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Prevalence of hyponatremia in acute medical admissions in tropical Asia Pacific Australia

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ABSTRACT

Objective: To determine prevalence of hyponatremia in acute medical admissions in Northern Australasia. **Methods:** We studied 469 consecutive acute medical admissions to a hospital in Australia's Far North Queensland during the colder months of June and July 2012. Prevalence of hyponatremia and its relationship with gender, age, diagnosis and prognosis in acute medical admissions were investigated. **Results:** On admission, hyponatremia (plasma sodium <136 mmol/L) was present in 39.4% of patients, with mild (130-135 mmol/L), moderate (126-129 mmol/L) and severe (<126 mmol/L) hyponatremia being present in 25.2%, 10.7% and 3.6% respectively. Overall, adding together admission hyponatremia with that developing during admission, 45.2% of patients were affected with 11.5% moderate hyponatremia cases and 4.1% severe ones. Hypokalemia and hyperkalemia were present in 17.0% and 18.1%, respectively. Overall, 275/469 patients (58.6%) presented with an electrolyte abnormality. There were significant correlations of hyponatremia with age but not with gender and in-hospital mortality. Prevalence of hyponatremia was high across all diagnostic categories. **Conclusions:** The prevalence of hyponatremia appears to be high in the tropical North Australian population, being the highest prevalence reported amongst acute hospital admissions. The previously reported correlations with age and mortality do appear to hold good for this population with a high prevalence of electrolyte disorders. Further prospective analysis on a larger population in the area is needed to confirm our findings.

1. Introduction

Hyponatremia is the commonest electrolyte abnormality and is frequently encountered in hospitalized patients[1-3]. However, its prevalence of acute admissions in specific patient groups particularly in the area at risk of tropical infectious diseases[4,5] is surprisingly poorly documented. Although patients often do not report symptoms of hyponatremia, it is not a benign condition being associated with abnormalities in physical and mental function[6], increased morbidity and mortality[7-9], and increased in-hospital costs[9-10]. Patients with mild hyponatremia frequently present again with more severe disturbance if a diagnosis is not made and the abnormality is not corrected[11]. Uncertainty about the prevalence of hyponatremia in hospital patients has arisen because of differences in definition and differences in populations studied, leading to estimates of between 2.5% and 30.0%[2]. In a large database study in Singapore[12], 28.2% of acute hospital admissions were hyponatremic, while a further 14.4% developed hyponatremia during their admission. To our knowledge, there are no published studies of the prevalence of hyponatremia in hospitalized patients in tropical Asia Pacific Australia. A substantial proportion of the land mass of Australia is subtropical or tropical, and thus a significant proportion of the Australian population might be at high risk of electrolyte disturbances. This study was carried out in tropical Far North Queensland where the population is expanding rapidly. We hypothesised that the prevalence of hyponatremia amongst patients admitted as medical emergencies would be high. Further, we

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investigated the relationship between hyponatremia and age/gender, underlying diagnosis and prognosis.

2. Materials and methods

The study was carried out at the Townsville Hospital, a 580 bed public tertiary hospital in tropical North Queensland after obtaining ethics approval. The patients were consecutive admissions to the Emergency Medical Unit during colder months of June and July. All patients admitted during this period were included, and all patients had plasma electrolytes measured on admission. Age, gender and diagnosis were noted for each patient. When there was a difference between provisional diagnosis on admission and discharge diagnosis, the latter was used. Electrolytes were measured in the hospital laboratory (Queensland Health Pathology Service) and results were obtained by querying the pathology database (Auslab). Normal ranges for plasma sodium and potassium were 136–145 mmol/L and 3.6–4.5 mmol/L respectively. For the purposes of this study and in keeping with previous work[2,13,14], hyponatremia was defined as plasma sodium of less than 136 mmol/L. We used the following ranges: mild hyponatremia, 130–135 mmol/L; moderate hyponatremia, 126–129 mmol/L; and severe hyponatremia, <126 mmol/L.

Analysis of the possible influence of age was undertaken with patients divided into quintiles according to their age at the time of admission. For diagnosis, patients were classified according to the predominant system which was affected by their diagnosis. The metabolic category included those admitted with fluid and electrolyte disorders as the predominant working diagnosis. The social category included not only patients who could not cope at home but also those who presented with relatively minor symptoms (e.g., dizziness or falls) but required admission on the grounds of age, infirmity, or home circumstances. The various category included diagnoses which did not occur sufficiently frequently to allow analysis on themselves. This included hematological, oncological and musculoskeletal diagnoses. Statistical analysis (*t*-test, ANOVA, and chi-square test) was carried out using SPSS version 16.

