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Original Research Article

Post craniotomy and electrocardiographic monitoring

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ABSTRACT

Background: Post craniotomy management mainly emphasizes monitoring complications that occur. Close supervision and monitoring are needed in post craniotomy patients, especially in the first 48 hours so that the patient is placed in the intensive care unit (ICU). Various studies have identified various complications that arise from mild complications to severe complications, namely the death of patients after craniotomy, so that hemodynamic monitoring tool are needed. Electrocardiography is one of the hemodynamic monitoring tools in the intensive care room which is very useful in monitoring heart rhythm abnormalities in post-craniotomy patients.
Methods: This descriptive study was conducted on 30 respondents post craniotomy and were treated in the Intensive Care Unit (ICU) for 1-3 days of treatment. An electrocardiographic monitoring analysis was performed on 30 respondents, then confirmed by examination of blood electrolytes and blood gas analysis.
Results: In this study 90% of respondents experienced electrocardiographic rhythm abnormalities, 50% sinus arrhythmia, 33.3% sinus tachycardia, 6.7% sinus bardycardia. The results of electrolyte examination 18 respondents experienced electrolyte balance disorders where 4 respondents experienced hyponatremia, 7 respondents experienced hypernatremia+hyperchloremia, 1 respondent experienced hyponatremia+hypochloremia, 5 respondents experienced hyperchloremia and 1 respondent experienced hypokalemia. There are 7 respondents experiencing acid-base balance disorders.
Conclusions: in this study showed that most of the patients after craniotomy had heart rhythm abnormalities. The most common arrhythmia is sinus arrhythmia. The pathological conditions that accompany these rhythm disturbances are mostly caused by electrolyte balance disorders, acid-base balance disorders or a combination of the two disorders.

Keywords: Acid-base balance disorders, Electrocardiographic monitoring, Electrolyte balance disorders, Post craniotomy

INTRODUCTION

Handling after craniotomy surgery includes handling and monitoring complications due to surgical procedures, due to the disease causing the craniotomy and common complications that occur in postoperative patients. In general, patients who have undergone a craniotomy are treated in the intensive care unit, which requires close monitoring for the first 48 hours.[1] Craniotomy is a surgical procedure on the head by opening the skull bone so as to provide direct access to the brain.[2] The number of craniotomy patients treated in the intensive care room is still quite large, of the 432 patients treated in the intensive room there are 400 (92%) craniotomy patients. Post-craniotomy care really needs serious attention because there are still many post-craniotomy mortality rates.

The mortality rate of post-craniotomy patients was 57% after 5 days of treatment in the intensive room.[3] Tanriono et al, reported from the period June 2016 to June 2017 in

the ICU Room, Prof. R.D Kandou Manado there were 30 craniotomy patients and 11 patients died or about 36%. The post-craniotomy mortality rate is caused by several factors, including; basic diagnosis is performed by craniotomy, complications after craniotomy and other factors.[4] Pribadi conducted a study from February 2010-February 2012, there were 103 craniotomy patients and as many as 51 patients (49.51%) died after craniotomy treatment in ICU and HCU rooms at Dr. Kariadi Semarang.[5] In order to reduce the mortality of post craniotomy patients, close monitoring/monitoring is required, one of the hemodynamic monitoring tools needed is electrocardiographic.

Electrocardiographic (ECG) is the most frequently used tool in monitoring patients in the intensive care unit. One of these ECGs can detect rhythm abnormalities in the heart, can help establish patient diagnoses and can alert nurses to changes in the patient's condition. This ECG monitoring must be done very carefully, if not done carefully, there will be errors in the interpretation of the ECG, errors in diagnosis, and can cause errors in patient management.[6] A good understanding is needed for nurses who work in intensive care unit to avoid these mistakes, especially to detect post craniotomy complications in patients treated in the ICU.

METHODS

The design of this study used a descriptive study approach where post craniotomy patients were monitored by electrocardiography for 1-3 days in the intensive care unit (ICU). To identify the cause of the electrocardiogram changes, respondents were observed the results of blood gas and electrolyte analysis. The sampling technique used was incidental sampling, with a total of 30 respondents. This research was conducted in the intensive care unit (ICU) of Tarakan General Hospital, North Kalimantan Province, starting from October 2020 to February 2021. Research inclusion criteria; men and women; age 17-65 years; post craniotomy days 1-3. The exclution criteria are; under 17 years old, patients before craniotomy who showed an acut coronary syndrome. The aim of this research are; analyzing electrocardiographic changes in post-craniotomy patients; analyzing blood electrolytes in post-craniotomy patients and; analyzing blood gas analysis in post craniotomy patients.

The first step taken by the researcher was to apply for ethical conduct to the research ethics committee of the Tarakan City Hospital along with a research permit to the Director of Tarakan City Hospital, North Kalimantan Province.

