

## SERUM ELECTROLYTES AND ITS IMPLICATION IN POST OPERATIVE DELIRIUM IN ORTHOPAEDIC SURGERIES – A PROSPECTIVE DESCRIPTIVE STUDY IN TERTIARY CARE CENTERS

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### Abstract

**Background:** Postoperative delirium is a severe central nervous system dysfunction caused by surgical stress, resulting in delayed recovery, increased hospitalisation, and potential bedsores and fractures. **Aim:** The present study aimed to study the electrolyte changes, especially sodium and potassium, following various orthopaedic surgical procedures and their implications in patients who developed postoperative delirium. **Materials and Methods:** This prospective study was conducted on 41 patients who developed delirium in the immediate postoperative period in the Govt Chengalpattu Medical College Hospital and SRM Medical College Hospital from February to November (2022). Serum electrolytes (Na, K, Cl) of each patient were estimated one day before the operation (-1), on the day of operation (0) after surgery & next four consecutive postoperative days (+1, +2, +3, +4). **Results:** This prospective study was conducted on 41 patients who developed delirium in the immediate postoperative period in the Govt Chengalpattu Medical College Hospital and SRM Medical College Hospital from February to November (2022). Serum electrolytes (Na, K, Cl) of each patient were estimated one day before the operation (-1), on the day of operation (0) after surgery & next four consecutive postoperative days (+1, +2, +3, +4). **Conclusion:** Preoperative factors like age, hospitalisation duration, surgery type, anaesthesia, comorbidities, and postoperative delirium contribute to postoperative delirium in older patients, necessitating careful monitoring and intervention.

## INTRODUCTION

Major Orthopaedic trauma is followed by a series of changes collectively referred to as metabolic response to injury, the magnitude and duration of the response being directly proportional to the severity of the trauma. Chronic orthopaedic conditions also present a deranged metabolic situation. Orthopaedic Operative procedures further impose a grave impact on the physiology of fluid and electrolytes within the body. Fluid and electrolyte management has thus been an integral part of the care of every major orthopaedic surgical patient in the postoperative period. The inorganic electrolytes, i.e., sodium, potassium, chloride, calcium, etc., are important constituents of body fluid as they play a vital role in cellular function and survival, in regulating fluid balance in respective zones, the excitability of tissues

and acid-base equilibrium and other manifestations associated with life.<sup>[1]</sup> Fluid volume and electrolyte composition changes occur preoperatively, intraoperatively and postoperatively. Operative procedures greatly impact the physiology of fluid and electrolytes within the body.<sup>[2]</sup> Apart from blood loss, a sequence of events consists of increased fluid loss through the lungs and the pooling of plasma and ECF in the operative site. Therefore, a successful postoperative result depends on the individual need and the physiological and biochemical response that come into play when surgery distorts normal pattern.<sup>[3]</sup>

Postoperative delirium leads to delayed recovery, extended hospitalisation and increased medical costs. It can also lead to bedsores and fall-related fractures. There is no standard procedure for preventing and treating postoperative delirium.<sup>[4]</sup> Perioperative

factors include old age, duration of hospitalisation, type of surgery, anaesthesia, preoperative hospitalisation, preoperative comorbidities, preoperative and postoperative haemoglobin, postoperative electrolyte disorders, blood loss, operation time, postoperative intensive care unit (ICU) care and blood transfusion contribute to the development of delirium.<sup>[5]</sup>

We aim to study the electrolyte changes, especially sodium and potassium, in patients who developed postoperative delirium following various orthopaedic surgical procedures. And assess its implication in the principles of fluid and electrolyte replacement therapy.

## MATERIALS AND METHODS

This prospective study was conducted in patients in the Department of Orthopaedic Surgery, Govt Chengalpattu Medical College Hospital, and SRM Medical College Hospital, Tamilnadu, from February to November (2022). Institutional Ethical Committee approval and informed consent were obtained before the study started.

### Inclusion Criteria

The cases were selected among indoor patients who developed postoperative delirium following various orthopaedic surgical procedures. Patients having no other pathology except for which they were operated on and without clinical manifestations of deranged fluid and electrolyte balance were selected.

### Exclusion Criteria

Serum electrolytes (Na, K, Cl) of each patient who was to undergo major orthopaedic surgery, both emergency trauma and elective surgeries like joint replacement spine surgeries, were estimated one day before operation (-1) as routine and on the day of operation (0) after surgery. For patients who developed postoperative delirium, serum electrolytes were estimated for the next four consecutive postoperative days (+1, +2, +3, +4) and the 7th postoperative day (+7). 3.0 mL of blood was collected from all the subjects, and electrolytes (Na<sup>+</sup>, K<sup>+</sup>, Ca<sup>2+</sup> and Cl<sup>-</sup>) were analysed.

