



## BONE CEMENT IMPLANTATION SYNDROME ----- A RARE BUT FATAL DISASTER.(A CASE REPORT).

### Anaesthesiology

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### ABSTRACT

The bone cement implantation syndrome (BCIS) is not completely understood yet. For patients undergoing cemented hip arthroplasty, it is a most significant factor in intraoperative as well as postoperative mortality and morbidity. In the older population, hip hemiarthroplasty surgery is becoming more prevalent. The risks of BCIS in elderly population undergoing cemented hip hemiarthroplasty has increased due to co-existing comorbid conditions. Bone cement implantation syndrome (BCIS) is characterized by hypoxia, hypotension, cardiac arrhythmias, increased pulmonary vascular resistance and cardiac arrest. We report an interesting case of 83 year old male with multiple comorbidities undergoing right hip hemiarthroplasty under spinal anaesthesia.

### KEYWORDS

Bone Cement Implantation Syndrome(BCIS), PMMA (Polymethyl Methacrylate), Hip Hemiarthroplasty, Spinal Anaesthesia.

### INTRODUCTION

Hip fracture surgery is common in elderly population and associated both with frequent perioperative complications and postoperative deaths. Thirty-day mortality rates following hip fracture surgeries are as high as 10.5%, and 27.3% patients who have hip fractures treated surgically do not survive the first year. Hip hemiarthroplasty is an extremely common procedure that is associated with the second highest complication rate of all orthopaedic surgeries. When treating older patients with hip total or hemi-arthroplasty for femoral neck fractures, there is considerable debate about whether to use cemented or uncemented devices. While much evidence favors using cement for this indication, concerns remain about this approach. This holds true as nearly one-third of all patients who underwent hip hemiarthroplasty developed BCIS.(1,2)

The exact incidence of BCIS is not known due to the wide range and ambiguity of its symptoms. Bone cement implantation syndrome (BCIS) is a poorly defined, rare and potentially fatal intra-operative complication occurring in patients undergoing cemented hip surgeries. BCIS was first reported in 1970, almost ten years after the insertion of bone cement in hip arthroplasty surgery. However, several mechanisms have been proposed, involving the release of poly methyl methacrylate (PMMA) cement monomer into the circulation following cementation. Different theories such as histamine release, complement activation and endogenous cannabinoid-mediated vasodilatation have also been proposed.(1,2)

Most published case reports of BCIS are generally supported by clinical findings of patients' haemodynamic instability during and after operation. We report an interesting case of 83 year old male with multiple co-morbidities posted for right sided bipolar hip hemiarthroplasty.

### Case Report

A 83-year-old male had allegedly slipped and fallen in his house while doing routine work. He was admitted to hospital approximately three hours after the fall and was subsequently diagnosed to have a closed inter-trochanteric fracture of the neck of his right femur. He was already having history of parkinsonism, old CVA, long standing COPD and ischemic heart disease with ejection fraction of around 40-45%. He was on regular treatment for all mentioned co-morbidities. He was planned for cemented right bipolar hemiarthroplasty under spinal anaesthesia. He was evaluated by multidisciplinary team of anesthesiologist, orthopaedics, cardiologist, physician, neurophysician and pulmonologist. He was declared as very high risk case for surgical procedure to be conducted under anaesthesia. His all relatives were explained about intraoperative and postoperative morbidity as well as mortality. His all routine investigations were within acceptable limits and his 2d echo showed ejection fraction of 40-45%. After patient shifted to operation theatre right internal jugular vein line insertion and left radial arterial line insertion done under local anaesthesia. All standard monitoring parameters were applied including invasive BP monitoring. Patient was hemodynamically stable following spinal

anaesthesia. Surgery was commenced and continued with bone cement was injected into the medullary canal using cement gun and long stem femoral prosthesis was inserted. Injection hydrocortisone was given prior to bone cementing. Upon completion of surgery (approximately 20-25 mins after cementing) his heart rate suddenly dropped from 96 to 45 per minute, BP dropped to 80/50 mm of Hg, oxygen saturation fall to 65% and he became unresponsive. Immediately his airway was secured with no. 8 ET tube and intravenous vasopressor phenylephrine boluses, noradrenaline infusion and atropine were given. Patient shifted to intensive care unit for further management. However, his blood pressure and heart rate continued to fall and suddenly he developed cardiac arrest. Immediately cardiopulmonary resuscitation started as per ACLS protocol and ROSC achieved. Immediate 2d echo done at bedside which showed dilated right ventricle, right atrium, poor systolic function with poor contractility and ejection fraction of around 15-20%. Patient was kept on high inotropes and vasopressor support with ventilator support. However despite full inotropic and ventilatory support, he did not respond and passed away approximately one hour post procedure.

