

Intraoperative Hyperglycemia in Patients Undergoing Emergency Craniotomy for Traumatic Brain Injury

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Abstract: *The study aimed to investigate the prevalence and risk factors of intraoperative hyperglycemia in adults undergoing emergency craniotomy for traumatic brain injury TBI at the Government Medical College, Thrissur. Conducted over 1.5 years, the cross-sectional prospective observational study included 214 patients after excluding 26 based on specific criteria. The findings revealed that 79.9 of the patient's experienced hyperglycemia during surgery, with a significant association observed with advanced age 65 years, subdural hematoma SDH, low preoperative Glasgow Coma Scale GCS 9, and preoperative hyperglycemia. The study emphasizes the need for vigilant monitoring and management of blood glucose levels during emergency craniotomies to mitigate the risk of adverse outcomes.*

Keywords: intraoperative hyperglycemia, traumatic brain injury, emergency craniotomy, risk factors, glucose monitoring

1. Introduction

The number of people with diabetes in India rose from 26 million in 1990 to 65 million in 2016. The prevalence of diabetes in adults aged 20 years or older in India increased from 5.5% in 1990 to 7.7% in 2016, with an increase in every state of India. This prevalence was highest in the more developed states such as Tamil Nadu and Kerala.

Traumatic brain injury, defined as an alteration in brain function or other evidence of brain pathology, (National Institute of Neurological Disorders and Stroke definition) caused by an external force, is a leading cause of death among adults.

Traumatic brain injury (TBI) induces a variety of changes that exacerbate the patient's condition. Primary brain injury is the immediate physical damage acquired at the time of the injury to the brain during head trauma. Secondary injury consists of systemic brain insults such as hypoxemia, hypo-/hyperglycemia, hypotension, hypo-/hypercapnia, hypo-/hyperthermia, anaemia, electrolyte imbalance, and acid-base abnormalities.

A retrospective cohort study conducted in 185 patients >18 years at Harborview medical centre, who underwent emergency craniotomy for traumatic brain injury showed that intraoperative hyperglycemia was common, and in hospital mortality was higher in patients with intraoperative hyperglycemia.

Since there is little that medical professionals can do to ameliorate the symptoms of a primary brain injury, the main focus of head injury treatment is on preventing further injuries.

Objective

Primary objective

To study the prevalence of intraoperative hyperglycemia during emergency craniotomy for traumatic brain injury

Secondary objective

To identify the risk factors for intraoperative hyperglycemia during emergency craniotomy for traumatic brain injury

Study design: Cross sectional prospective observational study

Setting: Department of Anaesthesiology Government medical college, Thrissur

Period of study: 1.5 year from the date of clearance from the Institute Ethical Committee

Sampling technique: Continuous sampling method is used in this study

2. Methodology

Inclusion criteria

Adults > 18 yrs undergoing emergency craniotomy for traumatic brain injury in Govt. Medical college, Thrissur, who are consenting to be part of the study

Exclusion Criteria

- Not consenting to be part of the study
- Age <18 Years
- Pregnant patients
- Repeat craniotomy
- Patients on steroids

Sample size

Based on the study by Pecha T, Sharma D, Hoffman NG, Sookplung P, Curry P, Vavilala MS. Hyperglycemia during craniotomy for adult traumatic brain injury. *Anesthesia & Analgesia*. 2011 Aug 1;113(2):336-42., sample size is calculated by the formula:

Sample size, $n = 4pq/d^2$

$= 4 \times 15 \times 85 / 5^2 = 204$

Where p = prevalence,

$q = 1 - p$,

d = absolute error

Sample size = 204

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Materials: Proforma, Case sheet and investigation reports, Capillary blood glucose analyser, blood glucose test strips

Study procedure

After obtaining ethical committee clearance, 240 patients who presented with TBI for emergency craniotomy in the EOT were screened, out of which 26 patients were excluded from the study based on the exclusion criteria.

The study was then conducted on 214 patients undergoing emergency craniotomy for traumatic brain injury.

After explaining the anaesthetic procedure, written informed consent for participation in the study was obtained from the caregivers of the patients mainly, since the majority of the study population had poor GCS scores with which they couldn't provide consent.

Preanaesthetic evaluation was done, detailed history and physical examination done. Pre-operative GCS and pre-operative blood glucose value was noted.

First hour and second hour intraoperative capillary blood glucose value was obtained.

Hyperglycemia was defined as GRBS value > 140 mg/dl (preoperative/intraoperative first hour or second hour GRBS value) Hyperglycemia was treated with either insulin bolus or infusion when GRBS value exceeded 180-190 mg/dl.

