World Journal of Biology Pharmacy and Health Sciences
eISSN: 2582-5542
Cross Ref DOI: 10.30574/wjbphs
Journal homepage: https://wjbphs.com/

(REVIEW ARTICLE)

An audit on the management of hypernatremia in a district general hospital in the UK

Indrajit Talapatra *

Department of Diabetes and Endocrinology, Royal Albert Edward Infirmary, Wigan, WN1 2NN, UK.

World Journal of Biology Pharmacy and Health Sciences, 2022, 12(02), 067–072

Publication history: Received on 08 October 2022; revised on 12 November 2022; accepted on 16 November 2022

Article DOI: https://doi.org/10.30574/wjbphs.2022.12.2.0198

Abstract

There are no specific clinical features of hypernatremia (raised serum sodium). It is usually diagnosed incidentally on blood testing. Other biochemical parameters for renal function, hyperglycaemia and hypercalcaemia also need to be checked. The underlying cause of hypernatraemia needs to be identified and in the process the plasma and urine osmolalities need to be measured. Hypernatraemia can lead to serious complications including subarachnoid and subdural bleed resulting from rupture of bridging veins and dural sinus thrombosis, leading to brain damage or death. Also, rapid correction of chronic hypernatremia causes cerebral oedema, seizure, and brain damage. Therefore, proper management of hypernatraemia is very important and fluid management should correct both circulating volume & water deficits. Hypernatraemia should be corrected gradually over 48-72 hours, particularly in longer and unknown duration.

Keywords: Hypernatraemia; Osmolality; Hypovolaemia; Water deficit

1. Introduction

Hypernatraemia, if severe, can be life threatening [1,2]. Hence proper management of hypernatraemia is very important in clinical practice. Hypernatraemia results from a deficit of water relative to sodium and can include causes like free water losses, inadequate free water intake, and, more rarely, sodium overload (3). It is defined as a serum sodium of greater than 145 mmol/l (3). The classification is controversial with no consensus; the most accepted classification is: Mild (serum sodium 146-150mmol/l), Moderate (serum sodium 151-160 mmol/l) and Severe (serum sodium more than 160 mmol/l).

- The underlying cause of hypernatraemia needs to be detected. The plasma and urine osmolalities therefore need to be measured (4,5).
- If the urine output is diminished and urine osmolality more than 800 mosmol/Kg, the likely cause is extrarenal water loss or reduced water consumption (5)
- If the urine output is high and urine osmolality low, with urine osmolality less than serum osmolality, the likely cause is diabetes insipidus (cranial or nephrogenic) (5)
- If the urine output is high along with high urine osmolality, the likely cause is osmotic diuresis (can result from urea, glucose, mannitol) (5)
- Fluid management should aim to correct both circulating volume & water deficits (5)
- If patient is also hypovolaemic, then urinary output and renal function are to be monitored (4). Hypovolemia is a common cause of hypernatremia in elderly demented patients
- The underlying cause once identified is to be treated. This is as important as treatment of hypernatraemia.
- If diabetes is simultaneously present, then blood glucose monitoring is required and if the blood glucose is >30mmol/L then the HHS (hyperglycaemic hyperosmolar state) guideline is to be followed

* Corresponding author: Indrajit Talapatra
Department of Diabetes and Endocrinology, Royal Albert Edward Infirmary, Wigan, WN1 2NN, UK.

- In complex cases, the free water deficit can be calculated, and this will help to guide the rate of water replacement. The best fluid to replace the deficit is 5% Dextrose
- Serum sodium should not decrease by more than 10-12 mmol/l over 24 hours.

Aim

High serum sodium or hypernatraemia is quite common in medical practice. The aim of this audit was to find out if patients admitted with hypernatraemia are being managed properly in our hospital

2. Material and methods

NICE (National Institute of Health and Care Excellence), UK Guidelines are not available for the management of hypernatraemia in adults. The Guidelines of UHL (University Hospital of Leicester, revised in 2020), GGC (Greater Glasgow and Clyde, last reviewed in June 2021) and the Guidelines mentioned in BMJ (2019, last reviewed on 19th December 2021) were taken into consideration for the purpose of the audit, I studied the biochemical details of all patients on all Wards on our Electronic Health Information System between 7th January and 31st January 2022 for the purpose of the audit. Next, I made a list of all patients with hypernatraemia and looked carefully into their management plan

