

ERYTHROCYTE SEDIMENTATION RATE IN INFECTED AND NON-INFECTED TOTAL HIP ARTHROPLASTIES

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The postoperative course of the erythrocyte sedimentation rate (ESR) following total hip replacement was studied in 18 patients with delayed infections and compared with the course in 75 uncomplicated cases. Normally, the ESR returned to the preoperative level in 3–6 months, but in delayed infections it was significantly increased already during the first postoperative months, and never returned to normal levels. There was also a small but significant difference between the preoperative values in the two groups, which in women may be explained by a pre-existing infection in the hip.

Key words: hip; arthroplasty; infection; erythrocyte sedimentation rate

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The early wound infections following total joint replacement cause the same local and systemic symptoms and signs as other wound infections during or shortly after the wound-healing stage, and are therefore unlikely to be overlooked. On the other hand, delayed infections that give symptoms months or years after the operation may be difficult to detect. The erythrocyte sedimentation rate (ESR) seems, in this respect, to be a simple and valuable asset (Carlsson et al. 1977, Mulier et al. 1973, Reichelt & Brand 1974).

Since total hip arthroplasty was introduced into the Department of Orthopedic Surgery at Malmö General Hospital in 1968, measurement of ESR has become a routine procedure in the laboratory investigation of all patients operated upon and at every visit to the out-patient clinic.

This investigation describes the normal

course of the ESR after uncomplicated total hip replacements, and compares it with the course in patients with a normal early postoperative wound healing but who subsequently prove to have a delayed infection.

MATERIAL AND METHODS

The ESR was performed by the Westergren method. Böttiger & Svedberg (1967) suggested the following normal ranges (mean $\pm$ 2 s.d.):

	Men	Women
< 50 years	0–13	0–21 mm
> 50 years	0–19	0–28 mm

The material consisted of two groups of patients. In both groups, patients with rheumatoid arthritis, pelvispondylitis or with any other known cause of an elevated ESR were excluded.

Group A

Seventy-five patients, 51 females and 24 males, underwent total hip replacement, according to Charnley at the Malmö General Hospital. The ages of the females ranged from 42 to 79 years (mean 65 years). Only two women were less than 50 years old—42 and 48 years, respectively. The

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ages of the males ranged from 27 to 79 years (mean 62 years). Only one man was less than 30 years old.

Group B

Eighteen patients, 10 females, and 8 males, were treated with total hip replacement according to Charnley or Brunswik, at the same hospital. The age of the females ranged from 63 to 79 years (mean 68 years) and of the males 52 to 75 years (mean 65 years). Three of the women had been operated upon previously because of fractures of the femoral neck. Of these, one, possibly two, became infected. But, at the time of the total hip replacement, the infections were considered healed and the patients were therefore included in this investigation.

In every one of these 18 cases there was primary healing, but all patients sooner or later experienced pain, and developed radiographic signs of infection. The ESR was followed until a sinus or abscess developed or until the prosthesis was extracted or exchanged.

RESULTS

In uncomplicated total hip replacements (group A), the ESR reached its peak values during the first postoperative weeks, averaging after 1 month 30 ± 3 mm. Subsequently, the ESR normalized and about 3 months postoperatively stabilized slightly above the preoperative level.

In patients who later on had clinical and radiographic signs of deep infection (group B), the elevation of the ESR was much more pronounced already in the early postoperative course, averaging, after 1 month, 75 ± 7 mm. However, this value was based on four observations only, in contrast to the following values which were based on 7–14 observations. During the next 3 or 4 months, the ESR decreased. Between 6 and 12 months postoperatively, there was a new significant peak, whereafter the ESR varied between 50 and 60 mm, without ever returning to normal levels.

All patients in group B suffered from pain in their hips, which was duly noted between 2 and 49 months, postoperatively (average 10 ± 10 months). In six hips, a sinus developed after 6 to 24 months.

