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Case Report

Diabetes insipidus in patiens with traumatic severe brain injury

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ABSTRACT

Traumatic severe brain injury is a fatal injury, with a mortality rate of up to 50%. About 1.5 million people experience severe brain injury in the United States. There are more than 50,000 deaths and 500,000 incidents of permanent neurological sequelae. About 85% of mortality occurs in the first 2 weeks after the injury. One complication of a severe brain injury is diabetes insipidus. There are no definitive data on the incidence of diabetes insipidus in patients with traumatic severe brain injury of Indonesia so far. In this case report, a male, 45 years old, was taken to the Emergency Installation (IRD) after experiencing a traffic accident 12 hours before being hospitalized. After surgery, the signs of diabetes insipidus was presented by polyuria of 300cc / hour urine production and 149mmol / L hypernatremia, although the immediate administration of desmopressin, the patients clinical and hemodynamic was not shown any improvements. The patient passed away in the days five of treatment in the Intensive Care Unit (ICU). The main treatments for diabetes insipidus in traumatic severe brain injury are adequate rehydration and administration of desmopressin. Adequate hypovolemic, polyuric and hypernatremia corrections are the keys to the successful treatment of diabetes insipidus. Diabetes insipidus in cases of brain injury requires complicated treatment. Therefore, in the case of being handled improperly, it can bring death.

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ABSTRAK

Cedera otak berat traumatis adalah cedera fatal, dengan tingkat kematian hingga 50%. Sekitar 1,5 juta orang mengalami cedera otak berat di Amerika Serikat. Terdapat lebih dari 50.000 kematian dan 500.000 insiden gangguan neurologis permanen. Sekitar 85% kematian terjadi dalam 2 minggu pertama setelah cedera. Salah satu komplikasi dari cedera otak yang parah adalah diabetes insipidus. Tidak ada data pasti tentang kejadian diabetes insipidus pada pasien dengan cedera otak traumatis berat di Indonesia sejauh ini. Pada laporan kasus ini, seorang pria, 45 tahun, dibawa ke Instalasi Rawat Darurat (IRD) setelah mengalami kecelakaan lalu lintas 12 jam sebelum dirawat di rumah sakit. Setelah operasi, tanda-tanda diabetes insipidus ditandai dengan adanya poliuria produksi urin 300cc / jam dan hipernatremia 149 mmol / L, meskipun segera diberikan desmopresin, kondis klinis dan hemodinamik pasien tidak menunjukkan perbaikan. Pasien meninggal pada hari kelima perawatan di Unit Perawatan Intensif (ICU). Perawatan utama untuk diabetes insipidus pada cedera otak berat traumatis adalah rehidrasi dan pemberian desmopresin yang adekuat. Koreksi hipovolemik, poliurik, dan hipernatremia yang adekuat adalah kunci keberhasilan pengobatan diabetes insipidus. Diabetes insipidus dalam kasus cedera otak membutuhkan perawatan yang rumit. Karena itu, jika ditangani dengan tidak tepat, bisa menyebabkan kematian.

Kata kunci : Diabetes insipidus, cedera otak, hipernatremia, desmopressin, ICU

INTRODUCTION

Traumatic brain injury is a fatal injury, with a mortality rate of up to 50%. About 1.5 million people with severe brain injury in the United States have more than 50,000 deaths and 500,000 permanent neurological sequelae (Agha and Thompson, 2006). Approximately 85% of mortality occurs in the first 2 weeks after the injury, which exhibits the initial impact of systemic hypotension and intracranial hypertension (Benvenga et al., 2000).

One of the complications of a severe brain injury is diabetes insipidus. (Agha and Thompson, 2006; Hannon et al., 2012). Diabetes insipidus is a disease caused by the lower production, secretion, and function of Anti Diuretic Hormone (ADH). Kidney abnormalities were marked by the unresponsiveness of physiological ADH stimulation, which is characterized by excessive thirst (polydipsia) and large amounts of urine (polyuria). There is no definitive data on the incidence of diabetes insipidus in patients with severe brain injury in Indonesia so far.