2.1. Criteria/Recommendations (1-5)

- Clinical hydration status, and urine output are to be assessed
- Serum urea and electrolytes, glucose, bone profile, serum osmolality and urine osmolality are to be checked in all cases
- If hypovolaemia is present, to administer normal saline as first line fluid replacement (5)
- If and when ECFV (Extracellular Fluid Volume) is normal, to administer 5% dextrose (5)
- Summary of management: Mild cases of hypernatraemia – to replace missing body water with oral water (not electrolyte drinks) or IV 5% Dextrose. In moderate or severe cases of hypernatraemia – to give Dextrose 5% IV unless the patient is volume depleted and hypotensive, in which case to give sodium chloride 0.9% IV
- To reassess clinically and repeat sodium and serum osmolality in 8 hours, if hypernatraemia is mild, in 4-6 hours if moderate (5)
- To discuss with on-call Senior Medical Doctor for advice, if hypernatraemia is severe
- Hourly input and output fluid charts are needed, if hypernatraemia is moderate or severe
- In severe hypernatraemia, close monitoring of fluid balance and electrolytes in HDU or ICU is advised
- In known cranial diabetes insipidus, to ensure desmopressin is being administered and to consider referral to endocrinology
- Decrease in serum sodium should not be by more than 10-12 mmol/l over 24 hours
- Free water deficit is to be calculated. Overall, it is a common practice for half of the free water deficit to be given in the first 24 hours, with the remaining half to be given in the next 24- 48 hours (See Appendix1)
- Sodium Chloride 0.45% Solution for Infusion is indicated for the treatment of hypertonic extracellular dehydration or hypovolaemia in cases where the intake of fluids and electrolytes by normal routes is not possible (6).

Treatment Principles thus include

- Restoration of Extracellular Fluid Volume
- Replacement of water deficit
- Treatment of cause

Treatment of Hypervolaemic Hypernatraemia is to be done with IV Dextrose and Frusemide

Hypervolemic hypernatremia can be corrected by ensuring that the negative Na (+) and K (+) balance exceeds the negative water balance. These difficult conflicting therapeutic goals are typically approached by administering intravenous 5% Dextrose and Furosemide (7).

If the patient is hypovolaemic or in shock or haemodynamically compromised, after administering enough normal saline till ECF volume is restored, some articles mention of use of dilute solutions (0.45% saline or 0.18% saline with dextrose) which can be substituted once tissue perfusion is adequate (8).

3. Results

- Total number of patients: 26
- Results: Age: 70-79 =2; 80=89=16; >90=8

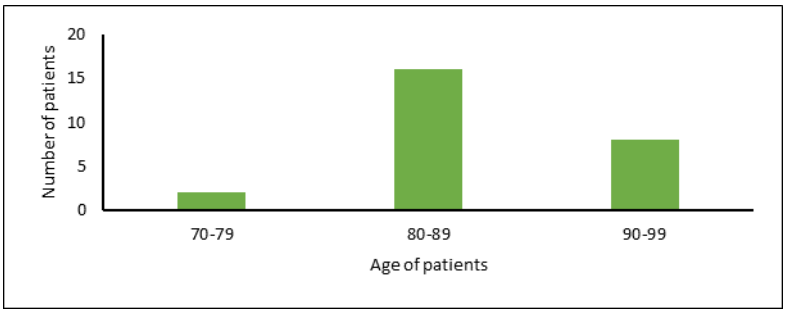

Figure 1 Age distribution

- Sex: Male: Female 11 (42.3%):15 (57.7%)

