

A Rare Cause of Pulmonary Edema in the Postoperative Period

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Abstract

With the increasing longevity of the population, the annual rates of hip arthroplasties performed have been steadily increasing over the past decade. Given the presence of medical comorbidities in the older patients, the peri-operative care of these individuals requires multi-specialty care, now more than ever. Hip arthroplasty is generally well tolerated, with early mortality after the procedure being <1%. Bone cement implantation syndrome (BCIS) is an entity that is occasionally encountered during or after the surgery. It is characterized by hypoxemia, hypotension, cardiac arrhythmias, and cardiac arrest leading to death, in severe cases. We report a case of a middle-aged female who developed refractory hypotension and pulmonary edema while undergoing hemiarthroplasty for a pathological femoral neck fracture and experienced cardiac arrest in the immediate postoperative period. Critical care physicians must familiarize themselves with promptly diagnosing and managing BCIS.

Keywords: Cementation/adverse effects, intraoperative complications, polymethyl methacrylate

INTRODUCTION

Bone cement Implantation Syndrome (BCIS) is a rare phenomenon that might occur during cemented arthroplasty. The presentation can range from transient hypoxemia or hypotension to life-threatening arrhythmias, pulmonary edema, and cardiopulmonary arrest. We describe a case of post-operative pulmonary edema due to BCIS and briefly review the pathogenesis, diagnostic modalities, and management of this condition.

CASE REPORT

A 49-year-old female was evaluated for new-onset, constant, nonradiating, right-sided hip pain of 2 weeks duration, which was restricting her mobility. She did not report any history of trauma.

Her medical history was significant for recently diagnosed adenocarcinoma of lung, end-stage renal disease requiring hemodialysis, and atrial fibrillation. Initial plain radiograph of the hip did not show any abnormality. Further evaluation with computed tomography (CT) scan of the pelvis demonstrated a nondisplaced right femoral neck fracture, and two lytic lesions within the right iliac bone concerning for metastatic disease. She underwent a cemented hemi-arthroplasty. Shortly after the cementation, she developed hypoxia and hypotension intraoperatively which was stabilized. Immediately after the

surgery, her hypoxia worsened and persisted despite maximal ventilator support. About 1 L of pink-colored frothy secretions was aspirated from her endotracheal tube. She went into cardiac arrest and was resuscitated with return of spontaneous circulation. She received large volume fluid resuscitation, and despite being sequentially started on 4 vasopressor/inotropic agents (epinephrine, norepinephrine, dopamine, and vasopressin infusion), she remained hypotensive. Her family requested comfort care measures only and she expired shortly after terminal extubation. Autopsy was declined.

DISCUSSION

With the increasing longevity of population, the incidence of debilitating osteoarthritis and femoral neck fractures is increasing.^[1] Consequently, the annual rates of hip arthroplasties, both hemiarthroplasty and total hip replacement, have increased. Hip arthroplasty can be uncemented or cemented; the latter procedure commonly uses polymethyl methacrylate cement.^[2] Bone cement implantation syndrome (BCIS) represents a

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constellation of findings characterized by hypoxia, hypotension, and cardiac arrhythmias which could progress to cardiac arrest.^[3] It usually manifests during the cementation or prosthesis insertion but it might manifest or progress during the early postoperative period. The true incidence of BCIS is hard to determine as the less severe forms result in mild hypoxia/hypotension and can be transient. Although the intraoperative mortality from BCIS is usually <1%, a recent analysis suggested that the 30-day mortality for patients even with a moderate episode of BCIS was significantly higher than compared to group without BCIS.^[3,4] This is of significance to critical care physicians as increasing numbers of elderly patients with multiple comorbidities who undergo hip arthroplasty are cared for in Intensive Care Units in the postoperative period.

The underlying pathogenesis in BCIS is believed to be multifactorial. Embolization of cement to pulmonary circulation and increased pulmonary vascular resistance appears to be a common mechanism. Presence of general factors such as old age, reduced preoperative cardiopulmonary reserve, and pulmonary hypertension places patients at a higher risk of developing severe BCIS.^[5] Local factors that alter vascular channels such as presence of metastasis, fractures, and osteoporosis have also been suggested to play an important role.^[6,7]

It is important to recognize that, although BCIS has been more commonly described after hip arthroplasty, cases following cemented arthroplasty of other structures such as shoulder and vertebral bodies have also been reported.^[8,9]

Early detection of BCIS is crucial for optimizing management. Intraoperatively, a decrease in the end-tidal CO₂ might be one of the first indicators of cement embolization to pulmonary vasculature and should be managed with increasing inspired oxygen concentration immediately. Invasive intraoperative monitoring with arterial line pressures and esophageal Doppler measurements for high-risk patients may help detect BCIS early.^[10] The initial management of BCIS involves optimal ventilatory and hemodynamic support. As embolization of cement to pulmonary circulation is widely accepted as one of the primary mechanisms of this syndrome, it is prudent to approach BCIS-related hypotension in the same manner as a right ventricular failure.^[11] Fluid resuscitation and immediate initiation of vasopressors are recommended. CT of chest with contrast might help assess for the presence of large cement emboli in pulmonary circulation that might possibly be amenable to removal. As described above, elderly individuals with reduced cardiopulmonary reserve, osteoporosis, or bony metastasis are at a high risk of developing BCIS and more likely to have a poor outcome from it.^[3] Careful selection of these patients for cemented arthroplasties can reduce

the risk of BCIS. Some surgical measures have been shown to reduce the risk of BCIS, including, achieving good hemostasis prior to cement insertion, performing medullary lavage, and minimizing the length of prosthesis.^[3,12,13]

CONCLUSION

BCIS is a pathophysiological entity that manifests as cardiopulmonary compromise during or after a cemented arthroplasty. This condition has a very high mortality. Critical care physicians must be able to recognize and manage this condition postoperatively. Treatments that can specifically target the endogenous mediators responsible for hemodynamic effects in BCIS merit further evaluation.

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Conflicts of interest

There are no conflicts of interest.

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