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PRE HOSPITAL MANAGEMENT IN EMERGENCY HYPOGLYCEMIA: A CASE REPORT

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ABSTRACT
The management of hypoglycemia emergencies is a unique challenge for emergency medical services (EMS) providers. Hypoglycemia can occur in many different conditions. If left untreated, it can lead to serious complications, including seizures. The correct management of hypoglycemia in the pre-hospital setting can be a preventative measure against a range of complications that can be associated with hypoglycemia. This study aims to describe cases of prehospital management of hypoglycemic patients with seizures. This study uses a case report approach with an emergency care approach consisting of airway, breathing, circulation, disability and exposure. The case used in this case report is a woman with a history of diabetes mellitus, hypertension and Guillain-Barre Syndrome who experienced emergency hypoglycemia with seizures and decreased consciousness. The case study discusses how pre-hospital care is provided and highlights the pre-hospital management of patients with hypoglycemia associated with seizures. Data were collected by observing the clinical signs and symptoms that appeared, then analyzed to determine the appropriate treatment of hypoglycemia emergencies according to evidence. The results showed that pre-hospital interventions can be pharmacological and non-pharmacological. Recommendations from this case study can be used to consider interventions to be used in prehospital management of patients with hypoglycemia with seizures.

Keywords: case report; diabetes mellitus; emergency hypoglycemia; pre hospital management; seizures

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INTRODUCTION

A seizure is an event that results from excessive and synchronized abnormal neural activity in the brain. They result from the disruption of multiple systems such as the central nervous system, cardiac disorders, psychiatric causes and possibly other etiologies. Prehospital seizures are the seventh most common condition requiring prehospital care (Fuest et al., 2022). Data shows that 75% of patients with seizures are evacuated to the nearest hospital emergency department (Dickson et al., 2016). Seizures can occur when recurrent hypoglycemia leads to a reduced autonomic response to hypoglycemia. The maladaptive response in the brain is characterized by increased glucose transporter 1 activity in an attempt to maintain brain function and altered glucose sensing in the ventromedial hypothalamus (VMH). This is mediated by increased levels of gamma-aminobutyric acid (GABA) (Nakhleh & Shehadeh, 2021). The physiological response of the body to prevent hypoglycemia is called counter-regulation and involves the interaction of hormones and neural signals to regulate endogenous insulin release, increase hepatic glucose output and alter peripheral glucose use (Mathew & Thoppil, 2024).

The brain's dependence on glucose for fuel can make people susceptible to hypoglycemia. Patients with diabetes mellitus who experience hypoglycemia will temporarily stop insulin delivery, but the insulin administered will remain active in the body. When glucose falls below 3.8mmol/L, endogenous glucagon secretion from pancreatic alpha-cells induces glycogenolysis and gluconeogenesis. However, if it drops further, the adrenal medulla secretes adrenaline, which promotes hepatic glucose release. Some of these mechanisms may fail and the body will release growth hormone and cortisol to stimulate gluconeogenesis, a condition seen in prolonged hypoglycemia (Hölzen et al., 2024).

Most hypoglycemia occurs in people with diabetes mellitus (DM) who are treated with meglitinides, sulfonylureas or insulin because the drug's mechanism of action is to prevent blood glucose from rising rather than to lower glucose concentrations (Dewan, Johnson, & Robson, 2020). Inadequate food intake is one of the risk factors for low blood glucose in people with diabetes. Hypoglycemia is a feared complication of DM therapy. It can occur even in people with diabetes who are well controlled (Maffi & Secchi, 2017). Severe hypoglycemia causes signs and symptoms, one of which is neuroglycopenic symptoms, or a lack of glucose directly in the nervous system. Signs and symptoms include behavioral changes, confusion, fatigue, seizures, coma and possible death if not treated immediately (Mathew & Thoppil, 2024). These symptoms usually occur with glucose levels below 50 to 55 mg/dL (ADA, 2021).