Diabetes insipidus in cases of brain injury requires complicated treatment. Diabetes insipidus can lead to death when handled improperly. Therefore, the authors are interested in discussing the management of diabetes

CASE REPORT

A 45-year-old man was taken to the Emergency Hospital (IRD) Dr. Soetomo after a motorcycle traffic accident 12 hours before being hospitalized. The patient is unconscious since the accident occurred. First aid was given in the previous health facility; RSUD Tuban, thus the patient was referred to IRD Dr. Soetomo.

The patient has attached a collar brace at the arrival in resuscitation room of Dr. RSUD Soetomo. Responding to pain, with the examination of anisocoria round pupils 4/3 mm, both eye light reflexes were decreased. Spontaneous breathing 30 times per minute

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presented with an additional gurgling breath with oxygen saturation of 92% using an oxygen mask of 5 liters per minute. Blood pressure 110/75 mmHg (MAP 86), pulse 120 times per minute. Tip of the extremity were warm, dry and red with an examination of capillary refill time <2 seconds. The right parietooccipital hematoma was found. The patient was immediately suctioned and oxygenated with Jackson Reese 10 liters per minute, a two-lane intravenous line was attached and 30° head-up position. The patient was prepared to be intubated using ETT No.7 and the lip border was 21cm. The ventilator used PCV mode with RR 16, PC 15, trigger 2, I: E 1: 2, FiO2 50%. Reached VTE 406, MV 6.5, frequency 16, and SpO2 100%.

Routine blood laboratory test showed 11.8 hemoglobin, 12,540 leukocytes, 115,000 platelets, HCT 34,1. random blood sugar and kidney function were within normal limits, liver function SGOT 112, SGPT 57, Albumin 3.47. There was an increase in blood sodium 149, while potassium and chloride were within normal limits. The coagulation function was within normal limit. Blood gas analysis showed pH 7.52 with PCO2 25.2, PO2 352.1 HCO3 26.6, BE -2.5, P / F ratio 352, saturation 93%. The following are the results of the patient's radiological examination.

