

Sudden hypotension and profuse bleeding during intramedullary nailing of the femur in cancer patients

A report of two cases

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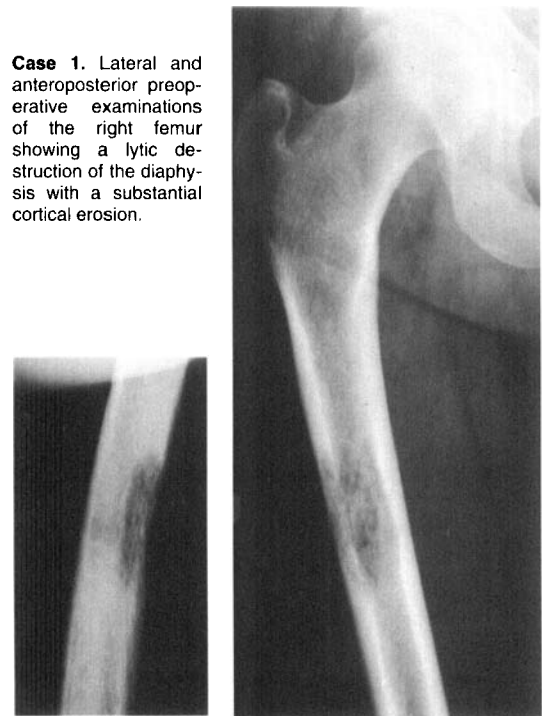
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Case 1

A 53-year-old woman with sarcoidosis (treated with Prednisolone[®] 10 mg daily) but no history of allergy or cardiovascular disease was first treated for breast cancer in 1988. Because of metastases in the diaphysis of the right femur, she was admitted for prophylactic intramedullary nailing in October 1992 (Figure 1). There were no other known metastases. Before surgery she was given low molecular weight heparin (Fragmin[®]) 5,000 U s.c., morphine 10 mg i.m., and Prednisolone[®] 10 mg p.o. Anesthesia with prilocaine-adrenaline was administered without complications via an epidural catheter, and was maintained with bupivacaine-adrenaline. Midazolam was given i.v. in incremental doses at the request of the patient. Dicloxacillin 2 g i.v. was given immediately before the incision.

The patient was placed on a fracture extension table and the technique for conventional closed nailing was followed. After opening of the medullary canal medial to the greater trochanter, a guide was passed down to the distal femoral metaphysis. Up to this time the anesthesia was uneventful, apart from a persistent tachycardia (110–130 bpm). The systolic blood pressure was stable at 150 mmHg and there was no significant bleeding. As the medullary canal was reamed, the patient suddenly developed profound hypotension (50 mmHg) and hypoxia (S_pO_2 88%), which lasted about 15 min. After resuscitation with atropine, fluids, hydrocortisone and ephedrine, the blood pressure was 120 mmHg and remained at that level (100–120 mmHg) throughout surgery; oxygen saturation was about 95%. Surgery was continued and the medullary canal was reamed to 11.5 mm. A 10-mm, 40-cm Russel-Taylor[®] reconstruction nail was inserted and interlocked proximally

with screws in the femoral head and distally in the metaphysis (Weikert and Schwartz 1991). The metastatic site was not opened and methylmethacrylate was not used. The peroperative bleeding was 1,400 mL which had been replaced by packed red cells, 5% albumin and dextran to a final Hb of 126 g/L and an Htc of 46%. Monitor ECG was normal regarding the ST-interval (V_5 -lead). Severe sinus tachycardia developed (160 bpm) which was unsuccessfully treated with digoxin. In response to repeated ques-



Case 1. Lateral and anteroposterior preoperative examinations of the right femur showing a lytic destruction of the diaphysis with a substantial cortical erosion.

tions, the patient complained of discomfort but denied chest pains.

Postoperatively, the patient was taken to the intensive care unit. Coagulation tests were abnormal (APTT 51 s, prothrombin complex (PK) 28%, fibrinogen 0.4 g/L, FDP/dimer ratio 4.0–8.0 and ATIII 0.17 U/L). The ECG showed no signs of myocardial infarction, chest radiographs showed congestion. The patient gradually went into shock, was intubated for ventilatory support and subsequently given fluids, blood components, infusions of dopamine, dobutamine, adrenaline and nitroglycerine. A PA-catheter was established. Cardiac output was 2.7 L/min, CVP 17, MPAP 31 and PCWP 25 mmHg. Despite all efforts, the patient died after a couple of hours. Autopsy showed an acute myocardial infarction but normal coronary arteries. Metastases were found in the lungs, the liver, the skeleton and in the pons.

