

Fat embolism during hip replacement. Risk Reduction

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Fat embolism is a complication of long bone fractures, intramedullary fixation and joint arthroplasty. It may progress to fat embolism syndrome, which can occasionally be fatal. Thromboembolic complications, which include the fat embolism syndrome, are well-known consequences of femoral total hip replacement. The increase in intramedullary pressure in the femur is the most decisive pathogenic factor for the development of embolic phenomena. Three cases of intraoperative death during total hip replacement of patients aged over 65 are reported. The efficiency of new techniques developed to prevent the risk of intraoperative pulmonary embolism was assessed. The observed mortal cases were discussed and the increased risk in elderly patients addressed. All the options to reduce the amount of fatty tissue in the medullary cavity and pressure during total hip arthroplasty should be considered. Application of jet lavage is to be a regular practice in all clinics.

Key words: fat embolism, hip arthroplasty, elder patients, intraoperative death

Introduction

Fat microembolism is a complication with embolism of the vessels of internal organs with fat drops, entering the veins around fractures of long tubular bones and pelvis, extensive subcutaneous fat tissue trauma, or during intramedullary fixation and arthroplasty.

This phenomenon may progress to the development of fat embolism syndrome, which is relatively rare but leads to prominent clinical manifestations and in some cases to death [4, 5].

Thromboembolic complications that include fat embolism syndrome are well known for hip arthroplasty.

There are several theories about the pathogenesis of fat embolism.

The main mechanism (classical pathophysiologically confirmed theory) is entering in the veins of fat droplets from the site of tissue damage. They pass by the bloodstream through the heart and enter the arterioles and capillaries in the lungs, leading to obstruction (Fig. 1). Drops (to approx. 20%) can undergo pulmonary arterio-venous anastomoses and reach other internal organs – brain, kidneys (Fig. 2).

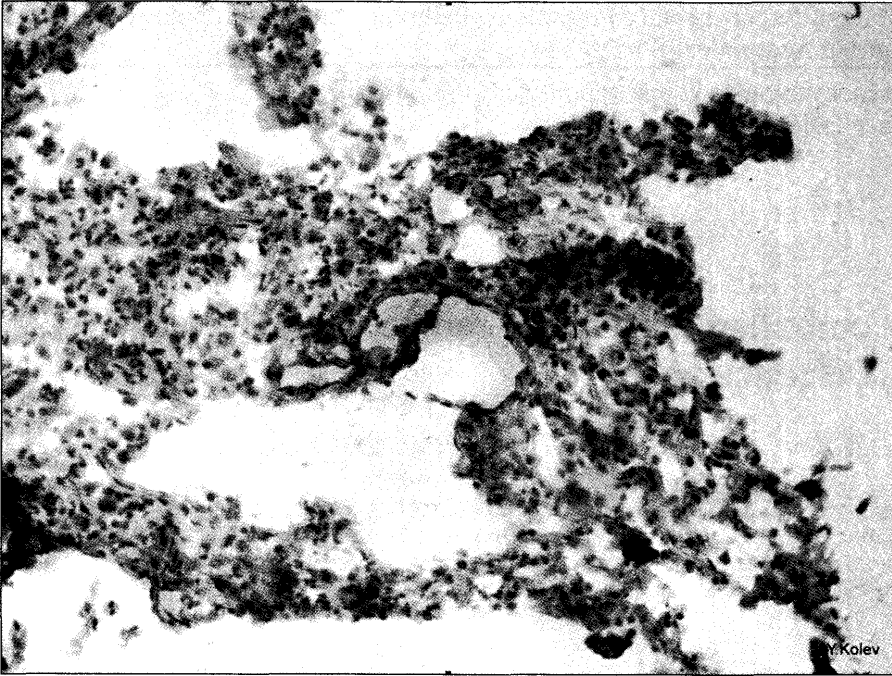


Fig. 1 Fat microembolism in lungs (Sudan III staining)

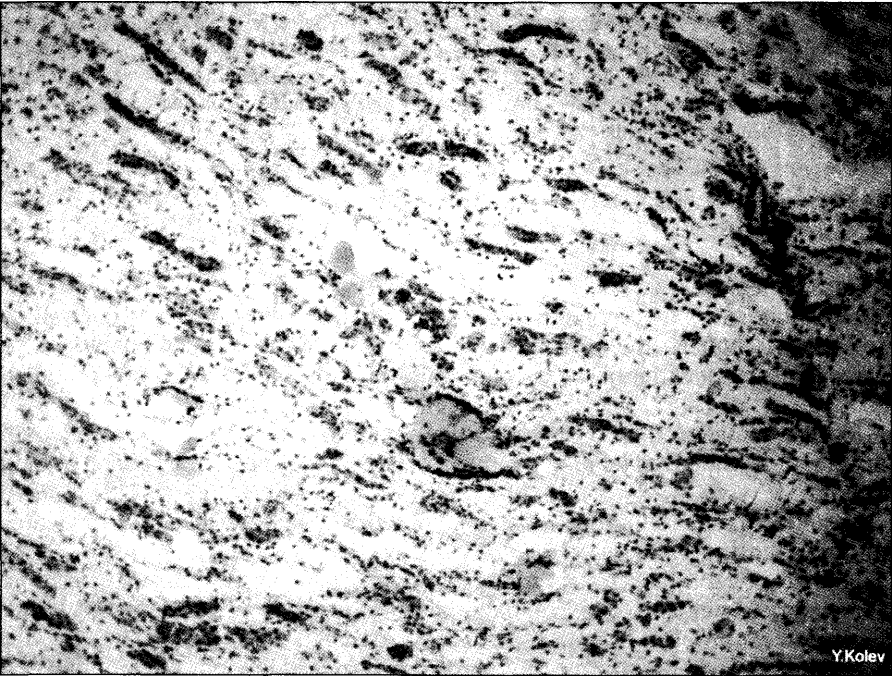


Fig. 2 Fat microembolism in kidney (Sudan III staining)

