, labelling methods, and assessment of extent of colitis

Case No	Diagnosis	Clinical assessment	Treatment	Labelling method	Regions of colon detected as inflamed*			
					Barium enema	Scan	Colonoscopy	Surgery
1	Ulcerative colitis	Active	Steroids	Tropolonate	1,2,3†	1,2,3		
2	Ulcerative colitis	Active	Sulphasalazine	Tropolonate	1,2,3†	1,2,3		
3	Ulcerative colitis	Active	Steroids, sulphasalazine	Acetylacetonate	1,2,3	1,2,3		1,2,3
4	Ulcerative colitis	Active	Steroids	Acetylacetonate	1,2,3	1,2,3		
5	Ulcerative colitis	Active		Acetylacetonate	1,2,3	1,2,3		1,2,3
6	Ulcerative colitis	Active		Acetylacetonate	1,2,3	1,2,3		
7	Crohn's disease	Active		Acetylacetonate	1,2,3‡	1,2	1,2	
8	Ulcerative colitis	Active	Sulphasalazine, steroids	Tropolonate	2,3‡	1,2,3	1,2,3	
9	Ulcerative colitis	Active	Steroid, sulphasalazine	Tropolonate	1,2	1,2		
10	Crohn's disease	Active	Steroids	Tropolonate	1,2	1,2		
11	Crohn's disease	Active		Tropolonate	1,2	1,2		
12	Crohn's disease	Active		Acetylacetonate	1,2‡	1		
13	Crohn's disease	Active		Tropolonate	1,2	1,2	1,2	
14	Crohn's disease	Active	Steroids	Tropolonate	1,2‡	1,2		1,2
15	Crohn's disease	Active		Tropolonate	1,2	1,2		
16	Crohn's disease	Active	Steroids	Tropolonate	1	1		
17	Ulcerative colitis	Active		Tropolonate	1	1		
18	Ulcerative colitis	Inactive		Acetylacetonate	0	0	Inactive	
19	Ulcerative colitis	Inactive		Acetylacetonate	0	0	Inactive	
20	Ulcerative colitis	Inactive		Tropolonate	0	0	Inactive	

* Region 1, descending colon; region 2, transverse colon; region 3, ascending colon.

† Barium enema performed more than two weeks before scan.

‡ Scan disagreed with extent assessed by barium enema.

FIG 1—Indium-111-leucocyte scan (at three hours) from patient (case 18) with inactive ulcerative colitis showing normal distribution of activity in spleen, liver, and bone marrow.

Discussion

Indium-111-leucocyte scanning provides an accurate method of assessing the extent of colitis and reliably distinguishes active from inactive disease. It is non-invasive, requires no bowel preparation, and so is safe in severely ill patients in whom conventional imaging with barium enema and colonoscopy might be hazardous.¹⁴ We have successfully used ¹¹¹In-leucocyte scanning to identify ischaemic colitis, pseudomembranous colitis, and colitis due to graft-versus-host disease at a time when patients were too ill for conventional radiology.

Indium-111-leucocyte scanning offers several important advantages over the currently available radionuclide ⁶⁷Ga-citrate. Images are obtained earlier with ¹¹¹In-leucocytes (as early as one hour after reinjection of the cells), whereas with ⁶⁷Ga-citrate images cannot be reliably interpreted for 24 or 48 hours. Furthermore, ⁶⁷Ga-citrate is normally excreted into the bowel, giving rise to false-positive results.¹⁵ Both ⁶⁷Ga-citrate and ¹¹¹In-leucocyte scanning are established as effective methods for abscess detection. With ⁶⁷Ga-citrate, however, the distinction between abscess and inflamed bowel can be difficult, as in both cases activity remains at the original site in later scans. With ¹¹¹In-leucocyte scanning distal transit of activity occurs with inflamed bowel, whereas with abscesses activity remains at the original site. Another advantage of ¹¹¹In-leucocyte scanning is that faecal excretion of the labelled cells can easily be measured and correlates with the disease activity.

In two cases scanning underestimated the extent of disease as assessed by radiology. Both scans were performed with cells

labelled in saline, which we now think give poorer images than cells labelled in plasma.¹⁶ Colonoscopy was available in one of these cases and agreed with the scan result. Nevertheless, between the scan and endoscopy the patient was given high-dose steroid treatment, which may have altered the extent of colitis. In the other discrepancy between scan and radiology colonoscopy confirmed the scan estimate. A major theoretical objection to ¹¹¹In-leucocyte scans for assessing inflammatory bowel disease is

FIG 2—Indium-111-leucocyte scan (at three hours) from case 16 showing localised disease of descending colon corresponding to distal colitis.

FIG 3—Indium-111-leucocyte scan (at three hours) from case 9 showing continuous disease from rectum to distal transverse colon in patient with ulcerative colitis.

FIG 4—Late barium follow-through film and ¹¹¹In-leucocyte scan (at three hours) from case 3 showing pancolitis.

the widespread use of steroids and sulphasalazine for the condition. Both drugs inhibit neutrophil mobility in vitro¹⁷ and it has been suggested that steroid treatment might give rise to negative results. We did not have any false-negative scans due to steroid or sulphasalazine.

From our experience it seems that ¹¹¹In-leucocyte scanning is a simple, non-invasive technique of imaging the extent of disease in colitis. Its diagnostic accuracy is equal to that of double-contrast barium enema.

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