Total number of major orthopaedic procedures done during the study period was 864. Among these, only 41 patients developed postoperative delirium and were taken up for further study. All the data were expressed as frequency and percentage.

## RESULTS

Among 864 orthopaedic surgeries, 41 cases (4.74 %) developed postoperative delirium. Among 41 cases, 38 were male (92.7%), and three were female (7.3%). Age ranged between 42 to 86 (mean 64) [Table 1]. Type of surgery, total hip replacement 7 cases (17.07%) (6 male, one female) total knee replacement 3 cases (7.3%) (male +3), trochanter fracture fixation

11 cases (26.8%) (male 10 cases, female 1), shaft of femur fracture fixation 14 cases (34.15%) (male 14), proximal tibia fracture fixation 4 cases (9.7%) (male=4), fracture both bone leg fixation 2 cases (4.9%) (1 male, one female) (Table 2). In total hip replacement, non-traumatic causes 4 cases, traumatic cause (neck of femur fracture) 3 cases [Table 2].

Serum electrolyte was estimated preoperatively and postoperatively. Electrolyte changes were observed in only 13 patients among the 41 cases. On the day of surgery, Serum sodium fall in these 13 cases ranged from 128 to 133. Serum chloride range was observed to be between 93 to 98. The serum potassium range was between 4.9 to 5.3.

On the 1st postoperative day, Serum sodium fall in these 13 cases ranged from 125 to 129. Serum chloride range was observed to be between 90 to 96. The serum potassium range was between 4.8 to 5.5. On the 2nd postoperative day, Serum sodium fall in these 13 cases ranged from 130 to 134. Serum chloride range was observed to be between 93 to 99. The serum potassium range was between 4.5 to 4.8. On the 3rd postoperative day, Serum sodium levels improved in these 13 cases, ranging from 133 to 139. Serum chloride range was observed to be between 99 to 104. The serum potassium range was between 4.2 to 4.9. On the 4th postoperative day, Serum sodium in these 13 cases ranged from 135 to 143. Serum chloride range was observed to be between 100 to 106. The serum potassium range was between 4.0 to 4.5. In the remaining 28 cases, no significant change in electrolytes was observed.

Among the 13 patients with postoperative electrolyte changes, 11 were on thiazide diuretics to treat systemic hypertension. For two other cases, opioids (Inj. Tramadol) were used intraoperatively for pain management and had vomiting episodes.

In all 41 cases, symptoms developed in the evening on the day of surgery. Twenty-one cases were recovered within two days. Seventeen cases started recovering on the 3rd postoperative day. Three cases recovered in the 4th postoperative day. All 13 (male 11, female 2) cases in whom electrolyte imbalance was observed were on treatment with diuretics (thiazide) for systemic hypertension. Alcohol and drug abuse was the cause in 25 cases (male 24, female 1). For 3 cases, underlying causes couldn't be found. There was no mortality in the patients who developed delirium. Six patients (THR 1, femur fracture fixation 3, proximal tibia fracture fixation 2) started walking without support in a delirious state before the symptoms could be controlled. No wound complication was observed in any of these 41 cases, despite 13 patients removing their postoperative dressing when under delirium. IV sedation was given only to those patients in whom no electrolyte changes were observed. Physician opinion was obtained in patients with hyponatremia hyperkalemia and treated accordingly [Table 3].

**Table 1: Distribution of gender and age group**

Gender	Frequency		Percentage
	Male	38	92.7
Female	3	7.3	
Age group	40-49	8	19.5
	50-59	18	43.9
	60-69	7	17.07
	70-79	6	14.6
	>80	2	4.8

**Table 2: Operative procedures in which patients developed electrolyte abnormality**

	Number of patients who developed postoperative delirium	Number of patients who had serum electrolyte changes
Total hip replacement (THR)	7 (17.07%)	3
Total knee replacement (TKR)	3 (7.3%)	1
Trochanter # fixation	11 (26.8%)	4
Shaft of femur # fixation	14 (34.15%)	3
Proximal tibia # fixation	4 (9.7%)	1
Both bone leg # fixation	2 (4.9%)	1