Clinical forms of fat embolism:

- ▶ Fulminant – leads to death within minutes
- ▶ Acute – developing in the first hours after trauma or intervention
- ▶ Subacute – a latency period of 12 to 72 hours

Clinical features of fat embolism:

- ▶ Cerebral disorders similar to hypoxic encephalopathy, disturbances in consciousness in the form of mental inadequacy
- ▶ Cardio-respiratory dysfunction
- ▶ Capillaropathy (petechial hemorrhages on skin and mucous membranes)
- ▶ Hyperthermia, which is unaffected by conventional therapy

Fat microembolism and total hip arthroplasty

According to Maxeiner, the hip arthroplasty is the most common cause of fatal fat embolism in the lungs [8].

Due to a well-developed venous system, especially in supracondylar area, the increased pressure in the femoral cavity leads to embolization by the contents of the bone marrow.

Pressure rise during the implantation of prosthetic joint with cement is an output of this mechanism [1, 2, 15].

Logical therapeutic measure is to avoid biological spontaneous drainage of the femur.

Several cases of perioperative death during total hip arthroplasty drew our attention:

▶ Case 1: A 69-year-old woman with coxarthrosis and rheumatoid arthritis, died at the end of the operation. The autopsy showed that the cause of death was a massive fat embolism in the lung vessels (Sudan III staining).

▶ Case 2: 75-year-old woman with a fracture of the femoral neck, died at the end of the operation. Autopsy and microscopic findings also suggest fat embolism in the lungs.

▶ Case 3: 72-year-old man with a basicervical hip fracture died at the end of the operation. Again, the cause of death was massive pulmonary fat microembolism.

Common to these cases, which are for a period of three years (2010-2012), was a case of death in people aged over 65.

Discussion

A specific feature in adults is the change of bone marrow substance (*medulla os-tium rubra*) in the bone cavity of the femur to adipose tissue (*medulla ostium flava*).

The main factor for higher mortality in adults with total hip arthroplasty is the above mentioned anatomical feature [16]. Embolism occurs in most cases during the implantation of the femoral component. The polymerization of cement increases the volume and temperature, the pressure rises.

Over the past 15 years there have been publications about such cases [6, 7, 11]. There are implemented suggestions for improvement in surgical techniques. The goal is risk reduction.

Implemented improvements:

- ▶ Better preparation of the intramedullary cavity, lavage, drainage
- ▶ Jet lavage [3] (Fig.3)

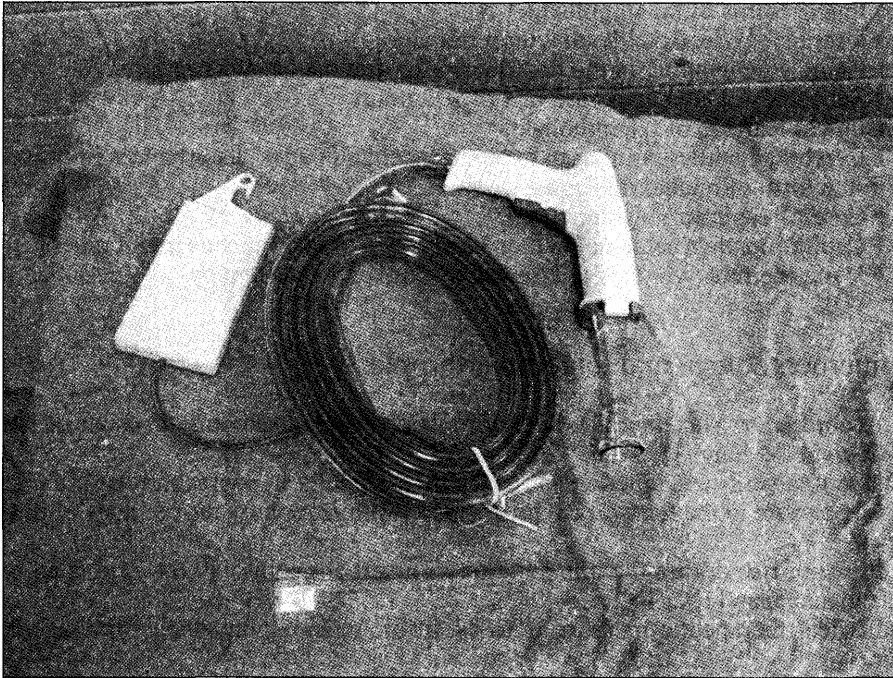


Fig. 3 Set for jet-lavage

▶ Trans-prosthetic + vacuum drainage system [14]

▶ Proximal drainage placed along the *Linea aspera* and distal drainage placed in the diaphysis, by creating a vacuum in the medullary cavity during insertion of the stem [12]

The improved technique reduces the risk substantially and actually allows almost no mortality in these operations [17, 18].

Conclusion

The observed mortal cases were discussed at clinical conferences and addressed the increased risk in elderly patients. All the options to reduce the amount of fatty tissue in the medullary cavity and pressure during total hip arthroplasty should be given. Application of jet lavage is not a regular practice in all clinics, but obviously should be, despite the increased expenses.

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