

Bone-Cement Implantation Syndrome – Postmortem Morphological Findings

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Cement implantation syndrome is a potentially fatal rapidly developing intraoperative complication which pathogenesis and methods of prevention are obscure. It presents with acute circulatory collapse and respiratory failure. We present a case of 85-year-old woman with closed fracture of the femoral neck, scheduled for a biarticular hip endoprosthesis replacement. Right after the cement implantation the patient goes into cardiac arrest. Despite to early initiation of cardio-pulmonary resuscitation, the patient died. Post-mortem findings showed massive pulmonary emboli, composed of bone marrow elements. Histopathological pulmonary findings, confirm the occurred intraoperative complication. Better knowledge of the pathophysiology and the ability for identification of high-risk patients could prevent the development of the syndrome and would help to reduce the mortality.

Key words: bone-cement, implantation syndrome, pulmonary emboli

Introduction

Bone-cement implantation syndrome (BCIS) is a poorly defined, rare and potentially fatal intra-operative complication that occurs within minutes of polymethyl methacrylate (PMMA) insertion, also known as bone cement in patients undergoing cemented orthopedic surgeries [1, 2, 4]. This syndrome is characterized by hypoxia, systemic hypotension, pulmonary hypertension, arrhythmias, loss of consciousness, and cardiac arrest or a combination of these, leading to death in 0.6-1% of patients [1, 3]. It should be noted that BCIS can also happen in the postoperative period, in a milder form [4].

Most of the case reports of BCIS are generally supported by clinical findings with no histological evidence. We report a case of BCIS confirmed by autopsy and histological examination.

Case report

We present a rare case of BCIS, as a severe complication of hip endoprosthesis replacement. The patient is an 85-year-old woman with closed fracture of the femoral neck, scheduled for a biarticular hip endoprosthesis replacement. Shortly after the cement implantation, the condition of the patient sharply deteriorates with the manifestation of severe bradycardia, hypotension, loss of consciousness and apnea. Despite the early initiation of cardiopulmonary resuscitation, the patient dies. The diagnosis is confirmed and supported by the autopsy.

Macroscopically, the lungs are enlarged, with dark-red color. On cut section, the parenchyma appears with dense consistency and after pressure is applied – profuse amount of blood leaks. Dilatation of the right ventricle is observed.

Microscopically, the alveolar spaces are diffusely filled by homogenous pink liquid – a severe pulmonary edema (**Fig. 1**). We observe massive emboli composed of bone marrow elements and adipose tissue which are pathognomonical for the final diagnosis (**Fig. 2A, B**). The rest of the organs are comparably unremarkable.

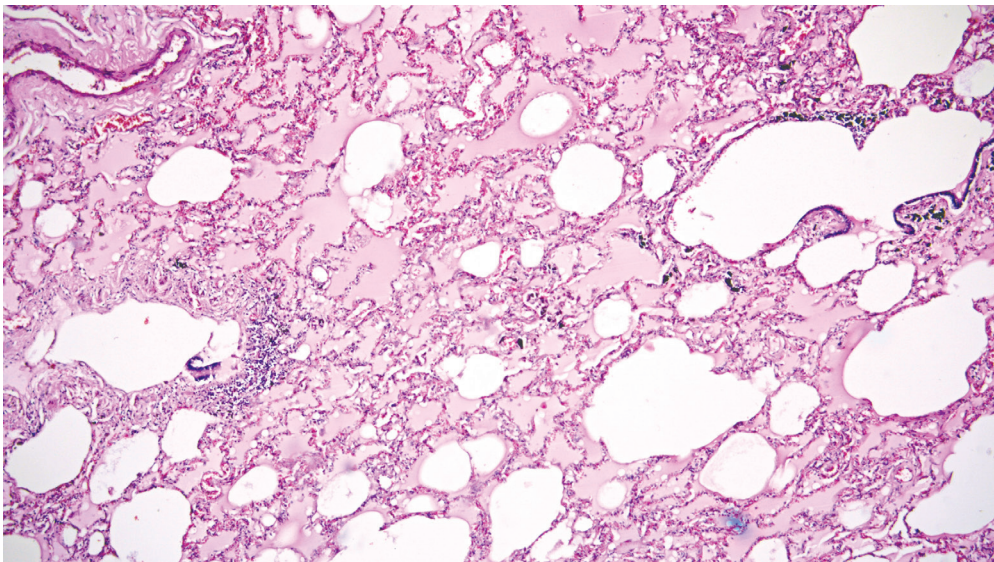


Fig. 1. Alveolar spaces filled by homogenous pink liquid – severe pulmonary edema. Haematoxylin-eosin, $\times 100$