Table 1. Preoperative ESR values in uncomplicated total hip arthroplasties and in operations complicated by delayed infection

	Group A Non-infected	Group B Infected	
Females	12.5 ± 6.0 $n = 51$	18.7 ± 7.7 $n = 10$	$P < 0.01$
Males	8.0 ± 4.4 $n = 24$	15.5 ± 8.5 $n = 8$	$P < 0.01$
Total	11.1 ± 5.9 $n = 75$	17.3 ± 8.0 $n = 18$	$P < 0.001$

The age and sex distribution did not differ between groups A and B. All patients, except one man with an ESR of 35 mm and one woman with 33 mm, both in group B, had had preoperative ESR within the normal range. Nevertheless the preoperative ESR in group A was 11 ± 6 mm, and in the infected group 17 ± 8 mm. The difference was significant ($P < 0.001$). The difference remained when males and females were considered separately (Table 1).

Prior to the total hip arthroplasty, the three women who had previously been operated on had an ESR of 20, 28 and 33 mm respectively—the highest values among the women in group B. If these values are excluded, the difference in preoperative ESR between group A and group B remains significant for males and females together but on a lower level ($P < 0.05$), whereas the difference considering only the women becomes insignificant.

DISCUSSION

The pathogenesis of deep infections diagnosed months or years following total joint replacement is still a matter for debate. Some authors consider most of these infections to be carried by hematogenous spread from a distant focus; others consider them to be due to bacterial contamination during the operation (Buchholz & Gartman 1972, Charnley 1972, Carlsson et al. 1977). Evidently, a minor part of these infections have a hematogenous origin, but from the

symptomatology it should be possible to differentiate them from delayed infections. Furthermore, the inflammatory reaction caused by surgery should have disappeared and the ESR returned to normal when a joint is hit by a hematogenous infection a reasonably long time after the operation (Ahlberg et al., in press). On the other hand, if the bacteria are implanted at the operation, there should be some signs of inflammation from the outset that do not disappear until treatment is instituted.

In 14 patients with "late" infections following total hip replacement, Reichelt & Brand (1975) not only observed a significantly elevated ESR already from the first postoperative month, but also that the ESR never returned to normal. Seeing that the same phenomenon was found in the present investigation, there is strong evidence that delayed infections are caused by bacteria implanted in the wound at operation.

The evaluation of an ESR necessitates a knowledge of its course following uncomplicated total hip replacements (a factor that seems to be of special importance during the first postoperative year).

The investigation of Reichelt & Brand (1975) showed that all males had an ESR below 20 mm, 93 per cent of the females an ESR below 30 mm and 100 per cent of the females an ESR below 40 mm, 6–12 months postoperatively in uncomplicated total hip replacements. In 147 uncomplicated total hip replacements, Mulier et al. (1973) found that within 4 months the ESR normalized in 93 per cent. In the remaining 7 per cent, the ESR normalized within 1 year postoperatively.

From the present investigation one can conclude (Figure 1) that an ESR of 40 mm or more, more than 3 months postoperatively strongly indicates a deep infection even if the patient is still free from symptoms, and radiographic signs of infection are absent. The statement only holds true when other diseases with elevated ESR and complications such as urinary tract infection or pneumonia are excluded.

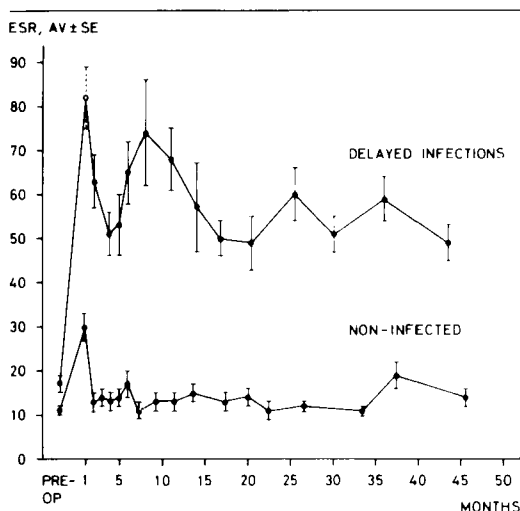


Figure 1. The course of the ESR $\pm$ SE in uncomplicated total hip arthroplasties compared with its course in delayed infections.

