International Orthopaedics (SICOT) (1988) 12: 163–167

International
Orthopaedics

Scintigraphy with Tc, Ga and In in painful total hip prostheses

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Summary. *A series of 40 patients were studied, who were operated upon for a painful total hip prosthesis, half of which were infected. In each case, preoperative scintigraphy was performed using Tc99, Ga67 and In111. The images obtained with Tc and Ga were compared with those of In111 and analysed with respect to sensitivity, specificity, accuracy and the predictive value of a positive or negative test. In111 had a predictive value of more than 90% and showed greater reliability in the diagnosis of an infection as the cause of a painful total hip prosthesis.*

Résumé. *Etude d'une série de 40 malades, opérés en raison de douleurs après arthroplastie totale de hanche. La moitié d'entre elles étaient infectées. On avait effectué dans chaque cas, avant l'intervention, une scintigraphie au Tc^{99}, au Ga^{67} et à $l'In^{111}$. Les images obtenues avec le Tc^{99} et le Ga^{67} ont été comparées à celles de $l'In^{111}$ et analysées en ce qui concerne la sensibilité, la spécificité, l'exactitude et la valeur prédictive d'une réponse positive ou négative. Celle-ci est supérieure à 90% avec $l'In^{111}$, qui se montre l'examen le plus fiable pour le diagnostic d'infection en présence d'une prothèse totale douloureuse.*

Key words: *Hip prostheses, Painful, Infection, Scintigraphy, Tc, Ga, In*

Introduction

The introduction of scintigraphy 1971, using Tc99m MDP, as a noninvasive technique for the diagnosis of osteoarticular pathology, signified a considerable advance [17], and the specificity of the method was increased to 80% by the sequential use of Tc99 and Ga67 [4, 5]. A new technique for the diagnosis of infection, using autologous leucocytes marked with In111, has been introduced recently and used for the diagnosis of septic loosening of hip protheses [11, 12].

In order to check the usefulness of this test as a means of diagnosis in patients with a painful total hip prosthesis, we have contrasted the data obtained from scintigraphy with the findings in patients who were later operated upon.

Materials and methods

A series of 20 cases where three was evidence of infection at operation was compared with a group of 20 selected at random from among those operated upon for loosening. In all cases scintigraphy had been undertaken using the 3 isotopes.

In the infected group, symptoms appeared between 1 and 11 years postoperatively, with an average time of 5 years. The average time in the aseptic group was 3.5 years, with a range of from 1–8 years. Radiographs, taken at the time when symptoms appeared and showing the suspected cause of the pain, were available for 11 noninfected and 8 septic cases. Many of these were not diagnostic and in some cases misleading. Six of the infected patients had a sinus.

A bacteriological examination was carried out in all cases. This was negative in those without infection and in 4 out of 20 infected hips. The organisms isolated from the 16 positive cultures are shown in Table 1. The erythrocyte sedimentation rate

Table 1. Micro-organisms isolated from 16/20 infected hips

Staph. aureus	7
Staph. epidermidis	3
Streptococcus	1
Proteus	1
Pseudomonas	1
Klebsiella	1