After other ethics and research permits were issued, the researcher identified the post craniotomy patient and observed electrocardiogram abnormalities for 3 days of treatment in the intensive care unit (ICU), analyzed the results of the blood gas analysis and analyzed the results of the blood electrolyte examination of the respondent. Researchers will analyze the three findings to answer the objectives of this study.

RESULTS

The results of research that have been carried out in the intensive care unit (ICU) of the Tarakan Regional General Hospital, North Kalimantan Province in October 2020 to February 2021, where all research respondents were post craniotomy, totaling 30 respondents.

Table 1: Frequency distribution of electrocardiographic in post craniotomy patients in the ICU in 2020.

ECG Interpretation	N	%
Sinus rhytm	3	10
Sinus arrhythmia	15	50
Sinus tachycardia	10	33.3
Sinus bradycardia	2	6.7
Total	30	100

Table 2: Frequency distribution of blood electrolyte imbalance in post craniotomy patients in the ICU in 2020.

Electrolyte imbalance	N
Hyponatremia	4
Hyponatremia+hypocloremia	1
Hypernatremia+hypercloremia	7
Hypercloremia	5
Hypokalemia	1
Total	18

Table 3: Frequency distribution of blood gas analysis abnormalities in post craniotomy patients in the ICU in 2020.

Acid base disorder	N
Respiratory acidosis	2
Metabolic acidosis	2
Respiratory alkaliosis	2
Metabolic alkaliosis	1
Total	7

Electrocardiographic in post craniotomy patients

The electrocardiographic picture found in post craniotomy patients can be seen in table 1.

Based on table 1, the most electrocardiogram images found in post craniotomy patients are sinus arrhythmias and sinus bradycardia is the least common rhythm.

Blood electrolyte levels in post carniotomy patients

The description of changes in blood electrolyte levels found in post craniotomy patients can be seen in table 2.

Based on Table 2, the most common blood electrolyte imbalance found in post craniotomy patients was hypernatremia+hyperchloremia, while the least was hypokalemia.

There were 3 respondents who experienced mixed disorders, namely electrolyte imbalance and hypoxemia as many as 2 respondents and 1 respondent experienced electrolyte imbalance and acid-base balance disorders.

Analysis of blood gases in post craniotomy patients

Overview of blood gas analysis in post craniotomy patients can be seen in Table 3.

Table 4: Frequency Distribution of Electrocardiographic Abnormalities with Imbalance of Blood Electrolyte Levels, Abnormalities of Blood Gas Analysis and Arterial Blood Oxygen Saturation in Post Craniotomy Patients in the ICU in 2020.

	Electrocardiographic interpretation		
	Sinus arrhyt-hmia	Sinus tachy-cardia	Sinus brady-cardia
Disorders of acid base balance	3	2	
Electrolyte balance disorders	8	5	2
Hypoxaemia	0	3	
Electrolyte balance disorders and Hypoxemia	2		
Disorders of acid-base balance and disorders of electrolyte balance	1		
Disorders of acid base balance and hypoxaemia	1		
Total	15	10	2

Based on table 3, the most abnormal blood gas analysis in post craniotomy patients is metabolic acidosis and the least is metabolic alkaliosis. There are 2 respondents who have mixed disorders, 1 respondent has an acid-base balance disorder and an electrolyte balance disorder, and 1 respondent has an acid-base balance disorder and hypoxemia.

Analysis of electrocardiographic changes to imbalance in blood electrolyte levels, abnormalities of blood gas analysis and arterial blood oxygen saturation

The relationship between electrocardiographic changes in post-craniotomy patients with deviations from normal values in blood electrolyte levels, blood gas analysis and arterial oxygen saturation can be seen in Table 4.

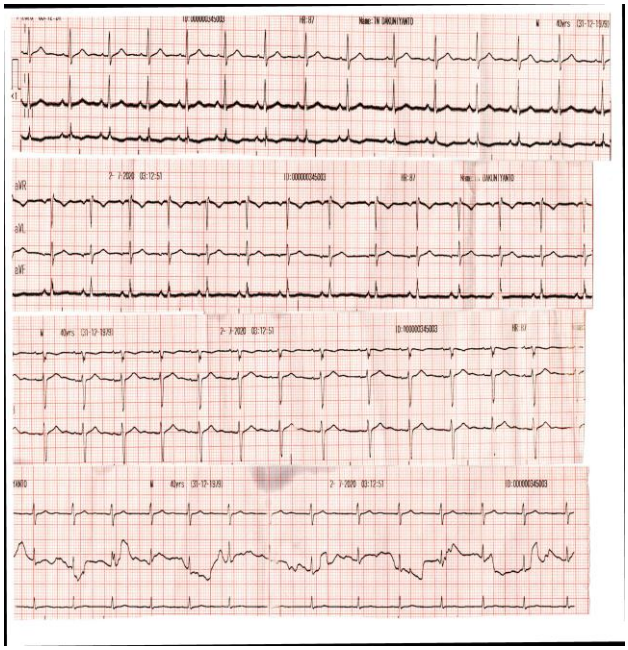

Figure 1: Respondent number 5 after the second day of craniotomy showed sinus arrhytmia.