The ESR was not checked until 1 month postoperatively. During the first 2 or 3 weeks, the level is not only influenced by the surgical trauma or by infection but also by other treatments, e.g., Dextran 70 infusions (Arthurson & Wallenius 1964, Rø & Kluge 1971).

The preoperative ESR must also be considered. In this investigation no patient in the non-infected group had an ESR of more than 15 mm above the preoperative value 6 months postoperatively—the highest value being 34 mm. The ESR was also determined 2–3 months postoperatively in 58 of the 75 non-infected cases. At no stage did it exceed the preoperative value by more than 21 mm.

The difference between the preoperative values in the infected and non-infected group is remarkable. In females, but not in males, this difference may be explained by a pre-existing low-grade infection contracted at a previous operation. Thus, in males a higher ESR, even within the normal limits, for no understandable reason coincides with a higher rate of infection.

With a knowledge of the normal course of the ESR following total joint arthroplasty, it

should be possible to diagnose the infection at an earlier stage. However, it is still necessary for 2 to 3 years to elapse after surgery before statements concerning the incidence of infection are made. One reason for this is that most hematogenous infections occur at a late stage (Ahlberg et al. in press). Another reason is that in rheumatoid arthritis and other conditions with elevated ESR, the evaluation of the actual ESR is difficult, necessitating a reliance on other diagnostic methods such as radiography and scintigraphy.

Every patient in group B experienced pain, but the time of onset, average 10 months, must be considered uncertain, seeing that the debut is seldom, if ever, acute. On the contrary, in most cases slowly increasing pain in the thigh or groin is the first sign. Furthermore, one gets the impression that many patients with delayed infection never become completely symptom-free postoperatively, and, indeed, some never manage to walk without a stick.

A definite correlation between elevated ESR and postoperative pain was found by Mulier et al. (1973).

ESR is a simple and reliable laboratory method. As an elevated ESR may be the first sign of an infection, it is recommended that the method be included in the routine procedures at every examination of a patient undergoing total joint replacement.

REFERENCES

- Ahlberg, Å., Carlsson, Å. S. & Lindberg, L. Hematogenous infection in total joint replacement. *Clin. Orthop.* (In press).
- Arthurson, G. & Wallenius, G. (1964) The intravascular persistence of dextran of different molecular sizes in normal humans. *Scand. J. clin. Lab. Invest.* **16**, 76–80.
- Buchholz, H. W. & Gartman, H.-D. (1972) Infektionsprophylaxe und operative Behandlung der schleichenden tiefen Infektion bei der totalen Endoprothese. *Chirurg* **43**, 446–453.
- Böttiger, L. E. & Svedberg, C. A. (1967) Normal erythrocyte sedimentation rate and age. *Brit. med. J.* **2**, 85–87.
- Carlsson, Å. S., Lidgren L. & Lindberg, L. (1977) Prophylactic antibiotics against early and late, deep infections after total hip replacements. *Acta orthop. scand* **48**, 405–410.
- Charnley, J. (1972) Postoperative infection after total hip replacement with special reference to air contamination in the operating room. *Clin. Orthop.* **87**, 167–187.
- Mulier, J. C., Desmet, L., Martens, M. & Hoogmartens, M. (1973) The value of clinical data and laboratory findings to predict "low grade" infections of total hip replacements. *Arthroplasty of the hip*, ed Chapchal, George. pp. 201–206. George Thieme Publishers.
- Reichelt, A. & Brand, A. (1975) Das Verhalten der Blutsenkungsgeschwindigkeit nach der Implantation von Totalendoprothesen des Hüftgelenkes. *Z. Orthop.* **113**, 900–903.
- Rø, J. S. & Kluge, T. (1971) Increased erythrocyte sedimentation rate following anti-thrombotic treatment with dextran. *Scand. J. thorac. cardiovasc. Surg.* **5**, 47–50.

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