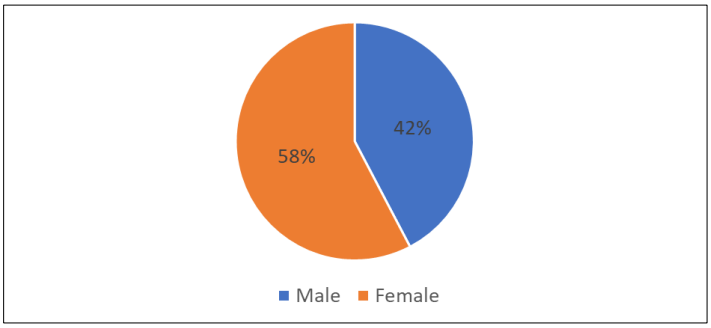

Figure 2 Gender distribution

- Hypernatraemia- Classification: Mild: 9 (34.6%); Moderate:11 (42.3%); Severe: 6 (23.1%)
- Patients with dementia: 13/26 (50%)
- If blood glucose and bone profile have been measured
- Bone profile: 20/26 (76.9%); Capillary blood glucose 100% (26/26)

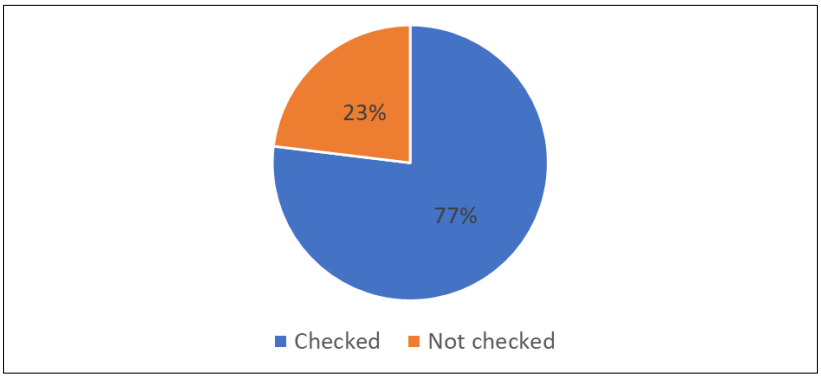

Figure 3 Patients with bone profile checked

- Patient with HHS =0
- Intake/Output monitored: 26/26 (100%)
- Serum Osmolality measured: 2/26 (7.7%)

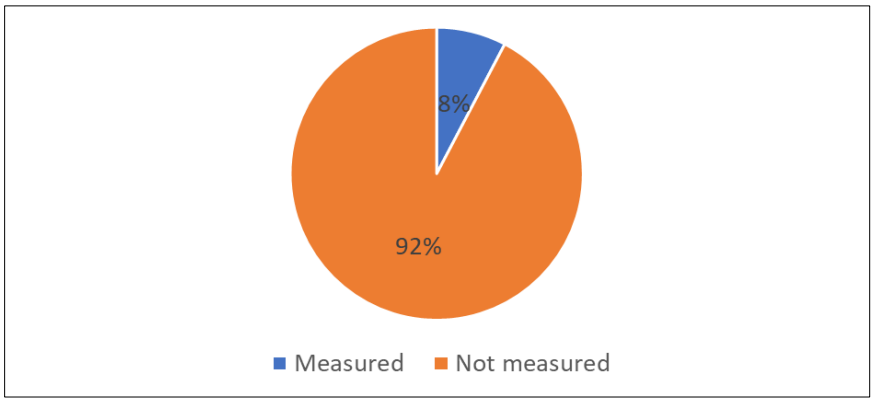

Figure 4 Patients with serum osmolality measured

- Urine Osmolality measured: 1/26 (3.8%); Urine Sodium: 0/26

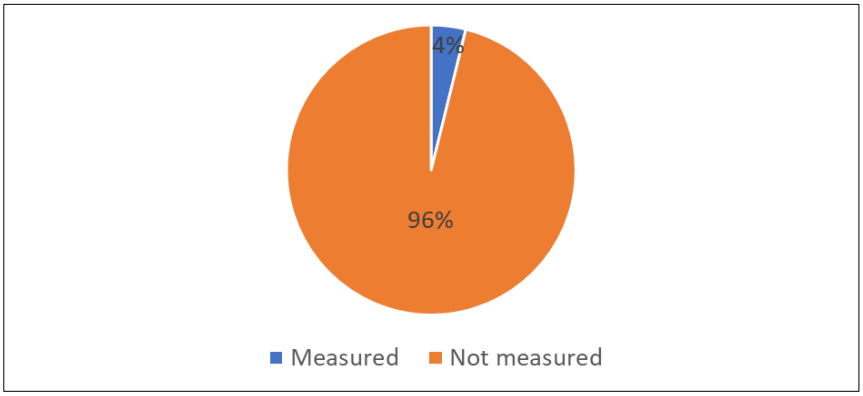

Figure 5 Patients with Urine Osmolality measured

- Water deficit calculated: 0/26
- Clinical hydration status- mentioned: 8/26 (30.8%)

