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Hemarthrosis in undisplaced cervical fractures

Tamponade may cause reversible femoral head ischemia

In eight undisplaced intracapsular fractures of the femoral neck, an intracapsular hematoma was diagnosed by computed tomography. ^{99m}Tc-MDP scintimetry revealed markedly reduced or absent blood supply to the head of femur. The intracapsular pressure was 23 (2.7–43) kPa with the hip in neutral position. Following aspiration of 12 (0.5–36) ml of blood, pressure was reduced to zero, and postaspiration scintimetry revealed restitution of blood supply to the femoral head. Hip joint tamponade in these patients has caused femoral head ischemia, reversible by aspiration.

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Introduction

Previous authors have suggested the possibility of femoral head ischemia due to hip joint tamponade in the adult (Soto-Hall 1964, Deyerle 1980), as has been demonstrated experimentally in immature animals (Woodhouse 1964, Lucht et al. 1983). This has also recently been demonstrated clinically in various conditions in children (Minikel et al. 1983, Wingstrand et al. 1985) using radionuclide scintimetry. We present a series of patients with posttraumatic hip joint tamponade with high intracapsular pressures causing femoral head ischemia. Following joint aspiration, the femoral head ischemia was reversed. A report of our two first patients was published by Strömqvist et al. 1985.

Patients and methods

During 1 year, eight consecutive patients with hip joint trauma with pain in the hip on active or passive motion and inability to walk and without radiographic evidence of fracture (4 patients) or with a minimally displaced fracture of the neck of femur (4 patients) were admitted to our regional hospital. None of the patients had any history of previous hip disorders. The mean age was 78 (63–87) years. The duration from the time of trauma to the first scintimetric examination varied from 12 hours to 2 days. For further clinical data, see Table 1.

Conventional radiographs were obtained in AP and lateral views. ^{99m}Tc-MDP scintimetry was performed and evaluated quantitatively as described by Strömqvist (1983), i.e., a region of interest was selected over the head of femur and an uptake ratio injured/intact hip was determined.

Computed tomography (Toshiba TCT 80 A) was performed in a transverse plane across both hip joints at levels between the head of femur and the minor trochanter.

Hip joint aspiration was performed 2–8 hours after scintimetry via an anterolateral approach with a 1.4 mm epidural needle connected via a saline filled closed system to a piezoelectric pressure transducer. Pressure was recorded graphically and digitally on an oscilloscope. The intracapsular position of the needle was evident, as a sudden rise in pressure was obtained when penetrating the capsule. Measurements and aspiration were performed with the patient supine and in either local or general anesthesia, the latter was chosen when a radiographically evident fracture was nailed; in Case 8 aspiration revealed massive leakage of free fat of intraosseous orgin, and osteosynthesis was then performed. The intracapsular pressure was recorded with the hip in extension and neutral position, extension-inward rotation, extension-outward rotation and, in four patients, in 45° of flexion. The volume of aspirated blood was recorded.

A follow-up scintimetry was performed 12–20 hours postaspiration and again approximately 2 weeks later to determine the healing prognosis according to Strömqvist (1983).

Results

Computed tomography demonstrated an intracapsular hematoma in all patients, distending the hip joint capsule anteriorly-medially along the neck of femur (Figure 1).

Preoperative scintimetry (Figure 1, Table 1) revealed markedly reduced or absent isotope uptake in the head of the femur in all patients with a mean ratio (SD) injured/intact side of 0.67 (0.09). In four cases there was also a slight increase in uptake in the distal part of the neck of the femur indicating fracture. After aspiration the ratio rose ($P < 0.001$) to 1.01 (0.13) indicating restoration of blood supply to the head of femur.

The scintimetry ratio 2 weeks after aspiration was 1.59 (0.59), indicating an uneventful course of healing in all patients (Strömqvist 1983). Follow-up scintimetry also revealed femoral neck infractions in the four cases with no fracture visible in the inital radiographs or in the preoperative scintimetry. In two of these patients there was also a condensation line in follow-up radiographs, confirming a fracture through the neck.