**Table 3: Per operative duration and Blood loss**

	Mean age (in years)	Mean surgical time duration (in mins)	Mean intra & postoperative blood loss (in ml)
THR	58	105	250 ml
TKR	64	88	200 ml
Trochanter # fixation	69	70	150 ml
Shaft of femur # fixation	55	110	150 ml
Proximal tibia # fixation	53	55	150 ml
Both bone leg # fixation	50	56	50 ml

## DISCUSSION

Postoperative delirium is an acute central nervous system dysfunction after surgical stress. It can include clinical features such as acute and nonspecific disturbance of consciousness, attention, cognitive ability and sleep-wake cycles. In this study, we prospectively selected 41 patients who developed postoperative delirium after different orthopaedic surgeries, including internal fixation for major fractures, femoral head replacement (hemiarthroplasty), total hip arthroplasty (THA) and total knee arthroplasty (TKA). We looked for specific risk factors among this population and investigated the mechanism of postoperative delirium. In addition, we tried to find clinical evidence for the prevention and treatment of postoperative delirium.

Currently, there is no standard procedure for preventing and treating postoperative delirium. Gleason reported that donepezil was effective for treating postoperative delirium.<sup>[6]</sup> Still, in contrast, the study of Sampson et al. found that donepezil could not significantly reduce the incidence of postoperative delirium or shorten the resulting period of hospitalisation.<sup>[7]</sup> Low-dose haloperidol and olanzapine are probably effective for treating postoperative delirium but not for its prevention. Theoretically, early prevention based on aetiology can reduce the incidence of postoperative delirium or may reduce the harm of its effects. However, the aetiology and the mechanisms of postoperative delirium are still unclear.

Previous studies reported that many factors might be associated with postoperative delirium, such as Alzheimer's disease (AD), preoperative

hospitalisation, anaesthesia, diabetes, haemoglobin level, blood loss, operating time and blood transfusion. Cisternas et al. found that an increased potassium intake can improve cognitive performance and might be important in preventing AD onset.<sup>[8]</sup> Cherbuin's study confirmed that higher intakes of potassium, calcium and magnesium are associated with a reduced risk of developing vascular dementia.<sup>[9]</sup> Therefore, we have reasons to propose that an electrolyte disorder may be a risk factor for some psychiatric disorders, including postoperative delirium.

Caplan's study,<sup>[10]</sup> found that significantly lower serum levels of magnesium and phosphate, not potassium, were associated with delirium. Thus, the exact mechanism by which electrolyte disorders contribute to the occurrence of postoperative delirium is unclear. According to the delirium guideline,<sup>[11]</sup> an electrolyte disorder is a very plausible risk factor for postoperative delirium, and a disturbance in sodium or potassium levels is usually associated with a disorder of body fluids, including hypotonic or hyperosmotic dehydration.

In our study, electrolyte changes were observed in only 13 patients among the 41 cases. In all cases, there was a fall in serum sodium and chloride levels on the day of operation, which attained a still lower level on 1st postoperative day. From the 2nd postoperative day onwards, there was a gradual rise and attained preoperative value by the 4th postoperative day in most cases and by the 7th postoperative day in all cases. There was also an elevation in serum potassium level from the day of operation, which became highest on 1st postoperative

day. This followed a gradual fall from the 2nd postoperative day onwards and attained preoperative level in most cases by the 4th postoperative day and, in all cases, by the 7th postoperative day.

In all 41 cases, symptoms developed in the evening on the day of surgery. Twenty-one cases were recovered within two days. Seventeen cases started recovering on the 3rd postoperative day. Three cases recovered in the 4th postoperative day. All 13 (male 11, female 2) cases in whom electrolyte imbalance was observed were on treatment with diuretics (thiazide) for systemic hypertension. Alcohol and drug abuse was the cause in 25 cases (male 24, female 1). For 3 cases, underlying causes couldn't be found. Thiazide usage for treating systemic hypertension could also be associated with electrolyte changes postoperatively, leading to delirium.

## CONCLUSION

Postoperative delirium is the most common mental disorder encountered in older patients. However, it isn't easy to diagnose. Perioperative factors, including old age, duration of hospitalisation, type of surgery, anaesthesia, preoperative comorbidities, preoperative and postoperative haemoglobin, postoperative electrolyte disorders, blood loss, operation time, postoperative intensive care unit (ICU) care and blood transfusion contribute to the development of delirium. Alcohol withdrawal and substance abuse-related delirium were the leading causes. Watchful expectancy, meticulous monitoring and intervention are necessary to overcome the complications.

### Limitations

It is a short-term study, as postoperative delirium is only acute, and patients recovered fully, so long-term follow-up was unnecessary. Many factors may be related to postoperative delirium; not all related factors were included in our study.

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