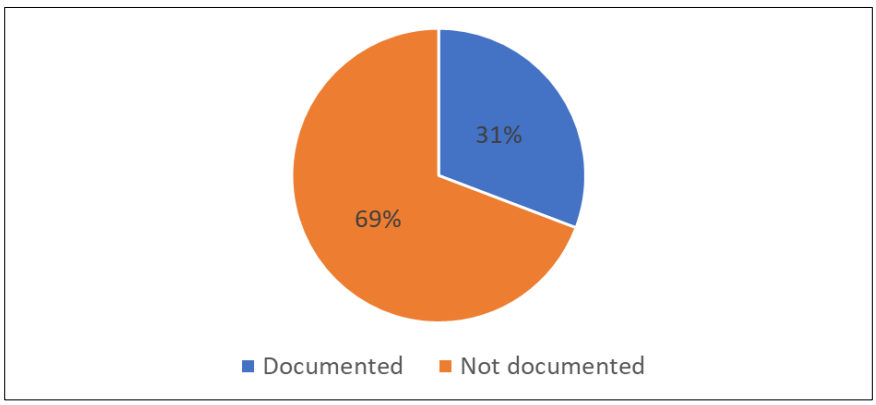

Figure 6 Patients with hydration status documented

- If hypovolaemic- whether 0.9% Saline was given= 11/26 or 42.3% (initially Normal saline followed by 5% Dextrose in 2 cases); hydration status mentioned in 5 patients
- 0.45% Saline alternating with 5% Dextrose: 1/26 (hydration status mentioned)

- Whether only 5% Dextrose was given= 12 or 46.2%; (hydration status mentioned in 2 patients); 3 other patients received 5% Dextrose as above where 5% Dextrose was used following 0.9% or 0.45% Saline (Total 15/26 or 58%)
- Oral fluids: Total 2/26 in total or 2/9 cases of mild hypernatraemia (22%)

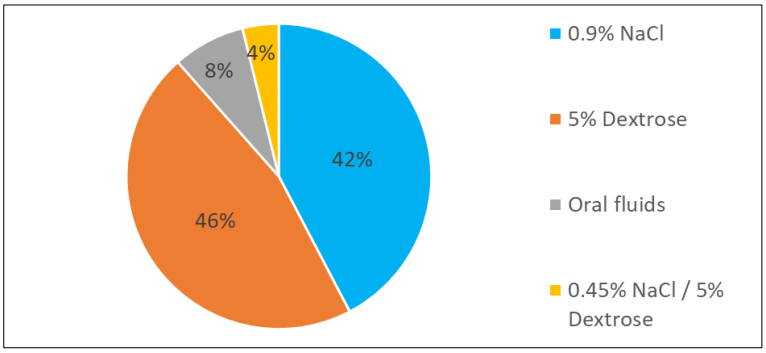

Figure 7 Fluids administered in the patients

- If the patients were re-assessed clinically and with measurement of serum osmolality and sodium in 8 hours in mild hypernatraemia= 0/9 and in 4-6 hours with moderate hypernatraemia= 0/11
- Decrease in Serum sodium by <10 mmol/l over 24 hours: 100%
- Whether the Medical Registrar or senior doctor was involved in severe hypernatraemia: 5/6 (83.3%)
- After correction of hypernatraemia with IV fluids- 1 patient was put on Desmopressin followed by Amilioride; Diabetes Insipidus was suspected and was referred to Endocrinology. This patient was transferred initially treated on ITU

3.1. Summary of results

- 50% of the patients in the study had dementia
- Serum Calcium was measured in approximately 77% of patients
- Serum Osmolality was calculated in 7.7% of patients
- Urine Osmolality was calculated in 3.8% of patients
- Free Water deficit was not calculated in any patient (0%)
- Hydration status was mentioned in 31% patients
- 5% Dextrose only was given in 46% patients
- Normal Saline was administered in 42% patients
- Proper clinical re-assessment and measurement of serum osmolality and sodium were not done after the required time (8 hours in mild, 4-6 hours in moderate cases) following administration of fluids in any patient.