Table 1. Data in eight consecutive patients with traumatic hip joint tamponade

A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	75	M	2	0.56	1.01	1.4	–	32	37	23	4.0	8	–
2	82	F	1	0.78	1.15	1.3	–	24	48	21	1.2	5	–
3	75	F	1	0.60	1.10	2.8	–	16	31	27	2.7	18	–
4	87	F	½	0.66	0.83	1.1	+	12	38	12	–	3	+
5	85	F	1	0.65	0.92	1.7	+	39	50	43	–	11	+
6	63	F	1	0.75	–	1.7	+	2.7	15	8.9	–	0.5	+
7	73	M	2	0.60	0.90	1.1	+	18	49	–	–	11	+
8	84	F	1	0.80	1.14	–	–	43	–	–	5.9	36	+

A = Patient number. B = Age. C = Sex. D = Duration of symptoms at time of initial scintimetry (days). E = Preoperative scintimetric ratio femoral head injured/intact side. F = Postoperative scintimetric ratio as in E. G = Prognostic scintimetric ratio femoral head injured/intact side about 2 weeks postoperatively. H = Visible fracture on conventional radiography. I = Intracapsular pressure (kPa), in extension-neutral position, J = Intracapsular pressure (kPa), in extension-inward rotation, K = Intracapsular pressure (kPa), in extension-outward rotation, L = Intracapsular pressure (kPa), in 45° of flexion. M = Volume of aspirated blood (ml). N = Osteosynthesis.

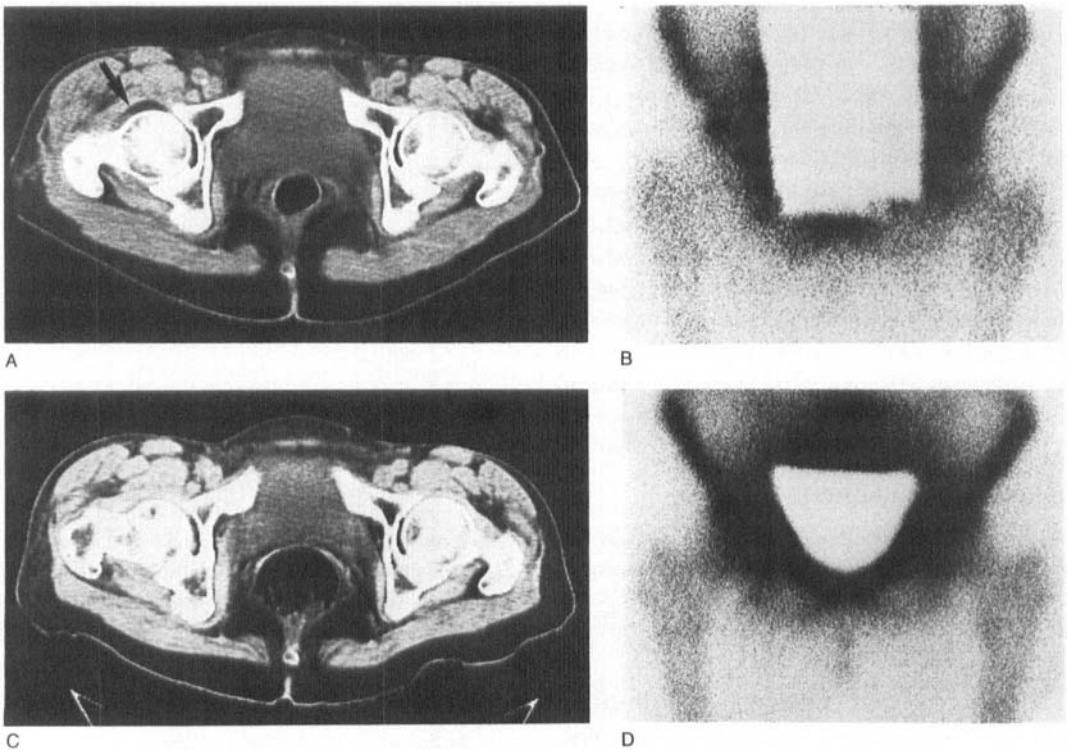

Figure 1. Hip joint tamponade, Case 3.
A. Preoperative computed tomography with an intracapsular hematoma with free fat in the right hip. (arrow)
B. Preoperative scintimetry with a decrease in isotope uptake in the head of the femur in the right hip (ratio = 0.60).
C. Postoperative computed tomography following aspiration of 18 ml of blood and fat.
D. Postoperative scintimetry with a restoration of isotope uptake (ratio = 1.10).