3. Results

The patients included in the study were 436 consecutive admissions with acute medical problems. They were 234 women and 235 men with a mean age of 67.4 years (range 16 to 97 years). The prevalence of hyponatremia is shown in Figure 1. On admission, 185 (39.4%) presented with hyponatremia, including 118 (25.2%) mild cases, 50 (10.7%) moderate cases and 17 (3.6%) severe cases. The corresponding figures for mild, moderate, and severe hyponatremia developing during the period of admission were 21 (4.50%), 4 (0.85%) and 2 (0.42%), respectively. In all, 212/469 (45.2%) of patients had hyponatremia with 54 (11.5% of all patients) having moderate hyponatremia and 19 (4.1%) having severe hyponatremia. The prevalence of hypernatraemia on admission was low (3/469, 0.64%). On admission, hypokalemia (plasma potassium <3.5 mmol/L) was present in 80 (17.1%) patients, 43 of whom had normal plasma sodium. Hyperkalemia (plasma potassium >4.5 mmol/L) was present in 85 (18.1%) patients, 41 of whom had normal plasma sodium. A total of 275 of the 469 patients (58.6%) had an abnormality of sodium, potassium, or both.

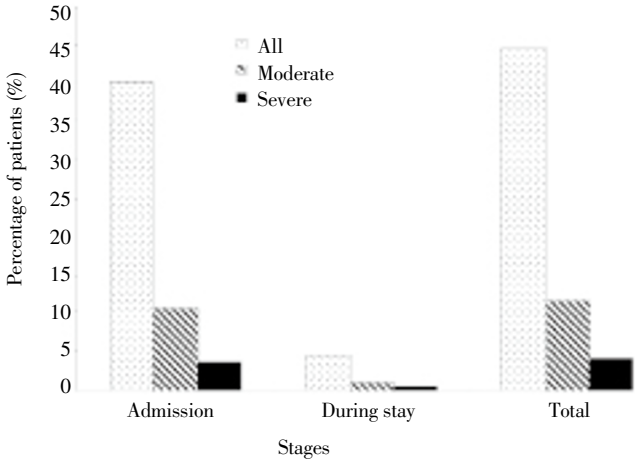

Figure 1. Prevalence of hyponatremia.
The prevalence of hyponatremia (plasma sodium <136 mmol/L), especially moderate (<130 mmol/L) and severe (<126 mmol/L) cases, is shown.

We sought to determine whether admission hyponatremia related to gender, age, underlying diagnosis, and in-hospital mortality. Hyponatremia was present in 91/234 (38.9%) women with moderate and severe hyponatremia occurring in 23 (9.8%) and 9 (3.8%) respectively. The corresponding figures for men are 97/235 (41.2%), 23 (9.8%) and 9 (3.8%), respectively. There was no significant difference in hyponatremia incidence according to gender. Age however did affect the risk of a patient having admission hyponatremia. The prevalence of hyponatremia was 5.1% (24/496), 6.4% (30/496), 13.0% (61/496)and 14.9% (70/496) in the <30, 31–50, 51–70 and >70 age groups, respectivley. Furthermore, there was a significant difference between the admission sodium and quintiles of increasing age ($P<0.05$). The underlying diagnosis did not appear to have a major effect on the prevalence of hyponatremia at presentation (Figure 2). The metabolic group had a high prevalence, but the patients who were admitted with electrolyte disorders as their primary diagnosis were placed in this group. Those with cardiac and neurological groups had slightly lower prevalence of hyponatremia. More severe degrees of hyponatremia were also fairly evenly distributed across diagnostic categories (except metabolic), and 21 of the 469 patients died during their hospital admission. The

prevalence of admission hyponatremia in these patients was 12/21 (57.1%) compared with 176/448 (39.3%, P=0.102 in chi-square test) for the patients who survived their admission.

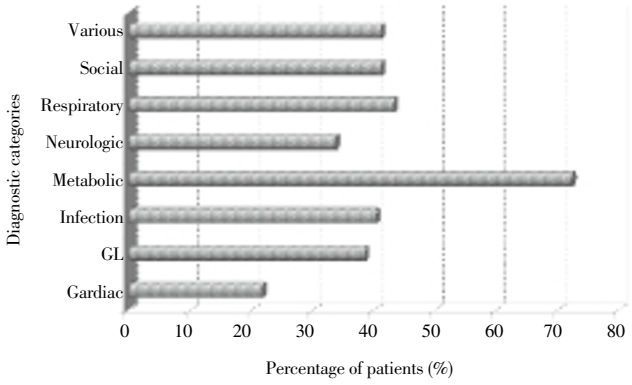

Figure 2. Influence of underlying diagnosis.
The figure shows the prevalence of hyponatremia (plasma sodium <136 mmol/L) on admission.