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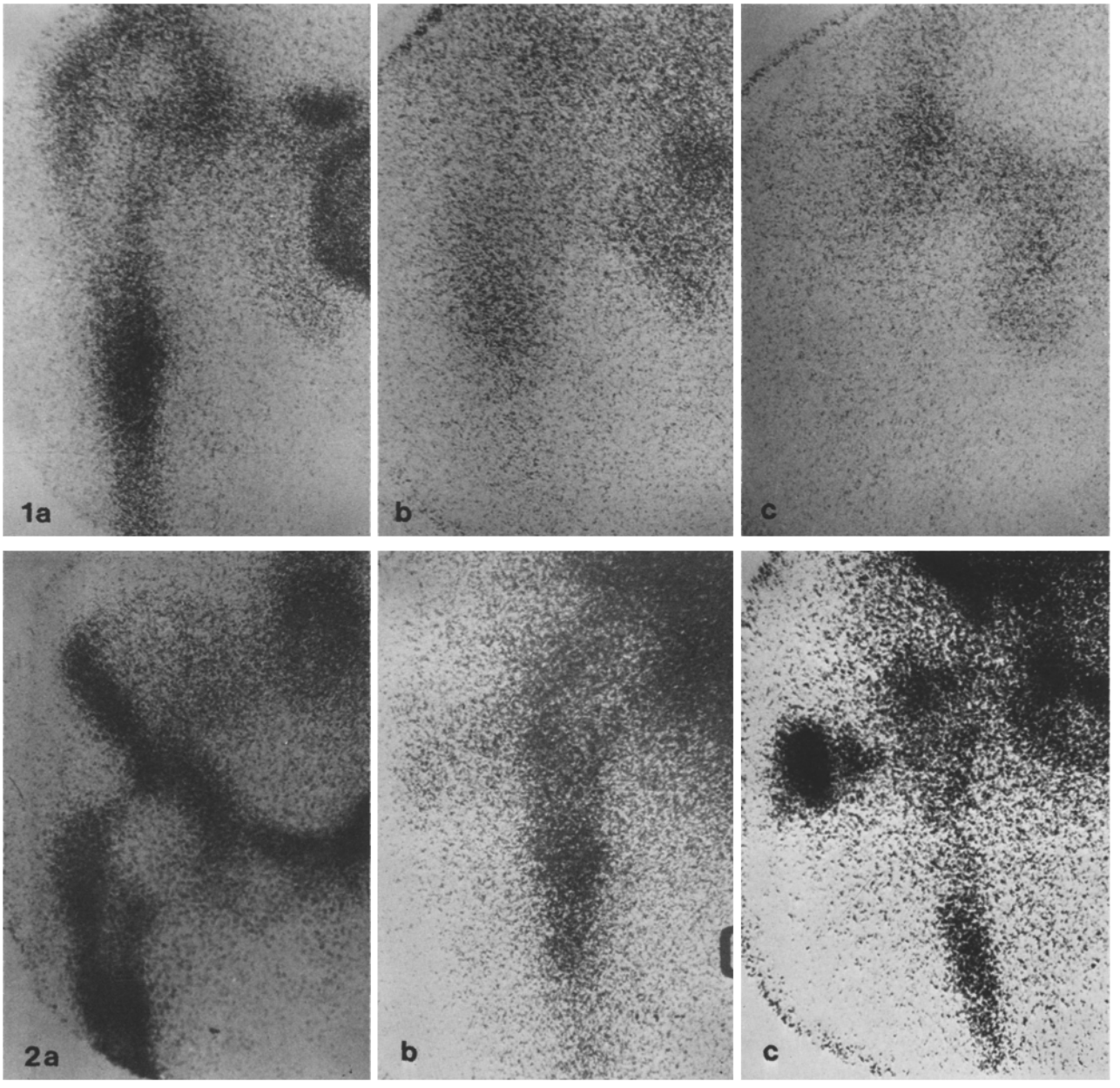

Fig. 1a–c. Aseptic loosening: **a** Increased Tc uptake, especially in the femur; **b** Minimal Ga uptake; **c** Normal image with In^{111}

Fig. 2a–c. Infected prosthesis. **a** Increased Tc uptake; **b** Intense Ga image. **c** Abnormal In image with a fistula track visible laterally

and the leucocyte count were analysed for each group. We found an average value for the ESR of 72 in the infected hips (range 2–135) and 19 (range 2–65) in the noninfected group. This difference is statistically significant. However, there was no significant difference in the average figures for the leucocyte count of 7,926 for the infected hips and 7,486 for the others.

Results

Images obtained with the sequential use of Tc-Ga were considered positive for infection when the Ga67 image was spatially incongurent with that of the Tc99, or, if spatially congruent, of greater intensity [2, 9]. In111 images were considered positive if more intense than that of the contiguous bone and negative otherwise (Figs. 1–4).