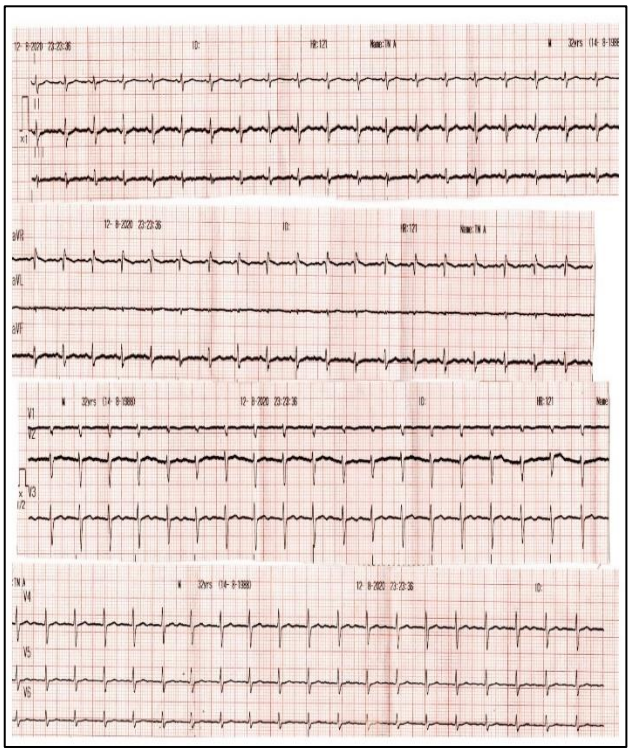

Figure 2: Respondent number 1 after the first day of craniotomy showed sinus tachycardia.

Based on table 4, the most electrocardiogram abnormalities associated with blood electrolyte imbalance, abnormalities in blood gas analysis and arterial oxygen saturation are sinus arrhythmias with blood electrolyte imbalance.

Electrocardiogram abnormalities that are at least associated with blood electrolyte imbalance, abnormal blood gas analysis and arterial oxygen saturation are sinus arrhythmias with acid-base balance disorders and electrolyte balance disorders as well as acid-base balance disorders and hypoxemia.

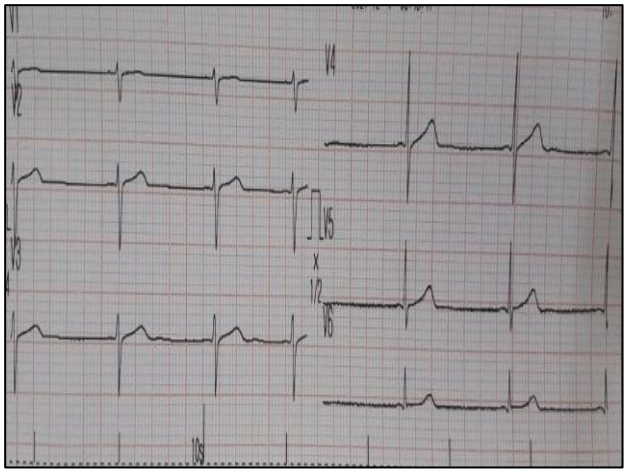

Figure 3: Respondent number 18 after the fisrt day of craniotomy showed sinus bradycardia.

DISCUSSION

Post neurosurgical management includes the management of complications related to the initial disease, surgical procedures and complications that commonly occur in post-surgical patients. In post-craniotomy cases, patients are generally treated in the intensive care unit (ICU) which requires close monitoring of complications that occur. The results of this study showed that of the 30 respondents who underwent post-craniotomy procedures, there were 27 respondents who had electrocardiographic abnormalities, namely sinus arrhythmia (50%), sinus tachycardia (33.3%) and sinus bradycardia (6.7%). Based on research conducted by Lonjerat, et al, complications that occur in patients after craniotomy due to brain tumors are postoperative nausea and vomiting (25%), neurology (16%) and hemodynamic instability (9%) consisting of bradycardia, arterial hypertension and arterial hypotension.[7] The description of electrocardiographic abnormalities in the form of bradycardia was found in post-craniotomy patients due to brain tumors, this is in line with the results of this study where bradycardia was found in 6.7% of respondents who underwent post craniotomy monitoring.

