Scintigraphy with $^{99m}$Tc(V)-DMSA in monitoring patients with inflammatory bowel disease

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Abstract

The clinical significance of pentavalent technetium-99m dimercaptosuccinic acid ($^{99m}$Tc(V)-DMSA) scintigraphy in diagnosing inflammatory bowel disease (IBD) has not yet been fully elucidated. The aim of this prospective paper was to study the above. This study included 54 patients, 22 females and 32 males (mean age: 36.68±11.49; range: 18–63 years) with IBD who came to our clinics for follow-up and were examined clinically by colonoscopy and $^{99m}$Tc(V)-DMSA scintigraphy. On the follow-up studies, five patients (9.25%) relapsed, and 49 (90.74%) remained at a steady condition. There was a good correlation between the scintigraphic results and the clinical and colonoscopy data of the patients (P<0.05). In conclusion, our results indicated that $^{99m}$Tc(V)-DMSA scintigraphy can be complementary to colonoscopy for the diagnostic evaluation of IBD.

Introduction

Inflammatory bowel disease (IBD) includes two chronic idiopathic diseases, Crohn’s disease (CD) and ulcerative colitis (UC). There has been an increase in the incidence of IBD in recent years, mostly because of changes in lifestyle and eating habits [1, 2]. Optimal management of IBD requires appropriate localization, determination of the severity and therapeutic management [3]. The extent of the inflammatory process can be investigated by colonoscopy with multiple biopsies is the gold standard for the investigation of the large intestine and the terminal ileum; however, colonoscopy in cases of abnormal shape of the bowel (octoid, zig-zag dolichocolon) is not always applicable, as usually in cases of progressed IBD [4].

Several studies demonstrated the reliability of various scintigraphic imaging procedures for the assessment of disease activity in IBD [5–11], while radiolabeled leukocytes are still widely used due to their high sensitivity and specificity [12, 13]. However, high cost, time-consuming labeling procedures and radiation dosimetry may limit the application of some of the scintigraphic techniques [14, 15]. Pentavalent technetium-99m-dimercaptosuccinic acid ($^{99m}$Tc(V)-DMSA) has been successfully used for the scintigraphic diagnosis of inflammatory processes such as osteomyelitis, psoas major abscess, and bone and joint infections [16–18]. Although this procedure offers high patient acceptability, low cost, easy preparation, and good image quality, there are rather few papers on the efficacy of $^{99m}$Tc(V)-DMSA scintigraphy in IBD [19–21]. The aim of this prospective study was to investigate the clinical significance of $^{99m}$Tc(V)-DMSA scintigraphy in the diagnosis of disease activity in patients with IBD.

Subjects and methods

Participants and study design

This study was conducted on 54 patients with IBD 52 patients with UC and 2 patients with CD, 22 females and 32 males (mean age: 36.68±11.49; range: 18–63 years). The duration of disease was 6.06±3.19 years and patients referred for follow-up examinations. Patients were recruited from a university hospital in Gorgan, Golestan Province, Iran, between May 2011 and December 2012. The diagnosis was supported by history, laboratory tests, colonoscopy, histology, and radiology. The patients underwent dynamic and static planar $^{99m}$Tc(V)-DMSA scintigraphy. Exacerbation was defined as recent worsening of the symptoms, with a CD activity index greater than 150 in CD cases [17] or a simple clinical colitis activity index greater than 3 in UC cases [18]. Standard labora-
Scintigraphic data were interpreted by two nuclear medicine specialists unaware of the clinical or laboratory findings and differences of judgment were solved by consensus. The bowel was divided into the following five segments: small intestine, ascending, transverse and descending colon, and rectosigmoid. A discrete focus of increased $^{99m}$Tc(V)-DMSA activity on the scintigraphy in the abdomen and pelvis was considered positive for disease activity.

Statistical analysis
The data were represented as mean±SD. The scintigraphic results of $^{99m}$Tc(V)-DMSA imaging were compared with clinical data, laboratory data, and/or colonoscopy and histology findings. Patients with active disease and radiotracer activity on the scans were defined as true positive (TP), while those with active disease and negative tracer activity were considered false negative (FN). Patients with inactive disease without abnormal radiotracer activity were defined as true negative (TN), whereas those with inactive disease and radiotracer activity were considered false positive (FP). Sensitivity, specificity, negative and positive predictive values, and also accuracy were determined for each scan.