The intracapsular pressure was high in all patients, with a maximum of mean 38 (3) kPa with hips in extensions-inward rotation. In extension-neutral position, the pressure was 23 (4) kPa, whereas in 45° flexion it fell markedly to 3.5 (2.0) kPa (Table 1). The aspirated volumes were 12 (0.5–36) ml of blood with free fat droplets, indicating fracture in all the patients. Patients aspirated under local anesthesia obtained immediate relief of pain and restoration of active and passive motion.

Postoperative computed tomography was performed in five patients, revealing a decrease in intracapsular hematoma (Figure 1).

Discussion

The negative effect of hip joint tamponade on the blood supply to the proximal femoral epiphysis in immature dogs has been proven by several authors (Woodhouse 1964, Kemp 1981, Lucht et al. 1983), the blood supply depends on intracapsular branches from the medial circumflex artery. These are vulnerable to an increase in intracapsular pressure, and since there is no collateral supply across the growth plate, occlusion of the intracapsular vessels causes epiphyseal ischemia. This tamponade mechanism has been demonstrated in hip joint effusion due to transient synovitis (Kloiber et al. 1983, Wingstrand et al. 1985), as well as in septic arthritis, and is most probable also in hip joint hemarthrosis in children with hemophilia (Minikel et al. 1983). In transient synovitis, intracapsular pressures were recorded at a mean of 17 kPa in the neutral position; but, like in the cases reported here, they depended very much on the position of the hip with marked decrease in 45° of flexion (Wingstrand et al. 1985).

In adult patients the intraosseous blood supply to the head of the femur is interrupted by a cervical fracture. Thus, like in the child, the head is dependent on the capsular vessels and vulnerable to the effect of tamponade. This may also explain why patients with rheumatoid synovitis sustaining femoral neck fractures have an increased incidence of femoral head necrosis (Strömqvist 1984b).

The intracapsular pressure in cervical hip fracture were reported to be 0–2.7 kPa (Soto-Hall et al. 1964, Körner et al. 1981) i.e., much lower than in our series. However, the measurements were mainly made in displaced fractures where intracapsular bleeding may be evacuated via a ruptured capsule or via the fracture itself, we have found only normal pressures in dislocated fractures. In undisplaced fracture on the other hand, the blood can be trapped intracapsularly. On extension of the hip joint with capsular torque, a pressure well above systolic pressure can be produced, as demonstrated here. However, also a lower pressure causing venous tamponade may decrease the blood-flow through the head of femur to a degree where metabolic demands are no longer met.

The preaspiration scintimitries suggested an almost totally ischemic femoral head in the majority of our cases, as a ratio injured/intact sife of 0.70 or below has been demonstrated to imply avascularity (Strömqvist et al. 1984a). Why do not all such hips progress to femoral head necrosis? The reason may be that the patients only intermittently extend their hip joints, thus occluding the capsular vessels, whereas in flexion the blood flow is restored. The less active or unconscious patient would thus be at risk; one may speculate about this factor in the development of necrosis in alcoholics. A case of femoral head necrosis probably caused by hip joint hemarthrosis was published recently by Bauer (1985).

Our eight cases were encountered during 1 year. As we admitted about 160 femoral neck fractures to our hospital in the same period, this would imply that at least one such case may be diagnosed per 20 femoral neck fractures.

We conclude that following trauma a radiographically silent or minimally displaced intracapsular fracture associated with hip joint tamponade may cause femoral head ischemis. The condition may be reversed by aspiration. These patients should be placed supine with the hip in 45° of flexion to reduce intracapsular pressure.

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