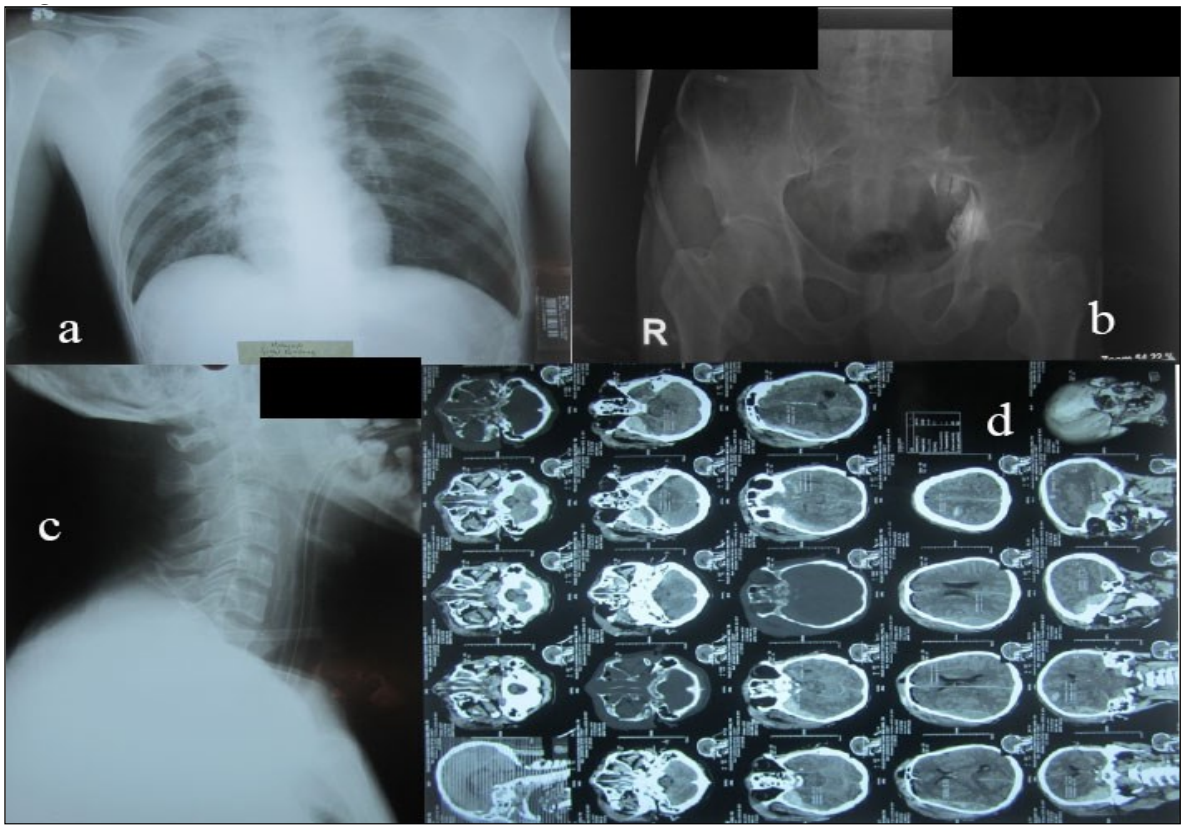

Figure 1. a. Plain Rontgen of Thoraks AP; Cor impression was within normal limits. Pulmo suggests a right lung infiltrate; b. Plain Rontgen of Pelvis presented within normal limits; c. Cervical Lateral Imaging was within normal limits; d. Head CT Scan without contrast: dextral temporo-basal EDH, dextral parietal contusional ICH, IVH, Le Fort II maxillary fracture. EDH = Epidural Hematoma; ICH = Intra Cerebral Hemorrhage; IVH = Intraventricular Hemorrhage.

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Table 1. Liquid balance pre and post operatively

	Pre-operatively	Durante-operatively
Input	RL 1500cc	PZ 1300cc
	PZ 200cc	WB 350cc
		Manitol 200cc
Output	700cc	2000cc
	-	800cc
	-	-
Balance	Excess	Deficit
	1000cc	950cc

On the first day of ICU treatment, the patient shows symptoms of diabetes insipidus with urine production up to 300cc/hour with severe hypernatremia. The diagnosis was carried out by placing CVC to measure central venous pressure and examination of blood electrolyte levels. Furthermore, the diagnosis of diabetes insipidus with Seckl and Dunger was made up by polyuria (> 3L / 24 hours), hypotonic quality of urine (osmolality <300mosm / kg) and plasma sodium concentration> 145 mmol / L. Diagnostic criteria based on Agha et al consisted of polyuria (> 3.5L / 24 hours), diluted urine quality (urine / plasma osmolarity <2), hypernatremia (> 145 mmol / L) and increased plasma osmolarity (> 300mosm / kg). Furthermore, the patient was treated intensively by referring to the protocol of diabetes insipidus by the addition of desmopressin immediately, correcting the hypernatremia and dehydration, and waiting for the results of routine urine laboratory test (UL) and 24 hours urine test.

During the treatment, the patients were unconscious but hemodynamically stable. The administration of desmopressin (DDAVP) and replacement of fluid and dextrose were given. The fluids were crystalloid low in sodium and colloid during hemodynamic instability. The patient was having edema by the use of colloidal fluid, gelofusin. The colloidal fluid led to excessive hypoalbumin and fluid exposure. Hypernatremia correction was done using D5 + insulin 5 units per 500 cc and ringerfundin. This aim to fix the patient's plasma osmolarity. After DDAVP administration, urine production was gradually normal before it dropped from 250 mL/hour to 50-100 mL/hour. However, when DDVAP ran out on the 3rd day, urine production raised so that a rebound phenomenon was found, which led to hypovolemia to hypovolemic shock. The following is a table of the patient's condition progress with a comparison of the fluid out-in curve, the sodium level, and the patient's hemodynamics.

