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ORIGINAL RESEARCH

Cementing in orthopedic surgeries and its effect on cardiovascular system

[1]Dr. Nikhil Gupta, [2]Dr. Sunil Kumar Sharma, [3]Dr. Abdul Basit, [4]Dr. Sanjeev Gupta, [5]Dr. Rashid Anjum, [6]Dr. Dinesh Kumar Chadgal, [7]Dr. Aakash Deep

[1,2,3,6,7]Resident, [4]Professor & HOD, [5]Lecturer, Department of Orthopaedics, GMC, Jammu, Jammu and Kashmir, India

Corresponding author
Dr. Abdul Basit
Resident, Department of Orthopaedics, GMC, Jammu, Jammu and Kashmir, India

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Abstract

Introduction: It is crucial for the anaesthesia and surgical teams to be aware of potential hemodynamic changes associated with the use of bone cement in order to minimise hazards. The purpose of this study was to identify and mitigate the risks of potential hemodynamic alterations and associated factors in total hip arthroplasty candidates utilising bone cement.

Methods: During June 2019-2022, 126 applicants for total hip arthroplasty in the department of orthopaedic surgery at a hospital in India were the subject of a descriptive-analytical study. Three minutes before, during, and three minutes after applying bone cement, the hemodynamic status (heart rate, blood pressure, and arterial oxygen saturation (SPO2) of all patients was monitored and changes were calculated.

Results: Before and after applying bone cement, there was a statistically insignificant rise in heart rate (P=0.125), diastolic and systolic blood pressure (P=0.221, P=0.195, and P=0.125, respectively). The patients' arterial oxygen saturation, however, stayed the same (P=0.999).

Conclusion: The findings demonstrated that utilising bone cement leads in small alterations in heart rate and blood pressure (systolic and diastolic).

Keywords: Bone cement, Cardiovascular changes, Total hip arthroplasty, Orthopaedics

Introduction

Candidates for orthopaedic surgery may be at risk from bone cement implantation syndrome (BCIS), which is frequently found in hip and knee arthroplasty procedures [1]. It may result in problems such pre- and post-operative embolism, hypoxia, hypotension, arrhythmia, increased pulmonary vascular resistance, and bradycardia [2, 3]. It is customary to give 30 mg of intravenous diphenhydramine 1 hour before to employing bone cement to minimise problems and lower plasma histamine release [4, 5].

Patients with chronic obstructive pulmonary disease who have severe BCIS are treated with prodrugs like diuretics, warfarin, and aspirin [6, 7]. The limitations of earlier studies include the use of aspirin, which is contraindicated in several surgical procedures like neurosurgery and severe trauma, as well as the neglect of pathological bone diseases, underlying illnesses, and age, all of which have an impact on the outcomes [8, 9].

This study aims to detect and prevent the risks of potential cardiovascular alterations and related factors while using bone cement in total hip arthroplasty candidates because of its significance for anaesthetic and surgical teams.

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Materials and Methods

Using the available sample technique and according to the inclusion and exclusion criteria, this descriptive-analytical study of 126 total hip arthroplasty candidates in the Department of Orthopaedic Surgery at a Hospital in India was undertaken during June 2019-2022. The exclusion criteria included a history of bone cement allergy, taking corticosteroids, a history of immunodeficiency disorders, patients in ASA class IV, and a history of severe seasonal and other allergies. The inclusion criteria were 18-65 years of age, elective arthroplasty candidates on one total hip, and the participants' consent.

After entering the operating room, the hemodynamic status of all patients was monitored and 500 cc of normal saline was intravenously administered. Then, using a gauge-25 needle to inject 15 mg of bupivacaine into the L3/L4 or L4/L5 region, spinal anaesthesia was induced in all of the patients who were seated. 10 mg of ephedrine was given to treat 30% of baseline hypotension, and 0.6 mg of intravenous atropine was given to treat bradycardia (heart rate less than 50 bpm). Data was gathered by an operating room nurse and a recovery anesthesiologist while all patients received oxygen therapy with a facemask at 6 L/m.