A chi-squared test was used to compare the statistical parameters of this technique. A value of $P<0.05$ was considered significant.

**Table 1. The clinical efficacy of $^{99m}$Tc(V)-DMSA scan for the diagnosis of active inflammatory bowel disease**

<table>
<thead>
<tr>
<th>Statistical parameters</th>
<th>Number</th>
</tr>
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<tbody>
<tr>
<td>True positive</td>
<td>5</td>
</tr>
<tr>
<td>False</td>
<td>0</td>
</tr>
<tr>
<td>True negative</td>
<td>95</td>
</tr>
<tr>
<td>False</td>
<td>0</td>
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</tbody>
</table>

PPV, NPV, sensitivity, specificity and accuracy were all 100%.

**Figure 1.** Anterior $^{99m}$Tc(V)-DMSA dynamic scintigram in a 39 years old male with active ulcerative colitis showed uptake in the transverse and hepatic flexure colon, congruent with the colonoscopy findings.

**Figure 2.** Anterior $^{99m}$Tc(V)-DMSA scintigram in a 21 years old male patient with active Crohn’s disease showed an intense activity adjacent to the bladder on the right side (terminal ileum), congruent with the colonoscopy findings.

**Figure 3.** Anterior $^{99m}$Tc(V)-DMSA scintigram in a 36 years old male patient with inactive ulcerative colitis showed no abnormal activity in the abdomen and pelvis.
Statistical analysis was performed using an IBM computer and PASW software, version 18.0 (SPSS, Inc., Chicago, IL).

Results

On our follow-up studies, relapse of the disease was confirmed in 5/54 (9.25%) of the patients and no change in the disease status with no tracer uptake was observed in the remaining 49/54 (90.74%) patients. Examples are shown in Figures 1-3.

In visual analysis of the scintigraphic images of the 5 patients in relapse, uptake was observed in the transverse, the descending, the rectosigmoid colon, the terminal ileum and finally, the hepatic flexure and transverse colon. There was a good correlation between the scintigraphic results and the clinical data of the patients (Table 1, P value <0.05). The $^{99m}$Tc(V)-DMSA scintigraphy was in all cases accurate in the diagnosis of disease activity (Table 1).

Colonoscopy with biopsy was carried out on all 5 patients with active disease which correlated completely with the scintigraphic findings.

Discussion

Diagnosis and follow-up of patients with IBD is mainly based on endoscopy and histology [5, 22]. Radiological methods such as computed tomography (CT), magnetic resonance imaging (MRI), and ultrasound are also being used as secondary to endoscopy [2, 23, 24]. However, patient compliance with these methods is poor, due to the necessity for adequate bowel preparation and the increased risk of complications, especially in the acute phase of bowel inflammation [2, 25, 26].

Several nuclear medicine studies have also been applied, like radiolabeled autologous leukocytes, human polyclonal immunoglobulins, antigranulocyte monoclonal antibodies, monoclonal antibodies against activated endothelial adhesion molecules, and fluorine-18-fluorodeoxyglucose ($^{18}$F-FDG) positron emission tomography (PET) scans [5-8, 27, 28]. Although radiolabeled leukocytes are still widely used because of their high sensitivity and specificity [12, 13, 28], high cost, labor-intensive in vitro labeling procedures, radiation physical characteristics (good counting statistics in imaging), no need for blood manipulation, and an easy preparation procedure. The cost of (V)-DMSA scintigraphy is approximately one half of the cost of WBC scintigraphy and also less than the cost of colonoscopy in our country.

The favorable results of the three previous studies, in combination with the advantages of the method, could establish this technique as an ideal alternative scintigraphic method. This study may recommend to the clinicians that the $^{99m}$Tc(V)-DMSA scintigraphy can be included in the work up of patients with IBD.

We have studied a relatively small sample size of our patients and excluded other types of colitis. We did not perform semi-quantitative analysis and colonoscopy. The other limitation of the study is that disease activity was determined based on composite indices of disease activity and we did not do colonoscopy in all patients.

In conclusion, our results indicate that $^{99m}$Tc(V)-DMSA scintigraphy can provide reliable and reproducible information to the clinicians (accuracy 100%) and we suggest when possible, to be included in the diagnostic algorithm of patients with IBD.

Acknowledgments

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The authors declare that they have no conflicts of interest.

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