Table 2 shows the results obtained with each group of isotopes when compared with the surgical findings. Using this data, the results, expressed as percentages, have been compared for sensitivi-

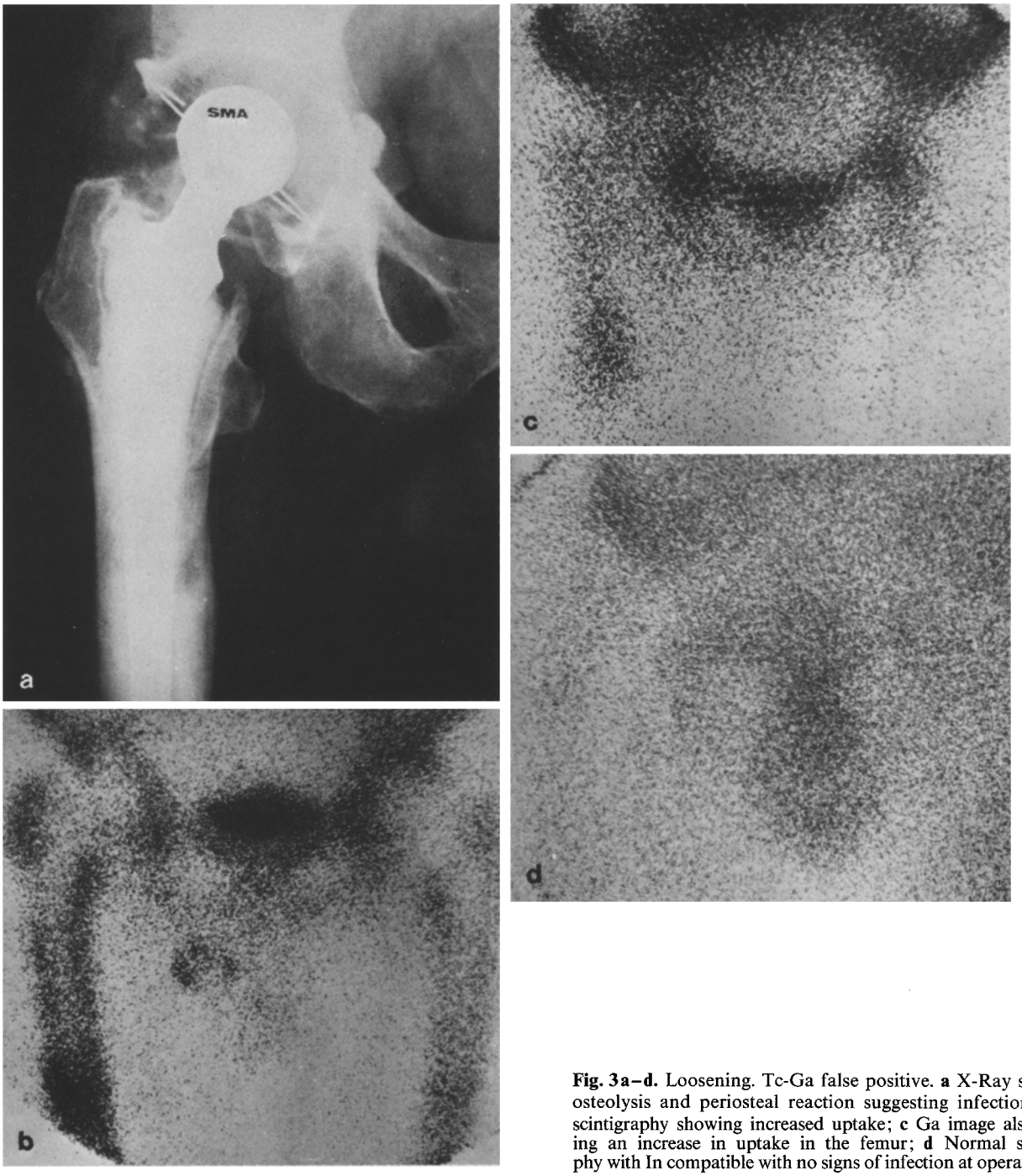

Fig. 3a–d. Loosening. Tc-Ga false positive. **a** X-Ray showing osteolysis and periosteal reaction suggesting infection; **b** Tc scintigraphy showing increased uptake; **c** Ga image also showing an increase in uptake in the femur; **d** Normal scintigraphy with In compatible with no signs of infection at operation

Table 2. Comparison of scintigraphic results with surgical findings

Surgical evidence			Tc-Ga	In
Infected prosthesis	True	+	14	19
	False	–	6	1
Aseptic prosthesis	True	+	18	18
	False	–	2	2

ty, specificity, accuracy and the predictive values of both positive and negative tests (Table 3).

A greater degree of reliability can be observed with the use of In111 in relation to Tc-Ga.

Discussion

Among the various causes of pain in patients with a total hip prosthesis the most frequent are loosening or infection [13].