Mortality in type 1 DM patients has a percentage of 2 - 4% and it is estimated that hypoglycemia is the cause of death. The mortality rate that occurs in type 2 DM with hypoglycemia is many times lower than type 1 DM (Soelistijo, 2021). An analysis conducted by Balooch Hasankhani, Mirzaei, & Karamoozian (2023) found that the average global incidence of DM from 1990 - 2019 increased with an increase of 3.73 cases per 100,000 people and DM mortality also increased by 0.62 until 2015 in developing countries. A study showed a hypoglycemia prevalence rate of 57.44% with 10.7% of the population experiencing severe hypoglycemia (Samya et al., 2019). Pre-hospital activation in cases of hypoglycemia accounts for approximately 2.3% of all activations in pre-hospital care (Schwerin & Svancarek, 2024). Study by Villani et al (2019) showed about 50% of clients with severe hypoglycemia require transport to hospital. Lack of prehospital care knowledge and late detection of hypoglycemia can lead to severe conditions such as seizures and loss of consciousness, which is the reason why clients are brought to the emergency room. Prehospital handling is an intervention provided in the form of assessment and emergency care for patients who experience an emergency or severe illness, both trauma and non-trauma, until transportation by ambulance to the emergency department (Kim & Oh, 2023).

Pre hospital management of hypoglycemia provides an opportunity for early identification and treatment leading to relatively rapid recovery of symptoms and prevention of worse conditions. Blood glucose measurement and IM glucagon administration can improve the client's condition and reduce the risk of severe hypoglycemia by medical personnel in pre hospital management (Woodburn & Rostykus, 2019). The American Diabetes Association (ADA) recommends oral glucose in the initial treatment that can be performed by everyone in conscious hypoglycemia patients (ADA), 2021). Study shows 598 paramedics out of 714 experienced dilemma in decision making of transferring and discharging hypoglycemia cases in several emergency health services Pre-hospital (Yücel, Eksi, Gümüşsoy, & Oztürk, 2023). A study conducted in the United States in emergency medical services reported that 0.64 patients were brought to health care with recurrent hypoglycemia and 0.42 were not brought to health care (Myers, Swanson, Glasgow, & McCoy, 2022).

Based on this background, fast and appropriate pre-hospital management needs to be done by paramedics, so that knowledge and skills on pre-hospital management interventions for clients with seizures with hypoglycemia need to be improved to reduce the dilemma felt by paramedics in dealing with cases until the transfer process is carried out in the hospital. This study aims to determine the correct pre-hospital management in hypoglycemia patients with seizures.

METHOD

This study uses a case report approach, which is a detailed report that contains case details up to the follow-up of an event. The structure contained in this case report is in accordance with that developed by Cohen (2006) which consists of an abstract, introduction, case description, discussion, and conclusion with a nursing process approach consisting of assessment, establishing nursing diagnoses, developing intervention plans, implementation, and evaluation. The case discussed in this case report is the pre-hospital treatment of clients experiencing hypoglycemia accompanied by seizures in one of the health and emergency service units in West Java Province. This case-report was conducted on 20 April 2024 in a short period of time, starting from the incoming call at the call center to the process of referring the client to the nearest hospital. Data collection was carried out by assessment through observation, interviews with the family, and direct examination of the client. Establishment of nursing problems and development of intervention plans are carried out through team collaboration when receiving calls to the client's location. Implementation and evaluation were carried out directly during pre-hospital management. The data collected is analyzed to assess the uniqueness of the problems that arise and is further reviewed to determine the management of pre-hospital care in clients with hypoglycemia accompanied by seizures.

In this case report, no harmful actions were taken by the researcher. Data were collected by observing the clinical signs and symptoms that appeared, then analyzed to determine the appropriate treatment of hypoglycemia emergencies according to evidence. The researcher has obtained permission from the patient and family in the form of informed consent, while still applying ethical principles including asking for consent before action, research is anonymous, and confidential information is not disseminated.

RESULTS

A 52-year-old woman was reported to have seizures and loss of consciousness. The client has a history of diabetes mellitus and controlled hypertension since 15 years ago, and the client has a history of being hypoglycemia due to diabetes mellitus and Guillain Barre Syndrome (GBS) just a month ago. In addition, the client had undergone Percutaneous Coronary Intervention (PCI) 3 years ago. The incident began with a report received by the health and emergency services unit. The team provided assistance using the emergency nursing care process approach. Assessment was carried out by assessing airway, breathing, circulation, disability, and exposure. In the airway, it was found that there were no airway obstructions, no sounds indicating disturbance, and the client could speak. The client's breathing assessment did not show symptoms of tightness but there was a decrease in oxygen saturation of 91% with a breathing frequency of 18x/minute. Positioning action was given without oxygen assistance for the client.