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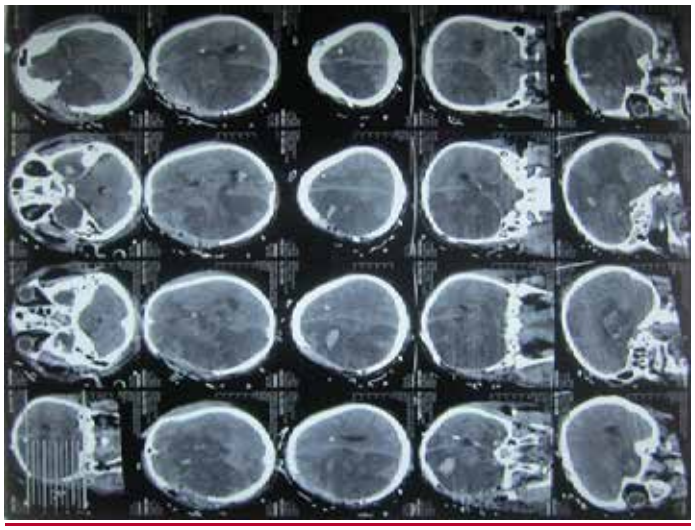

Figure 2. Head CT Scan of postoperative evaluation

Table 2. Follow up of the Clinical Condition of Post Operatively in ICU

Observation	Post Operatively day 0	Post Operatively day 1	Post Operatively day 2	Post Operatively day 3	Post Operatively day 4	Post Operatively day 5
B1	Tube in-free	Tube in-free	Tube in-free	Tube in-free	Tube in-free	Tube in-free
B2	Heart rate 92x/min BP 121/92 (MAP 101)	Heart rate 102x/min BP 100/68 (MAP 78)	Heart rate 74x/min BP 146/98	Heart rate 60x/min BP 121/82	Heart rate 130x/min BP 106/78	Heart rate 96x/min BP 91/74
B3	Sedated Pupil regular anisocor 6/4 Sluggish light reflex	GCS 1X1 Pupil regular anisocor 6/4 Sluggish light reflex	GCS 1X1 Pupil regular anisocor 6/4 Light reflex -/-	GCS 1X1 Pupil regular anisocor 6/4 Light reflex -/-	GCS 1X1 Pupil regular anisocor 6/4 Light reflex -/-	GCS 1X1 Pupil regular anisocor 6/5 Light reflex -/-
B4	300cc/hour	50-100cc/hour	50-100cc/hour	50-100cc/hour	50-300cc/hour	100-200cc/hour
B5	Soefl	Soefl; NGT black	Soefl; NGT black	Soefl; NGT -	Soefl; NGT -	Soefl; NGT -
B6	Edema -	Edema of inferior extremities +/+	Edema of inferior extremities +/+	Edema of inferior extremities +/+	Edema of inferior extremities +/+	Edema of inferior extremities +/+

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Table 3: Fluid follow-up and supporting parameters in the ICU