Complications that occur in post-cranioplasty patients, on days 1-30 days after cranioplasty the highest are neurological-related complications, namely 13.4%, pulmonary-related complications 9.1% and dysrhythmias 6% (494 people).[8] Complications dysrhythmias occur at the age of <18 years by 2.4% (28 people), at the age of 18-64 years by 6% (377 people) and at the age of 65 years by 10.5% (89 people).

This is in line with this study where sinus arrhythmia is the most common ECG picture found in post-craniotomy respondents, which is as much as 50%. The results of another study also showed that in patients after neurosurgical procedures where from 37 patients the most electrocardiographic abnormalities were T wave changes (75.6%), U wave appearance (48.6%), QT interval prolongation (45.9%), sinus arrhythmia (24.3%), sinus tachycardia (13.5%) and sinus bradycardia (13.5%).[9] In this study, no changes were found in T wave, U wave appearance and QT interval prolongation, but I found 3 abnormalities with the research above, namely, sinus arrhythmia (Figure 1), sinus tachycardia (Figure 2) and sinus bradycardia (Figure 3).

According to Thaler the causes of heart rhythm abnormalities (arrhythmias) are; hypoxia, ischemia, sympathetic stimulation, drugs, electrolyte disturbances, bradycardia and strain.[10] Based on the results of this study identified 15 respondents who experienced pure electrolyte disorders, where there are 3 main electrolyte disorders, namely sodium balance disorders (hypernatremia and hyponatremia), chloride balance disorders (hyperchloremia and hypochloremia) and potassium balance disorders (hypokalemia), while the other 3 respondents experienced mixed disorders, namely 2 respondents experienced electrolyte balance disorders and hypoxemia and 1 respondent experienced electrolyte balance disorders and acid-base balance disorders. Abnormalities in the electrocardiographic picture in post-neurosurgical patients can be caused by electrolyte balance disorders. Some patients show abnormalities in electrolyte balance which results in some changes in the electrocardiographic picture. This electrolyte imbalance is probably caused by electrolyte changes at the cellular level.[9]

Several studies have reported electrolyte balance disturbances in some patients after craniotomy. The phenomenon of hyponatremia and hyperkalemia in post craniotomy patients can be caused by the administration of mannitol therapy which causes an increase in plasma osmolarity so that it affects the balance of potassium and sodium in the body.[11]

Hyponatremia and hyperkalemia cause changes in heart rhythm, where there are arrhythmias on the electrocardiographic picture. The results of another study also showed that there were two cases of patients experiencing hyperkalemia in post-craniotomy patients, this was due to the administration of mannitol therapy.[12] Administration of mannitol therapy can cause electrolyte imbalances, especially sodium and potassium which can cause changes in the electrocardiogram picture, where symptoms are found. changes in T wave height, changes in P waves and changes in the QRS complex. Research conducted by Muriithi in elective craniotomy patients found some electrolyte imbalances, both sodium, potassium, and chloride.[13]

It was found that 25% of patients after elective craniotomy experienced hyponatremia and 14% of patients experienced hypernatremia, this is related to the amount of loss blood during the craniotomy process, where the more blood loss during the surgical procedure the more potential for hyponatremia. Similarly, the level of chloride in patients after craniotomy surgery, it was reported that 8% of patients experienced hyporchloremia and 6% of patients experienced hyperchloremia, this is related to blood loss during elective craniotomy procedures.

In addition to electrolyte balance disorders, acid-base balance disorders were also found, where there were 5 respondents only experienced acid-base balance disorders and 2 respondents experienced mixed disorders, namely 1 respondent experienced acid-base balance disorders and hypoxemia and 1 respondent experienced acid-base balance disorders and electrolyte balance disorders.

Disorders of acid-base balance can affect the heart rhythm, especially in conditions of acidosis and hypoxia. Acidosis and hypoxia can cause an imbalance in extracellular K concentration, causing a decrease in membrane potential and spontaneous depolarization. Apart from spontaneous depolarization, an increase in the extracellular potassium concentration (under hypoxic conditions) can cause the Purkinje fibers to depolarize, which can lead to extrasystole.[14]

The limitation in this study was that the research respondents who underwent post craniotomy were not specific, but the various causes behind the respondents being given a craniotomy.

CONCLUSION

In general, post craniotomy patients are treated in the intensive care unit (ICU) which requires close hemodynamic monitoring. One of the monitoring that is generally used in the intensive care room is electrocardiography. Rhythm changes detected in post craniotomy patients should be detected as early as possible and the underlying cause of the rhythm changes should be sought. Rhythm changes that can be found in post craniotomy patients include sinus arrhythmia, sinus tachycardia and sinus bradycardia which can be caused by electrolyte imbalance, acid-base imbalance, hypoxemia, or a combination of these three conditions. Changes in heart rhythm can cause changes in cardiac output, so nurses on duty in the intensive care unit can understand well the hemodynamic monitoring of post craniotomy patients.

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