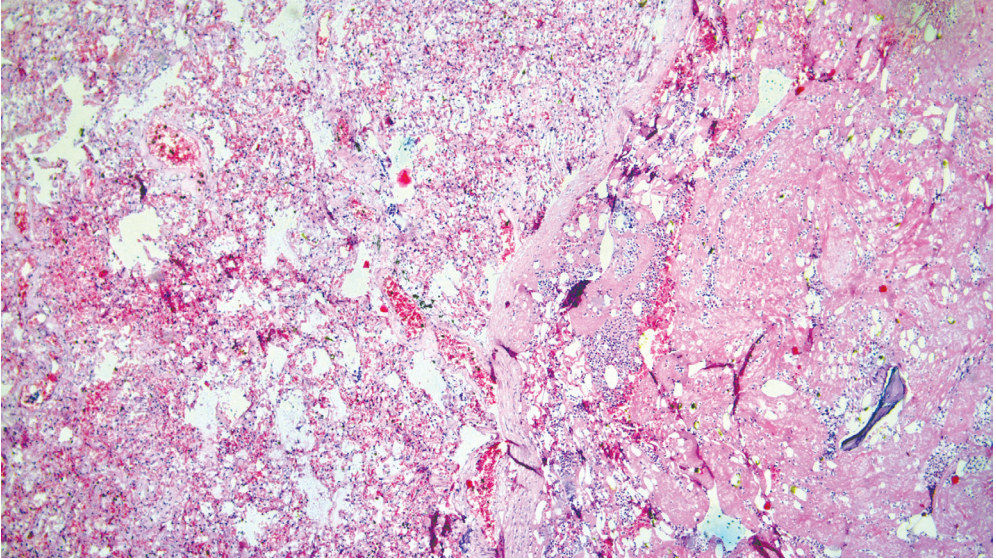


Fig. 2A. Massive emboli in the lungs composed of bone marrow elements and adipose tissue. Haematoxylin-eosin, $\times 100$

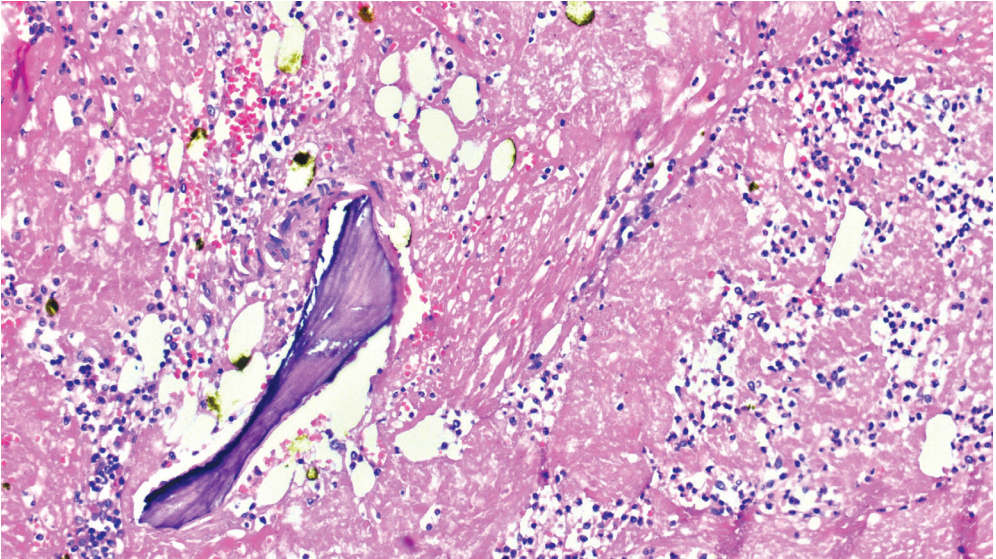


Fig. 2B. Bone marrow elements, adipose tissue, and a fragment of bone, forming the pulmonary emboli. Haematoxylin-eosin, $\times 200$

Discussion

Bone-cement implantation syndrome is a condition with incompletely clarified etiology and pathophysiology. Many theories have been discussed, but the most recent ones focus on the releasing of polymethyl methacrylate monomer into the circulation, and emboli formation during cementation which result in right ventricular failure [5].

Several mechanisms such as histamine release, complement activation, and endogenous cannabinoid-mediated vasodilatation have also been proposed [6]. Based on clinical observations, most researchers favor the theory that a combination of diverse mechanisms operates in any individual developing BCIS [2].

Numerous risk factors related to the patients have been discussed in the genesis of BCIS including old age, poor preexisting physical reserve, impaired cardio-pulmonary function, preexisting pulmonary hypertension, osteoporosis, bone metastases, and concomitant hip fractures, particularly pathological or intertrochanteric fractures [6]. The majority of the cases, described in the literature are females with various indications for cemented arthroplasty including osteoarthritis, rheumatoid arthritis of fractures [7]. However, there is no certain evidence that gender is a risk factor for occurrence of cement embolism [8].

In the presented case the patient is a high-risk candidate for bone-cementation as she is elderly (85-year-old) with a history of tuberculosis infection in the past, cardiac diseases, and previous hospitalizations for fractures. Minutes after the cement implantation the patient demonstrates the classical clinical findings of BCIS: cardiac arrhythmia (in this case presented by relapsing high frequency atrial fibrillation), decrease in respiratory function, hemodynamic collapse, and cardiac arrest.

The cause of death in this case is the right-sided heart failure secondary to massive pulmonary embolism composed by bone marrow elements.

Conclusion

In conclusion, better knowledge of the pathophysiology and the ability for identification of high-risk patients could prevent the development of the syndrome and will help in the reduction the mortality.

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