4. Discussion and Recommendations

- Hydration status is to be documented in all cases
- Serum calcium is to be measured in all patients
- Serum Osmolality is to be calculated in all patients
- Urine Osmolality and sodium are to be measured in all patients
- Free Water deficit is to be calculated. Half of it is to be administered in the first 24 hours and the remaining half in the next 24 to 48 hours
- Reduction in Serum sodium not to exceed 10-12 mmol/l over 24 hours
- 0.9% Saline is to be given if the patient is hypovolaemic
- Otherwise, 5% Dextrose is to be given and is the fluid of choice
- Orally water may be effective sometimes in mild hypernatraemia
- Proper Clinical re-assessment and measurement of serum osmolality and sodium are required after 8 hours in mild hypernatraemia and 4-6 hours in moderate hypernatraemia
- Severe hypernatraemia is to be reviewed by a senior doctor and if necessary, will need ITU admission.
- Our own hospital guidelines need to be developed for management of hypernatraemia
- Re-audit in 1 Year

5. Conclusion

The audit revealed that most of our patients were elderly with 50% having dementia. Although we were successful in most cases to provide the right fluid administration, there were certain areas where we would need to improve our performance in future and hence would require performing a re-audit in 1 year. This audit also aims to help the society in understanding the significance and complications of high serum sodium encountered in common medical practice and the way forward to managing such patients as mentioned above.

Appendix 1 (5)

Calculation of Free Water deficit

$$\text{Free Water deficit} = (\text{measured } [Na^+]/140 \times \text{TBW}) - \text{TBW}$$

TBW (Total Body Water) = Body Weight x 0.6 (males) or 0.5 (females); If elderly, use 0.5 for males and 0.45 for females

Example 1: In a 75 kg male patient with a serum sodium of 170 mmol/l

$$\text{Water deficit} = (170/140 \times 0.6 \times 75) - (0.6 \times 75) = 54.6 - 45 = 9.6 \text{ L}$$

Half of this free water deficit is to be given in the first 24 hours, with the remaining half to be administered in the next 24- 48 hours

Example 2. In a 60 kg female patient with a serum sodium of 160 mmol/L:

Using the same Formula

$$\text{Free water deficit} = (160/140 \times 0.5 \times 60) - (0.5 \times 60) = 34.3 - 30 = 4.3 \text{ L}$$

Half of the free water deficit is to be administered in the first 24 hours, with the remaining half to be given in the next 24 hours

Compliance with ethical standards

Acknowledgments

I like to acknowledge all my Endocrine colleagues and the Secretaries for helping me with the data collection towards preparation of the audit.

References

[1] Kim SW, Hypernatremia: Successful treatment. Electrolyte Blood Press. 2006; 4(2): 66–71

[2] Sonani B, Naganathan S, Al-Dhahir MA, Hypernatraemia: NIH. National Library of Medicine; July2022

[3] Hypernatraemia Guidelines, BMJ Best Practice; Feb2019 https://bestpractice.bmj.com/topics/en-gb/1215

[4] Management of Hypernatraemia. Adult Therapeutics Handbook. NHS Greater Glasgow and Clyde; June2021 https://handbook.ggcmedicines.org.uk/guidelines/electrolyte-disturbances/management-of-hypernatraemia/

[5] Hypernatraemia Guidelines UHL: University Hospital of Leicester NHS Trust; Jan2020 http://www.library.leicestershospitals.nhs.uk/PAGL/Shared%20Documents/Hypernatraemia%20UHL%20Guideline.pdf

[6] EMC. Sodium Chloride 0.45% solution for infusion. https://www.medicines.org.uk/emc/product/1869/smpc#gref

[7] Nguyen MK, Kurtz I, Correction of hypervolaemic hypernatraemia by inducing negative Na+ and K+ balance in excess of negative water balance: a new quantitative approach. Nephrology Dialysis Transplantation 2008; 23 (7): 2223–2227

[8] Guidelines on management of hypernatraemia. Children's Kidney Centre, University Hospital of Wales, Cardiff; Nov 2007.