Balace	Fluid	Post Operatively day 0	Post Operatively day 1	Post Operatively day 2	Post Operatively day 3	Post Operatively day 4	Post Operatively day 5
Input	**-Fluids :**						
	a)PZ	a)1000cc	-	-	-	-	-
	b)RL	-	b) 500cc	-	-	-	-
	c)Ringerfudin	-	c)1000cc	c)1000cc	c)1000cc	c)1000cc	c)1000cc
	d)D5$^{1/2}$NS	d)2900cc	d)380cc	-	-	-	-
	e)D5+insulin 5U	-	e)1000cc	e)1000cc	e)1000cc	e)1000cc	e)1000cc
	f)Gelofusin	-	f)1000cc	-	-	-	-
	g)Clinimix	-	-	-	g) 500cc	g)500cc	-
	h)Albumin	-	-	h)100cc	-	-	-
	-Blood	-			-	-	-
	Transfussion :		a)800cc	-			
	a)WB			b)400cc			
	b)PRC			c) 400cc			
	c)TC						
	-Sonde	-	-	300cc	1050cc	1200cc	1000cc
Output							
	Urine	4000cc	1950cc	2000cc	2200cc	4350cc	2375cc
	Hemorrhage	-	-	-	-	-	-
	NGT	-	1000cc	-	50cc	5cc	-
	Balance	Deficit 100cc	Excess 1730cc	Excess 1200cc	Excess 1300cc	Deficit 655cc	Excess 95cc
	Cummulative Balance	Deficit 100cc	Excess 1630	Excess 2830cc	Excess 4130cc	Excess 3475cc	Excess 4225cc
Blood routine laboratory test		Post Operatively day 0	Post Operatively day 1	Post Operatively day 2	Post Operatively day 3	Post Operatively day 4	Post Operatively day 5
Haemoglobin		11.8	6,6	7,7	12,7	12,5	12,1
WBC		12.540	11.280	9.630	7.810	10.380	9.040
PLT		115.000	29.000	23.000	46.000	27.000	26.000
HCT		34.5	20,5	23,8	36,8	38	38,9
GDA		-	191	152	89	75	140
Kidney Function		Post Operatively day 0	Post Operatively day 1	Post Operatively day 2	Post Operatively day 3	Post Operatively day 4	Post Operatively day 5
BUN		20	33	-	23	27	27
SK		2.2	1,73	-	1,02	1,6	1,89
Serum Electrolyte		Post Operatively day 0	Post Operatively day 1	Post Operatively day 2	Post Operatively day 3	Post Operatively day 4	Post Operatively day 5
Sodium		149	165	164	166	168,8	173,5
Pottasium		3,5	3,8	3,3	2,8	4,04	4,56
Chloride		111	134	133	132	136,4	135
Serum Osmolarity		313,6	352,3	346,74	345,15	351,4	346,41

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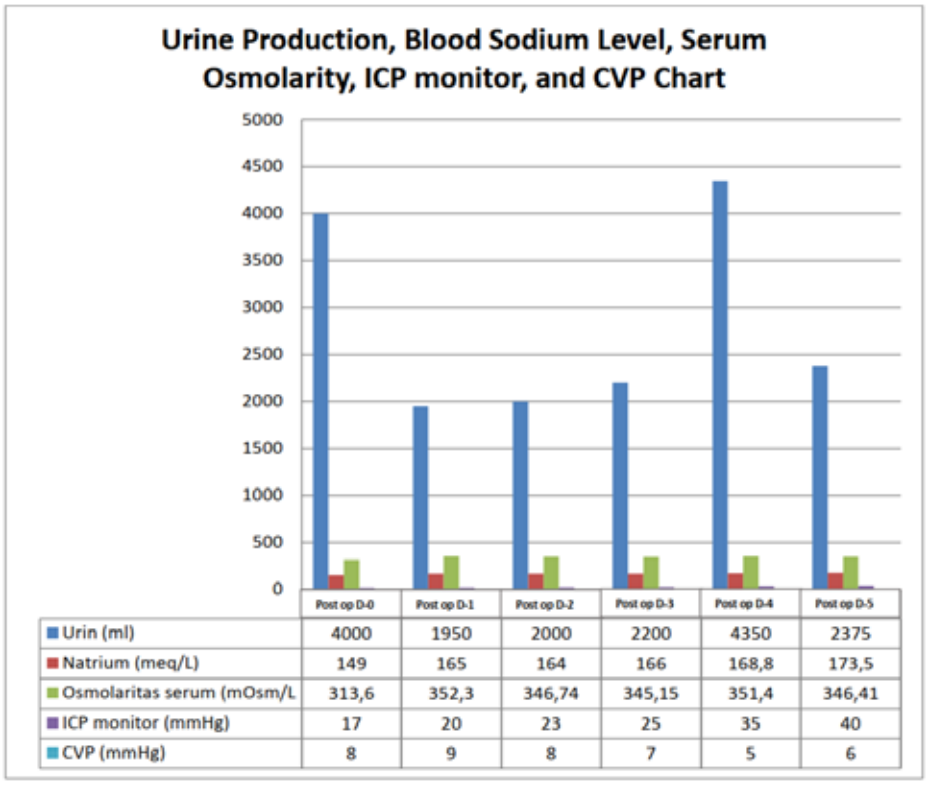

Graphic 1. Urine Production, Blood Sodium Level, Serum Osmolarity, ICP monitor, and CVP Chart

The patient's condition did not show any improvement. The patient was declared to be passed away after the following treatment of 5 days in ICU. We attach a table of patient progress and laboratory test during the treatment in ICU.