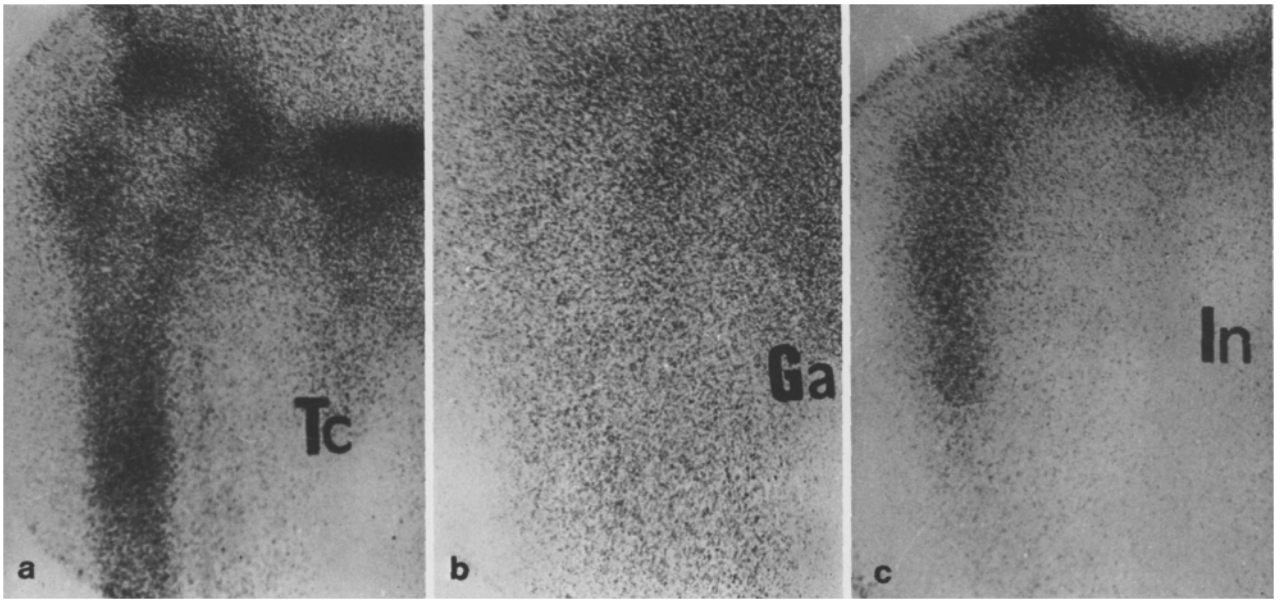

Fig. 4a–c. Infected prosthesis. Tc-Ga false negative. **a** High Tc uptake; **b** Normal Ga scintigraphy; **c** Intense uptake all around the prosthesis

Table 3. Comparison of Tc-Ga and I Scans

	Tc-Ga	In
Sensitivity	75%	95%*
Specificity	90%	90%+
Accuracy	80%	92,5%*
Predictive value of positive test	88%	91%+
Predictive value of negative test	75%	95%*

* significant at $p < 0.05$
\+ not significant

In many cases, the problem of the difference between simple mechanical loosening and infection cannot be solved by the usual diagnostic methods. The radiographic diagnosis may be evident in late cases, but at an early stage, conventional films are often inconclusive.

An ESR and a leucocyte count are the basic laboratory examinations to be evaluated. It is generally accepted that an ESR above 30 mm. and a leucocyte count of above 11,000 suggest the cause to be an infection [3], but it is not unusual for the ESR to be raised in aseptic loosening, or for other reasons. A normal ESR may be observed in some patients with an infection.

Tc scintigraphy [6, 8] is most valuable as an initial test, because the existence of loosening may be discounted if the test is negative. However, the low specificity of this test means that it is not valid for differentiating whether or not the cause of loosening is infection [18].

The sequential use of Tc-Ga has helped to increase the specificity of scintigraphy [7, 14, 15], but the large number of false negatives that we have observed must be taken into account. Some authors [1, 16] have ascribed a high validity to this test for the detection of low grade chronic infections in the evaluation of a painful hip prosthesis. In our series In111 was more reliable, with significantly higher values for sensibility, acuteness and negative test prediction, than those obtained with the use of Tc-Ga [10].

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