All cases were managed intraoperatively as per institutional treatment protocol, the decision to treat hyperglycemia (i.e. the level of intraoperative glucose to give insulin, whether to give bolus injection of insulin or insulin infusion, the amount of insulin given) was made by the attending Anaesthesiologist in charge of the table and was observed by the principal investigator.

The patient was prospectively followed up i.e. the length of stay in the ICU, GCS at the time of discharge from ICU to ward was noted. The data procured was analysed using appropriate statistical methods

Analysis

Data are presented as mean and standard deviation for continuous variables, and as frequency for categorical variables.

Analysis was carried out using Student's t-test, χ^2 test or Fisher's exact test as appropriate. Univariate analysis of factors associated with mortality, ICU length of stay were carried out using logistic regression analysis.

Interaction and confounding were assessed through stratification and relevant expansion covariates. Factors with a P-value < .20 in the univariate analysis were entered in a multivariable logistic regression analysis. P-values of $\leq .05$ were considered statistically significant.

3. Results and Observations

Prevalence of intraoperative hyperglycemia

Intraoperative hyperglycemia was common in our study population. Out of the 214 study participants, 171 had GRBS

value > 140 mg/dl in either the first or second hour (79.9%). GRBS value was less than 140 mg/dl in both first and second hour in 43 participants (20.09%)

Independent risk factors for intraoperative hyperglycemia

Binary linear logistic regression was fitted with each risk factors as independent variable for finding out the odds ratio corresponding to each risk factors. Thus, it was observed that the following were independent risk factors for intraoperative hyperglycemia

- Age ≥ 65 ;
- BMI ≥ 25 ;
- SDH;
- Preoperative GCS ≤ 9 ;
- Pre operative hyperglycemia

Factors	Odds ratio	95% CI	P-value
Age ≥ 65	18.555	2.49 - 138.38	0.004
SDH	2.667	1.39-5.12	0.003
Preoperative GCS ≤ 9	2.903	1.497-5.629	0.002
Pre operative hyperglycemia	17.657	8.032-38.814	<0.001

4. Discussion

Age:

Patients in the age group 26-64 years (Adults) contributed to 60.3% of the study population. 22% of the patients were in the age group 65 years and above (older adults) and young adults (18-25 years) constituted 17.8% of the study population.

Gender:

In our study population 75% were males and 25% were females. The age and gender distribution of our study population is concurrent with other published data.

Diabetes mellitus:

Fifteen percent of the study population were those with diagnosed diabetes mellitus, while the majority were nondiabetic (85%). In the diabetic individuals of the study population, (32 out of 214), 71.875% were on treatment with OHA, 25% were on insulin, while 3.125% were on diet control.

Hyperglycemia

Intraoperative hyperglycemia was common in our study population. Out of the 214 study participants, 171 had GRBS value > 140 mg/dl in either the first or second hour (79.9%). GRBS value was less than 140 mg/dl in both first and second hour in 43 participants (20.09%)

In the study population, the minimum preoperative GRBS value noted was 85 mg/dl, maximum was 412 mg/dl. The mean preoperative GRBS was 182.6, standard deviation was 63.06. The minimum first hour GRBS value noted was 102 mg/dl, maximum value was 385 mg/dl. The mean first hour GRBS was 183.36, standard deviation was 61.86. The minimum second hour GRBS value noted was 109 mg/dl, maximum value was 358 mg/dl. The mean second hour GRBS was 170.78, standard deviation was 48.06.

In our study population, 69.6% had preoperative GRBS>140 mg/dl. 72% had first hour GRBS>140 mg/dl. And 64.5% had second hour GRBS>140 mg/dl. In the study by Bhattacharjee et al on the perioperative glycemic status of adult TBI patients undergoing a craniotomy the preoperative capillary blood glucose value was 136.8 ± 11.9 mg/dL and the one-hour postoperative value was 166.7 ± 11.4 mg/dL.

In our study, we observed that the prevalence of intraoperative hyperglycemia is more in the older adults, aged 65 years and above.

It was observed that the prevalence of intraoperative hyperglycemia is more in the diabetic population.

It was also observed from our study that the prevalence of intraoperative hyperglycemia is high in patients with SDH.

There was no significant association between intraoperative hyperglycemia and EDH.

There was no significant association between intraoperative hyperglycemia and SAH.

It was observed that both preoperative GCS and GCS at discharge from ICU were lesser in patients who had intraoperative hyperglycemia

It was observed from our study that patients with preoperative hyperglycemia had more chance of developing intraoperative hyperglycemia

5. Conclusion

From the study it could be concluded that:

- Intraoperative hyperglycemia was common during emergency craniotomy for traumatic brain injury
- The following were independent risk factors for intraoperative hyperglycemia
- Age ≥ 65 years
- SDH
- Preoperative GCS ≤ 9
- Pre operative hyperglycemia