DISCUSSION

Diabetes Insipidus is the most common complication that occurs in traumatic severe brain injuries. Approximately 25% of the total population of patients who survived severe brain injury experienced hypopituitarism characterized by a condition of diabetes insipidus. Diabetes Insipidus is a condition with the rise of blood sodium levels, excessive urine production and electrolyte imbalances. It was found that the initial conditions of patients with suspected diabetes insipidus after traumatic severe brain injury were polyuria in the first few hours postoperatively and the imbalance of electrolyte (Sterns, 2015). Table 4 is the differential diagnosis of polyuria and electrolyte imbalance.

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Table 4. Differences between SIADH, Cerebral Salt Wasting, and Diabetes Insipidus

	SIADH	Cerebral salt wasting	Diabetes insipidus
Urin	Oligouria	Polyuria	Poliuria
Cvp	Normal/High	Low	Normal/ Low
Hidrasi	Overhydration	Hypovolemi	Hypovolemi
Osmolaritas plasma	< 275	<275	>295
Plasma ADH	High	Normal	Low
Plasma Na	Low	Normal/High	High
Urine Na	Increase	Increase	Normal
Terapi	Sodium Suplementation,	Rehydrate, Sodium Suplementation, fludrocortison (mineralocorticoid)	Rehydration of 0,45% saline, DDAVP administration (sentral), HCTZ (nefrogenic)

Source: Falvo AJ and Horst M, 2018

Correspond to the algorithm in Figure 3, it was found that an important point in the treatments of diabetes insipidus in post severe brain injury are fluid, DDVAP supplementation and electrolyte correction. (Monson et al. 1989, Benvenga et al. 2000, Agha and Thompson 2006, Sterns 2015). Fluid in the algorithm of diabetes insipidus therapy aims to correct hypovolemia and electrolyte imbalance. It due to fluids can replace water depletion due to large amounts of urination and dilution. As seen in Figure 3, it is stated that during unstable hemodynamics, administration of NaCl 0.9% in correcting hypovolemia is allowed, whereas patients with euvolemia, the fluids should be low sodium levels such as dextrose 5%. Desmopressin (1-deamino-8-D-argininevasopressin, DDAVP) is one of sort of DDAVP in the administration of ADH. It is a drug of choice for long-term therapy of central diabetes insipidus. It can be given parenterally, orally or intranasally. The recommended starting dose is 10 µg at night to reduce the presence of nocturia. This dose can be repeated in the morning if the nocturia still presents in the morning. Finally, this dose of desmopressin must be adjusted to the degree of polyuria. (Falvo AJ and Horst M, 2018).