Case 2

A 74-year-old man had been treated since 1989 with estramustin-phosphate for cancer of the prostate with generalized skeletal metastases. He had had a cardiac infarction in 1972 and mild hypertension treated with metoprolol but otherwise no clinical complaints or symptoms of cardiovascular disease. In November 1992, he had a pathological fracture of the right humerus that was successfully treated with intramedullary nailing and radiotherapy. In March 1993 he was admitted for intramedullary nailing of the right femur because of a large lytic lesion of the proximal diaphysis. Preoperative ECG showed a left anterior hemiblock. He had spinal anesthesia with bupivacaine, 0.5%, with a subsequent fall in blood pressure from 170–140 mmHg. Dicloxacillin 2 g i.v. was given immediately before the incision.

Placement of the patient and the surgical procedure were the same as in Case 1. It was difficult to penetrate the bone marrow canal because of a sclerotic tumor mass in the metaphysis proximal to the lytic destruction (Figure 2). Hence, it took about 45 min before the guide could be passed down to the distal metaphysis. No significant bleeding was noted up to this stage. Reaming was initiated with a 9 mm flexible drill. Firm drilling was required to pass distally to the metastasis as the canal was quite narrow there. The patient was very alert and talkative up to this point. During the second drilling through the tumor, the patient suddenly developed severe and persistent hypotension (40–60 mmHg) which temporarily was corrected with ephedrine. About 15 min



Case 2. The right femur preoperatively shows proximal sclerotic metastases and a large lytic diaphyseal destruction. Note the narrow bone marrow canal distal to the destruction.

later, an increasingly profuse bleeding was noted from the bone marrow canal. The patient again suddenly developed severe hypotension, worsened by the now excessive bleeding. The patient was intubated for ventilatory support and given fluids, packed red cells, fresh-frozen plasma and albumin, none of which had any effect on the blood pressure. Therefore, infusions of dobutamine and adrenaline were added. He never became desaturated and the monitor ECG remained unchanged, apart from a persistent tachycardia (140 bpm) throughout surgery. Shortly after the operation, he started to bleed profusely again. The wound was reopened and bleeding from the bone marrow was noted. The wound was packed with surgical towels and closed. The total bleeding was estimated at 6,000 mL which had been fully compensated with blood products and dextran. On the intensive care unit, there was no overt bleeding but, in order to maintain sufficient blood pressure, additional blood products had to be given (9 units of packed red cells and 11 units of plasma) over 12 h. His coagulation status was abnormal (APTT 58 s, PK 24%, fibrinogen 0.31 g/L, FDP/dimer ratio >8.0, ATIII 0.37 U/L). The circulation gradually stabilized during the next 24 h, but he had suffered a minor cardiac infarction. During the next 12 h period, 4 units of packed red cells and 3 units of plasma were needed to maintain an acceptable Hb

and Htc. 2 days postoperatively, he was in a good condition and was transferred to the ward. During the first week, the patient was mobilized, but his condition worsened with gastric retention and constipation. He died 2 weeks after the operation. Autopsy was not performed.

Discussion

Peroperative cardiac arrest in patients with femoral metastases during either intramedullary nailing (Karachalios and Geurickx 1992, Kerr et al. 1993) or insertion of a cemented long-stem component has recently been described in case reports (Patterson et al. 1991). The 2 cases we report here had not only sudden hypotension and myocardial infarction but also profuse bleeding.

These 2 patients had many features in common: neither had symptoms of overt cardiovascular disease, both had disseminated malignant disease, the surgery was prophylactic to circumvent pathologic fracture, the sudden hypotension occurred when the intramedullary drill penetrated the metastatic tumor and was followed by profuse bleeding shortly afterwards. The acute hypotension may have occurred due to fat and/or tumor embolism from the marrow canal. Whether the myocardial infarction was due to hypoxemia or embolism of marrow contents cannot be determined. The first patient was only 53-years old and autopsy showed an infarction without evidence of coronary arteriosclerosis.

The mechanism behind the sudden hypotension associated with fat embolism is not clear. Substances like prostacyclins, interleucins or tumor necrosis factors, etc., may be responsible for inducing the sudden hypotension. In our 2 cases, it is possible that factors activating the coagulation cascade system also were liberated (Dahl et al. 1988). In hip arthroplasty, reaming of the marrow canal and cementation induce the release of products that can activate intravascular coagulation. However, in a more recent study of hip arthrosis patients, the activation of the coagulation system was not more than could be expected during major surgery (Dahl et al. 1988). In our patients, factors liberated from the cancer cells as the tumor mass was reamed may have induced both the hypotension and subsequent coagulopathy (Rickles and Edwards 1983, Ward and Hosseinian 1994).

Fat embolism is rarely a fatal event in previously healthy young patients during intramedullary nailing of traumatic femoral fractures (Ganong 1993). However, femoral fractures below the hip in older

patients have been associated with a complication rate of 45 percent, dominated by cardiovascular complications (Boyd and Wilber 1992). In the study cited, there were 6 cancer patients with pathologic shaft fractures, of whom four died postoperatively.