Circulation assessment showed the client was weak, but there was no decrease in pulse and no signs of shock. However, the family revealed that the client had a seizure 1 hour ago with a duration of 15 minutes. Vital signs examination was conducted with the results of blood

pressure 160/90 mmHg and heart rate 86x/min. In the disability assessment, the client was found to have decreased consciousness with Glasgow Comma Scale (GCS) E2M5V3. The family revealed the client had decreased blood glucose levels. At 12.00 noon the client's blood sugar was 112 mg/dL but at 18.00 the client's blood sugar was 36 mg/dL. A blood glucose check was not done by the staff. When the signs of hypoglycemia appeared, the client refused to eat which was suspected to be the cause of the declining blood glucose level. However, there was no hypoglycemia management given by the staff. In the exposure assessment, a physical examination of the client was conducted. There were no signs of disturbances in other body systems, but both lower extremities were found to have grade 3 pitting edema. The assessment results obtained become the basis of the team's decision for further action. Actions taken during pre-hospital were checking vital signs, positioning to maximize ventilation, maintaining client awareness to maintain airway patency, and watching out for signs of worsening hypoglycemia and recurrent seizures. Comfort and safety principles were applied to position the patient and prevent falls. The client was referred to the emergency department of the nearest hospital. Treatment was stopped when the client was received by another nurse at the hospital.

DISCUSSION

Hypoglycemia can affect patients with diabetes mellitus despite having good glycemic control. In severe hypoglycemia, a person cannot treat it by himself, but needs help. To be able to prevent and limit the occurrence of hypoglycemia, patients with diabetes mellitus need to have good knowledge in recognizing the signs and symptoms and how to provide first aid in hypoglycemia emergencies (AlTowayan et al., 2023). Patients with diabetes mellitus, there is an impaired glucose response that also disrupts the activity of decreased insulin secretion and activation of glucagon-producing alpha cells, as well as sympathoadrenal activation (Iqbal & Heller, 2016). Even if a person experiences hypoglycemia, and then stops or reduces insulin administration, the insulin in the body will remain active in the body even though blood glucose levels continue to decline. The ability of the pancreas to detect hypoglycemia and increase glucagon secretion is also impaired, thus interfering with the ability of the pancreas to restore normal glucose levels by activating glycogen stores (Tesfaye & Seaquist, 2010). Esteves, Neves, Sá, & Carvalho (2018) stated that the most common cause of diabetes mellitus patients experiencing hypoglycemia is due to inappropriate insulin use. Severe hypoglycemia is an adverse event that requires the help of others for management and recovery of symptoms after treatment (Myers et al., 2022). Although many studies have revealed that the management of hypoglycemia requires treatment in hospital emergency departments, emergency treatment by the medical care team is needed (Rodríguez-Gutiérrez et al., 2021).

Hypoglycemia treatment can be done when the patient is at home or before arriving at the hospital emergency department. Research by Kaufmann et al (2019) stated that someone experiencing acute hypoglycemia can be helped at home without the need to be referred to the emergency department, provided there are no other accompanying signs and symptoms that aggravate the problem. However, efforts made also depend on the patient's level of consciousness so that in certain conditions home treatment efforts are not sufficient to restore the client's glucose status in normal conditions (Lowe, Williams, & Claus, 2022). When the patient is conscious and able to protect their airway, oral glucose administration is the recommended treatment to date (Woodburn & Rostykus, 2019). The Clinical Guidelines for Emergency Management Services (2020) recommend 25 g for adults and 0.5-1 g/kg for pediatric patients when blood glucose is less than 60 mg/dL (Dewan et al., 2020). Oral glucose administration can be repeated if hypoglycemia persists. The American Diabetes

Association (ADA) guidelines (2021) for patients with diabetes recommend 15-20 g of oral glucose when blood glucose is <70 mg/dL. This is the equivalent of about 8 ounces of orange juice.

IV dextrose is recommended for unconscious patients. Dextrose should be given gradually until the patient's mental status improves, with a maximum dose of 25 g in adults and 0.5-1 g/kg in children. The concentration of the dextrose solution administered also varies. However, recommendations suggest that concentrations of no more than 25% be used in children less than 8 years old, and no more than 12.5% in neonates and infants less than 1 month old (NASEMSO, 2022). D10 solution is becoming more commonly used due to the lower risk of tissue necrosis in case of extravasation, reduced risk of hypoglycemia due to over-correction of hypoglycemia, and lower cost compared to D50 (Sanello et al., 2018). However, this intervention presents challenges due to difficult infusion access as the patient is dehydrated (Woodburn & Rostykus, 2019).