### DISCUSSION----

Bone cement implantation syndrome (BCIS) is a catastrophe mainly linked with the introduction of PMMA (poly-methyl methacrylate) and is a major cause of intraoperative mortality and morbidity. Although BCIS occurs in patients undergoing other arthroplasties such as total hip replacement and knee replacement surgeries BUT it is more commonly associated with patients undergoing cemented hip hemiarthroplasty.(3,4)

Although the syndrome is poorly understood and has no standard definition, the cement placement results in sealing and prosthesis insertion causes pressurization of intramedullary canal. High intramedullary pressure (often >500 mmHg) forces medullary fat into the blood vessels. This embolic load can cause systemic, life-threatening hypotension, pulmonary hypertension, increased central venous pressure, pulmonary edema, bronchoconstriction, hypoxemia, sudden fall in EtCO<sub>2</sub>, cardiac dysrhythmia, cardiogenic shock, cardiac arrest, sudden death, hypothermia, thrombocytopenia etc. In different published articles, these clinical findings were reported to occur at one of the following time points during surgery, which might be cementation, prosthesis insertion or joint reduction in a patient undergoing cemented hip hemi-arthroplasty.(4,5)

In 2009, Donaldson et al. has given the first classification for BCIS according to its severity, which was as follows; (6)

|         |                                                                                                                                         |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------|
| CLASS 1 | : Moderate hypoxia [arterial oxygen saturation (SpO <sub>2</sub> ) < 94%] or hypotension (fall in systolic blood pressure (SBP) > 20%). |
| CLASS 2 | Severe hypoxia (SpO <sub>2</sub> < 88%) or hypotension (fall in SBP > 40%) or unexpected loss of consciousness.                         |
| CLASS 3 | Cardiovascular collapse requiring cardiopulmonary resuscitation (CPR).                                                                  |

Patient risk factors associated with the development of BCIS after cemented total or hemi hip arthroplasty surgeries include an age > 65 years, male sex, ASA score of three or over, severe cardiopulmonary disease, pre-existing pulmonary hypertension, poor pre-existing physical reserve, malignant tumors, osteoporosis, bony metastasis, pathological hip fractures and inter-trochanteric fractures. In the case of BCIS, underlying COPD contributes to hypoxia, acidemia, and the overall inflammatory response. Additionally, there are surgical risk factors that are associated to BCIS. Patients who have previously un-instrumented femoral bony canals are more likely to develop the syndrome than those who have revision surgery. Moreover, the use of a long-stem femoral implant component raises the chances of BCIS. The most likely explanation for BCIS is a combination of the theorized models in conjunction with an individual physiologic response. Pre-existing comorbid conditions, surgical procedure techniques, and the proposed type of surgery may all affect the patient's reaction to bone cement. (5,7)

We found with many studies in the literature suggesting that there are some advantages of using spinal anesthesia over general anesthesia for such procedures. It is proposed that regional anesthesia may improve outcomes and provide postoperative analgesia as well. In a retrospective study, Ahn et al. (8) demonstrated that in 96,289 elderly patients who underwent hip fracture surgery, regional anesthesia was associated with better outcomes in terms of mortality, delirium, intensive care unit admission and ventilatory care. White and Griffiths et al. (9) concluded that 15.1% of patients who experienced BCIS, observed a significant statistical decrease in BCIS prevalence when compared patients who received only spinal anesthesia to those who received only general anesthesia.

In our case, patient was already suffering from multiple co-morbidities including long standing COPD and ischemic heart disease with ejection fraction of around 40-45%. Therefore we have opted low dose spinal anesthesia as an anesthetic management technique with fentanyl as an adjuvant.

It has been suggested that in the context of BCIS, corticosteroids have been used to treat any inflammatory or anaphylactoid reactions associated with BCIS. Cardiovascular collapse should be treated with the administration of intravenous fluid therapy and inotropes. Additionally, secure the airway and pursue mechanical ventilator support if patient becomes unconscious. Intraoperative fluid resuscitation with blood or blood products should be taken into account. With complete hemodynamic monitoring guided administration of fluid therapy, vasopressors and/or inotropes, the patient should be managed in an intensive care unit setting for further supportive treatment. (10,11). Our patient has developed sudden onset of hemodynamic instability with loss of consciousness after completion of procedure for which we have secured the airway and started all supportive parameters including high inotropes support was started. For further management patient kept in intensive care unit.

## CONCLUSIONS

We have explored all the mechanisms suggested in the literature and concluded that the probable etiology behind this syndrome may be multifactorial. We have identified distinct patient populations who are particularly vulnerable to developing BCIS. We advise not to use a cemented prosthesis in patients who have a high likelihood of developing BCIS, unless there are important orthopedic indications.

**Conflict Of Interest**----- NONE

**Financial Disclosure**-----NONE

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