Age, gender, and weight were obtained from interviews and patient records for data collection prior to induction of anaesthesia, and systolic and diastolic blood pressure, heart rate, and arterial oxygen saturation were obtained and recorded in the checklist by monitoring, sphygmomanometer, and pulse oximetry. The parameters were measured 30 minutes prior to the procedure, throughout the application of bone cement, and 30 minutes following the procedure.

Quantitative information was displayed using descriptive statistics including frequency, percentage, mean, and standard deviation after the collected data were loaded into SPSS version 21. Analysis of variance was used to compare the data that was gathered (ANOVA). P value under 0.05 was regarded as significant.

Results

58 (46.03%) of the 126 patients were female, and 82 (65.07%) had arthroplasty on their right hip. Participant’s mean ages, heights, weights, and body mass indices (BMI) were 55.29 ± 5.41 years, 165.96 ± 12.29 cm, 81.55 ± 5.19 kg, and 28.85 ± 3.64 kg/m2, respectively. 104 participants (82.53%) had a history of managed hypertension, 64 (50.79%) had a history of diabetic mellitus, and 56 (44.44%) had a history of anaesthesia, according to the records. Blood pressure study revealed that the increase in blood pressure over time (between applying bone cement and previously) in both the diastolic and systolic measurements was statistically negligible (P=0.125). In addition, while the average heart rate of all patients increased, the arterial oxygen saturation remained constant (P=0.999), making the difference statistically negligible (P=0.099). The participant's cardiovascular changes are displayed in Table 1.

Table 1: Analyzing the cardiovascular changes of participants before, during, and after using bone cement

Variable	Before bone cement	During bone cement	After bone cement	p
Heart rate	86.10±11.35	91.10±24.85	95.11±33.09	0.099
Systolic blood pressure	135.15±02.22	142.18±85.95	148.14±52.75	0.221
Diastolic blood pressure	83.10±30.33	90.10±57.96	95.12±44.45	0.195
Arterial oxygen saturation	100	100	100	0.265

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Discussion

After airway support by anesthesiologists, cardiovascular stability is of secondary importance in ensuring patients receive enough breathing. A higher mortality rate, cardiac and cerebral ischemia, the need for prolonged hospitalisation, an increase in the need for medication and the risk of cardiopulmonary resuscitation, and hemodynamic changes greater than 20%–30% from the baseline are just a few of the irreversible effects that can result. Therefore, monitoring hemodynamic condition is crucial and is regarded by anesthesiologists as a key issue in anaesthetic management after delivering enough breathing and maintaining the airway open.

Due to its significance, cardiovascular status is constantly checked during surgery in order to detect even the smallest alterations [10]. Cardiovascular state during surgery can be affected by a number of factors, including bleeding, the size of the incision, blood transfusions, anaesthetic injections, and intraoperative operations. During surgical procedures, the use of foreign materials like bone cement may alter hemodynamic state. Bone cement is perceived by the body as a foreign substance, and the body responds accordingly. It is advised to provide corticosteroids 10–30 minutes before use to avoid this. Despite these precautions, some people may still experience severe reactions, such as cardiovascular abnormalities that result in later problems [11–13].

The largest rate of mortality occurred 48 hours after employing bone cement, according to research by Olsen et al. titled Bone Cement Implantation Syndrome in Hemiarthroplasty [14]. Changing the amount of bone cement used in orthopaedic surgery can alter the patient's hemodynamic status, but there are no significant concerns, according to a study by Hines et al. named Bone Cement Implantation Syndrome [4]. Therefore, it is advised that future research take the quantity of bone cement utilised into account.

Conclusion

The findings demonstrated that utilising bone cement leads in small alterations in heart rate and blood pressure (systolic and diastolic).

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