Is there an increased risk of cardiovascular collapse in the treatment of pathologic femoral fractures? The literature does not permit a definite answer, but there are some recent reports, besides our 2 cases, that indicate such a risk (Patterson et al. 1991, Karachalios and Geurickx 1992, Kerr et al. 1993). Interestingly, patients with pathologic fractures who sustain cardiovascular complications are younger than those without cancer. Apart from these cases, sudden hypotension has been mentioned in other series of pathologic fractures (Habermann et al. 1982, Levy et al. 1982, Behr et al. 1985, Boyd and Wilber 1992). We can assess the risk of sudden cardiovascular collapse during treatment of pathologic fractures of the femur at around 5 percent. One important question is whether prophylactic nailing of an imminent pathologic fracture is more dangerous than nailing of a patent fracture. Both of our 2 cases and 4 of the 6 reported by Kerr et al. (1993) had prophylactic intramedullary nailing. Hence, the risk may be higher in non-fractured femurs, possibly because of a greater increase in the intramedullary pressure. Similarly, in cemented arthroplasties, the risk of fat embolism appeared greater in patients who had an undisturbed medullary canal than in patients undergoing revision arthroplasties (Patterson et al. 1991).

To reduce the risk of hypotension in reaming of the medullary canal in femoral metastases, excessive increase of the intramedullary pressure should be avoided, e.g., by intramedullary lavage (Sherman et al. 1983), by creating a distal venting hole (Danckwardt-Lillieström et al. 1970), and by eliminating the cement-restrictor in hip arthroplasty.

We have adopted the following routine for prophylactic nailing of femoral shaft metastasis. We start the procedure by opening the metastatic site. The lesion is carefully curetted and a suction catheter is introduced proximally and distally as far as possible into the femoral canal. Therefore, both tumor deposits and fatty marrow are removed before reaming of the canal is initiated. After insertion of the intramedullary nail, the defect in the femur can be filled with cement if deemed necessary.

References

- Behr J T, Dobozi W R, Badrinath K. The treatment of pathologic and impending pathologic fractures of the proximal femur in the elderly. *Clin Orthop* 1985; 198: 173-8.

- Boyd A D Jr, Wilber J H. Patterns and complications of femur fractures below the hip in patients over 65 years of age. *J Orthop Trauma* 1992; 6 (2): 167-74.
- Dahl O E, Molnar I, Ro J S, Vinje A. Global tests on coagulation and fibrinolysis in systemic and pulmonary circulation accompanying hip arthroplasty with acrylic cement. *Thromb Res* 1988; 50 (6): 865-73.
- Danckwardt Lillieström G, Lorenzi G L, Olerud S. Intramedullary nailing after reaming. An investigation on the healing process in osteotomized rabbit tibias. *Acta Orthop Scand (Suppl 134)* 1970: 1-78.
- Ganong R B. Fat emboli syndrome in isolated fractures of the tibia and femur. *Clin Orthop* 1993; 291: 208-14.
- Habermann E T, Sachs R, Stern R E, Hirsh D M, Anderson W J Jr. The pathology and treatment of metastatic disease of the femur. *Clin Orthop* 1982; 169: 70-82.
- Karachalios T, Geurickx A, Newman J H. Fatal air embolism after prophylactic intramedullary nailing. A case report. *J Bone Joint Surg (Am)* 1992; 74 (7): 1101-2.
- Kerr P S, Jackson M, Atkins R M. Cardiac arrest during intramedullary nailing for femoral metastases. *J Bone Joint Surg Br* 1993; 75 (6): 972-3.
- Levy R N, Sherry H S, Siffert R S. Surgical management of metastatic disease of bone at the hip. *Clin Orthop* 1982; 169: 62-9.
- Patterson B M, Healey J H, Cornell C N, Sharrock N E. Cardiac arrest during hip arthroplasty with a cemented long-stem component. A report of seven cases. *J Bone Joint Surg (Am)* 1991; 73 (2): 271-7.
- Rickles F R, Edwards R L. Activation of blood coagulation in cancer: Trousseau's syndrome revisited. *Blood* 1983; 62 (1): 14-31.
- Sherman R M, Byrick R J, Kay J C, Sullivan T R, Waddell J P. The role of lavage in preventing hemodynamic and blood-gas changes during cemented arthroplasty. *J Bone Joint Surg (Am)* 1983; 65 (4): 500-6.
- Ward W G, Hosseini A A. Disseminated intravascular coagulopathy (DIC) complicating intramedullary fixation of impending femur fracture from metastatic prostate cancer. *Orthopaedics* 1994; 2 (5): 457-61.
- Weikert D R, Schwartz H S. Intramedullary nailing for impending pathological subtrochanteric fractures. *J Bone Joint Surg (Br)* 1991; 73 (4): 668-70.