4. Discussion

We reported a very high prevalence of hyponatremia in peak winter months amongst patients admitted to an acute medical unit in tropical Asia Pacific Australia. This electrolyte abnormality is known to be common[1-3], although prevalence rates amongst acute medical admissions in our region are not well documented. A conservative estimate of prevalence is 2.5%[2], although two fairly recent studies have suggested that the prevalence approaches 30% in patients hospitalized for any reason[12,15]. The study by Hawkins was based on querying a pathology database and did not include clinical data[12]. However, its findings are relevant to the present study as it was carried out in Singapore which has a climate similar to the setting of the present study. Our prevalence of hyponatremia was high in spite of the fact this preliminary study was carried out in the colder months of the year (mean daytime maximum temperature 20-24 ℃) when the mean serum sodium is reported to be lower[16,17], although study in Hong Kong did not find such seasonal variation[18]. Background serum sodium status may be chronically low in tropical populations[16,17]. The reason for this is not clear. However, our population, predominantly Caucasian, may suggest relative poor adaptation to conserve fluid and electrolyte status in the face of high temperatures and humidity in the region[5,17]. Hoorn *et al*. reported a high prevalence of hyponatremia (30%) in patients hospitalized in the Netherlands[15], but their study included hospital-acquired cases and there was almost certainly a selection bias since only 54% of the patients in their study actually had sodium levels measured. Unlike the two studies recently published[14,19], we reported a low incidence of hospital-acquired hyponatremia which is usually due to administration of hypotonic fluids[19] and adversely affects prognosis of admitted patients[19,20]. Even mild hyponatremia should be taken seriously, as it may be the precursor to more severe hyponatremia[11] and is associated with increased length of stay in hospital, increasing costs by up to 50%[9,10].

Hyponatremia is also associated with other electrolyte abnormalities, including those of potassium balance[21] as reported here. Overall, more than half of our patients had abnormal sodium or potassium on admission. It may be that the normal range for plasma sodium should be reconsidered for our population - however to do so would require an evidence that mild hyponatremia (as currently reported) does not carry adverse consequences. The poor prognosis associated with low sodium[7,8] is not only related to the electrolyte abnormality per se or attempts to correct it (which can cause osmotic demyelination if sodium is corrected too quickly)[13,14] but also related to the underlying diagnoses. Cardiac failure, hepatic cirrhosis and renal failure may all be associated with worse prognosis when plasma sodium is low. In our study, there was a non-significant tendency for patients who died to have lower sodium. This may reflect the size of our study, but it certainly does not appear that low sodium is a major determinant of prognosis.

Our study has also revealed in keeping with previous findings of hyponatremia more common in the elderly[12,22] because of a higher prevalence of underlying causes including cardiac failure and also usage of drugs which provoke syndrome of inappropriate anti-diuretic hormone[23]. Recently recognised risk factors for hyponatremia in hospitalized patients include increased C-reactive protein and the use of insulin, antibiotics, and opioids[24]. The lack of gender predilection in our report is in agreement with the findings of Hawkins[12], although women may be at greater risk of the neurological consequences of hyponatremia[25,26]. We grouped patients into diagnostic categories. Hyponatremia was common in all categories, even in patients who presented with what appeared to be a non-severe illness. The cause of hyponatremia was only investigated in those with severe disturbance. It is not always possible to assign a precise diagnosis as multiple factors are often involved (fluid loss, poor intake, drugs, and syndrome of inappropriate anti-diuretic hormone caused by underlying problems). It is becoming more important to assign a diagnosis to hyponatremic patients, as the poor prognosis of the condition is increasingly appreciated and as vasopressin receptor antagonists, which help at-risk patients excrete a water load, are being more widely used[27,28].

Our study faced with several limitations in addition to what had been highlighted already. First, it covered 2 months instead of a longer duration sufficient to draw a conclusion. However, being preliminary study, the observation derived from it will call for further investigation which may lead to a firmer conclusion. Second, in presenting our findings, it is important to note that there is a limitation to retrospective

studies in general. Observations from such studies may contain some missing information and thus may serve as a stimulus to further prospective work to clarify findings. The present work must be interpreted in the knowledge of the defects inherent in such studies. Nevertheless, our results are generally consistent with other reports[2,12].

From this observational study, we reported that the prevalence of hyponatremia is exceptionally high amongst tropical Asia Pacific Australia residents with an intercurrent medical illness. Furthermore, the previously reported associations with old age and in-hospital mortality appear to hold for this population. Further studies are required to determine the seasonality of hyponatremia, its consequences and its optimum management in tropical North Australia.

Conflict of interest statement

We declare that we have no conflict of interest.

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