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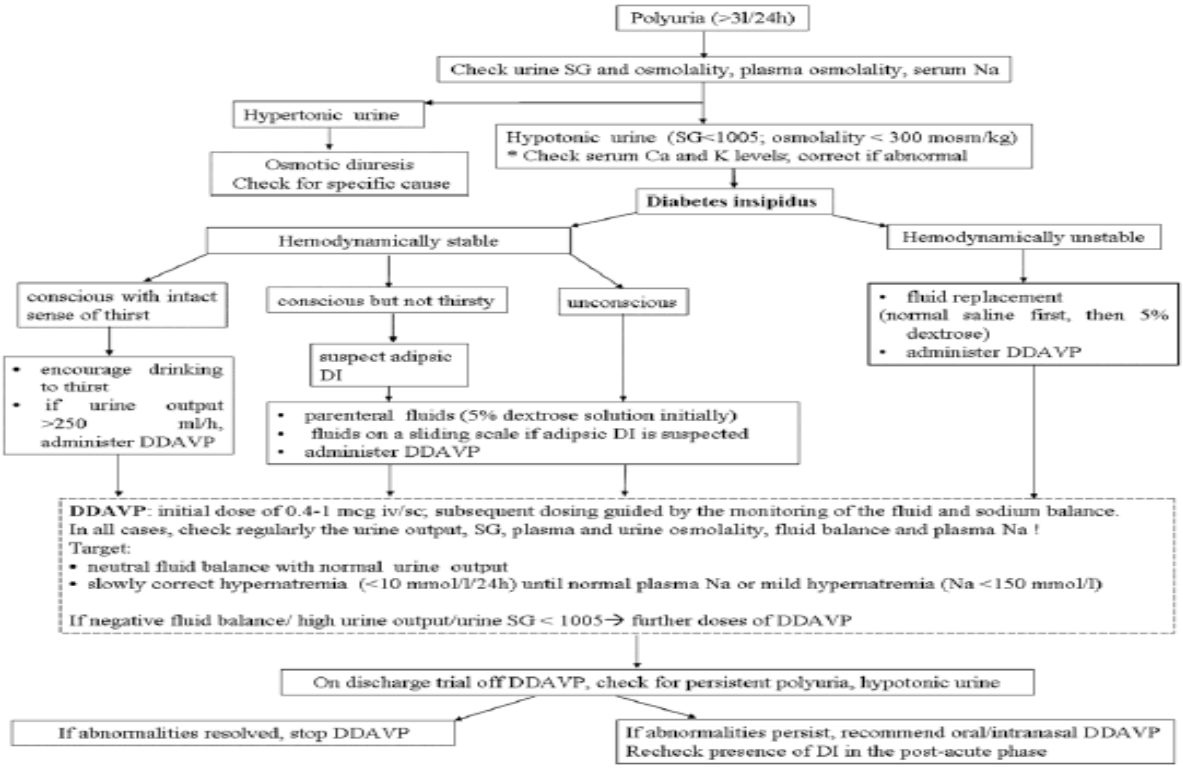

Figure 3. Algorithms for diagnosis and management of PTDI; iv: intravenous; sc: subcutaneous (Capatina Cristina 2015)

Patient's condition was found improved in the day one of care, this was due to early DDVAP administration and adequate rehydration. However, despite giving fluid replacement according to the needs and administration of DDAVP, the patient's hemodynamic parameters declined. One of the causes of deterioration in the patient's condition was a hypoalbumin. It causes intravascular fluid to shift into an interstitial fluid which led to edema, especially in the brain. Furthermore, hypernatremia can cause shrinkage of brain cells and interstitial edema that worsens intracranial pressure. This condition led to the rise of intracranial pressure correspond to the occurrence of herniation altogether with diabetes insipidus. Patient consciousness was not getting any improvement in this stage.

As a result, hypovolemia and neurogenic shock occurred. The death of the patients was related to hypovolemic shock and brain herniation that could not be handled properly. Clinically, the patient was not getting any improvement. Hemodynamics went down and MAP was not achieved. The results of the laboratory test were hypernatremic. A few days later, the symptoms of polyuria began to appear along with unstable hemodynamics. Fluid replacement and inotropic support were performed but the results did not show any improvement. Likewise, the laboratory test result appeared in hypernatremia and higher osmolarity. The patient could not survive and was declared in passed away on the day five of treatment. According to the literature, the mortality rate of severe brain injury patients with early onset reaches 85%. No one survived, even for patients with hypernatremia > 160 mmol / L

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CONCLUSION

Although treatment is difficult, diabetes insipidus in cases of traumatic severe brain injury should be initiated at the beginning of the postoperatively period. The main keys in managing diabetes insipidus after traumatic brain injury are the problem identification and polyuria monitoring, the management of electrolyte balance, and well hemodynamic preservation of patients. The main treatments are adequate rehydration and initial administration of DDAVP to control polyuria, correction of hypovolemia, and correction of hypernatremia. In addition, the general condition and initial modality of the patient are also the keys to the success of treatment in ICU.

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