With limited venous access, including difficulties due to limited space in the ambulance, intramuscular glucagon administration can be used to treat hypoglycemia (Woodburn & Rostykus, 2019). However, this therapy has the side effects of nausea and vomiting, so glucagon administration must be accompanied by airway monitoring (Lowe et al., 2022). Glucagon administration is recommended in a dose of 1 mg for adults and pediatric patients who weigh at least 20 kg (or more than 5 years old), and 0.5 mg for those under 20 kg (or less than 5 years old) (NASEMSO, 2022). Any diabetic patient at risk of severe hypoglycemia should be given intramuscular glucagon provided the family or caregiver can administer it correctly (ADA, 2021). Glucagon releases glucose from internal glycogen stores but does not provide an external glucose supply, thus reducing the effectiveness of glycogen in patients who have previously restricted carbohydrate intake, are malnourished, or fasting (Kahn, Wagner, & Gabbay, 2018; Ranjan et al., 2018). In this case, glucagon or dextrose was not administered due to the difficulty of accessing the intravenous due to dehydration and oedema, the client had also been given sugar solution one hour before the medical team arrived, and the client had not consumed any carbohydrates for more than 6 hours, so it was feared that it would worsen the client's blood glucose.

Metabolic disorders in patients with diabetes mellitus who experience hypoglycemia can lead to seizures. The principle of seizure management is to ensure airway safety and oxygenation. Patients with seizures usually experience hypoventilation, in the fully conscious it is temporary, but on the contrary in the unconscious hypoventilation will worsen. Nonetheless, supplemental oxygen should be administered via nasal cannula or simple mask to ensure adequate oxygen supply to the body (Rheims et al., 2019). This is because during a seizure, there is a dramatic increase in cortical neural activity, metabolism and oxygen consumption which is usually supported by an increase in regional cerebral blood flow, due to neurovascular coupling mechanisms (Smith, Abraham, & Shankar, 2021). As neural activity increases, there is a progressive decrease in brain tissue oxygenation and neurovascular coupling mechanisms are unable to compensate for the metabolic demands of the seizure, and may progressively decrease cardiac output, especially when recurrent seizures occur (Ferlini et al., 2021). The study of Rheims et al (2019) revealed that oxygen administration can increase saturation >91% which has an impact on reducing brain damage and reducing seizure duration 6.4 seconds faster. The use of oximetry is needed to monitor respiratory status. This is followed by rapid blood glucose testing and hypoglycemia management. In the event of a seizure, the use of anti-seizure medication is not meaningful if it is not balanced with controlled glycemic control. Even if the seizure is not due to hypoglycemia, monitoring of

blood glucose levels is necessary to control the glycemic balance in the body, which has a positive effect on improving neurological status (Schauwecker, 2012).

The use of intravenous access in seizure conditions has led to disagreement due to the absence of necessary medications that must be administered intravenously. Intramuscular administration of anticonvulsants is recommended over intravenous administration (Billington, Kandalaft, & Aisiku, 2016). Some studies suggest that blood glucose testing should be done before administering anti-seizure medication (Remick et al., 2017). However, recent evidence revealed that this decision can delay the administration of anti-seizure drugs by at least 5.9 minutes, which will result in further deterioration of the patient's neurological status (Van de Voorde et al., 2021). Therefore, it is important to check blood glucose after administration of anti-seizure medication. In addition, positioning the patient as comfortably as possible is beneficial to help keep the airway open and minimize the risk of falls (Silverman et al., 2017).

CONCLUSION

Emergency hypoglycemia can occur in patients with DM. Late treatment can worsen the client's condition, including seizures and loss of consciousness due to worsening blood glucose levels. Emergency medical services become the main gateway in providing first aid when the family cannot do anything to save the patient before being referred to the hospital. The results of this study showed that pre-hospital measures that can be taken include pharmacological and non-pharmacological efforts. Oral glucose administration can be the initial treatment in conscious hypoglycemia patients. Intravenous dextrose and intramuscular glycogen administration can be another alternative in hypoglycemia. Seizure conditions caused by hypoglycemia or other causes can be managed pre-hospital by administering anti-seizure drugs and ensuring there is no airway obstruction. Oxygen can also be given to ensure oxygen needs are met. Families who have family members with DM need to be aware of the signs and symptoms of hypoglycemia, so health education needs to be provided. In addition, clients and families also need to know pre-hospital management in the event of hypoglycemia so as to prevent worsening from occurring and even cancelling the client being referred to the hospital. This study has limitations, namely the existence of some pre-hospital management that was not carried out. So that in the future it is necessary to review similar cases, and be able to compare the treatment carried out according to the onset of signs and symptoms of hypoglycemia and educate the family about pre-hospital treatment.

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