








Research Article

Approach to Metabolic Causes of Confusion – A Practical Guidebook

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Abstract: Presentation of patients in emergency situations can be varied, with confusion being an important management dilemma. Although confusion is usually attributed to neurological conditions, metabolic causes of altered consciousness are important but often overlooked. Moreover, a practical guide for treatment of confusion in patients especially in emergency situations is vital to facilitate prompt management leading to reduction in morbidity and mortality. Therefore, the objective of this study is to design a guidebook for practical approach to patients with confusion due to metabolic conditions. As a result, a guidebook compiling important metabolic causes of confusion, detailing the spectrum of presentation, diagnostic criteria and succinct management algorithms. This novel approach aims to provide medical doctors with a focused and comprehensive guide in dealing with metabolic causes of confusion in a proactive manner as opposed to the traditional reactive method and tailored to local requirements. This guide contains three main metabolic categories: disorders in calcium, sodium and glucose metabolism, with seven subcategories: hypocalcaemia and hypercalcaemia, hyponatraemia and hypernatraemia, hypoglycaemia, and hyperglycaemic emergencies constituting of diabetic ketoacidosis (DKA) and hyperglycaemic hyperosmolar state (HHS). The innovation facilitating doctors managing patients in a prompt and focused approach is imperative to prevent complications and reduce mortality. This guidebook is a compendium of the more important metabolic derangements leading to confusion, with practical approach to management, aiming to aid health-care workers to recognize and deliver early and prompt treatment of these conditions

Keywords: confusion; metabolic emergencies; management algorithm; hypocalcaemia; hypercalcaemia; hyponatraemia; hypernatraemia; hypoglycaemia; diabetic ketoacidosis (DKA); hyperglycaemic hyperosmolar state (HHS)



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1. INTRODUCTION

Confusion is a state of altered mental status, and as a clinical feature presents a huge challenge in the recognition, diagnosis and management of this complicated condition. This is further compounded by the fact that there is a variety of causes of confusion with many overlapping

symptomologies. The central issue in patients presenting with altered mentation is the inability to give a coherent history, often with no significant complaint, underlining the importance of a valid clinical acumen.

Although frequently attributed to neurological abnormalities or drug and substance overdose, metabolic derangements are an important but unfortunately often overlooked cause of confusion. In fact, delay in diagnosis and hence institution of appropriate management of these metabolic abnormalities can lead to high morbidity (Gunturi S, 2021) with devastating consequences such as cerebral edema or and seizures and may even lead to increased mortality.

A guide for approach to confusion with emphasis on the metabolic angle is hence imperative, but sadly lacking in the current landscape of management algorithms. This guidebook was designed with the main objective of providing a practical and systematic approach to management of patients with confusion due to metabolic causes

2. METHOD & MATERIAL

A guidebook focusing on the more common and important metabolic causes of confusion was fashioned. This product was designed and compiled by the end-users, which are the physician and medical officers; resulting in a more relevant and focused management approach with the added advantage of being tailored to local requirements and specifications.

3. PRODUCT DESCRIPTION

This innovation product has been designed in the form of a guidebook for ease of use and reference, dealing approach to confusion due to metabolic causes. It is a compilation detailing the spectrum of presentation, diagnostic criteria and succinct management algorithm for each of the metabolic derangements. This manual is divided into sections for ease of reference, and the management steps are presented in a step-by-step algorithm to facilitate prompt institution of treatment in a systematic manner.

This guide contains three main metabolic categories, which are disorders of sodium, calcium and glucose metabolism. This is further divided into seven subcategories, consisting of the spectrum of abnormality for each metabolic these conditions, namely hypo and hypernatremia, hypo- and hypercalcemia, hypoglycemia, and hyperglycemic emergencies constituting of diabetic ketoacidosis and hyperglycemic hyperosmolar state.

Each of these subcategories come with a description of symptoms, with certain conditions having further detailing of the clinical features present at different levels of abnormal metabolic values. The diagnostic criteria are included in the same page, highlighting the importance of conforming to a standardized protocol of initial evaluation before proceeding to the management step. Given that many of these conditions have overlapping features, the significance of this part of the process is not to be underestimated.

The subsequent part of the approach is the management algorithm, which is one of the more vital sections in the approach of these conditions. The management steps are given in a systematic manner with a step-by-step description and elaboration as necessary, emphasizing the need for a structured treatment plan. Additionally, certain conditions even include contingency plans if initial management exhibits a delay in response or inadequate improvement.

3.1 Disorders of calcium balance

This section details the spectrum of presentation from low calcium (hypocalcaemia) to high calcium levels (hypercalcaemia) (Fig 1). Each of these abnormalities is further divided based on the severity of the metabolic derangements and management steps outlined for each subdivision. This section even includes steps to be taken if initial treatment is not effective, and the section on hypercalcaemia has additional treatment steps for refractory states

3.2 Disorders of sodium balance

Derangements in sodium levels is one of the metabolic abnormalities with the most potential for devastating consequences, especially if inadequate or delayed institution of treatment. This section concentrates of both low sodium (hyponatraemia) and high sodium levels (hypernatraemia) and outlines the approach for each of these conditions. Hyponatraemia management is subdivided based on the severity, with emphasis on the correct method to correct severe deficiencies. The algorithm then gives a step-by-step method of treatment, with further steps to be taken in the event of insufficient improvement. Approach to hypernatraemia opens with the causes and different presentation of this condition, and subsequently details the management by subdividing the abnormalities based on volume status, and even includes the formula and the rate of correction.

3.3 Disorders of glucose balance

This part of the guidebook deals with the different abnormalities of glucose metabolism, ranging from low glucose (hypoglycaemia) to high glucose (hyperglycaemic) emergencies, namely diabetic ketoacidosis (DKA) and hyperglycaemic hyperosmolar state (HHS) (Fig 2). The approach of each of these conditions is initiated with the presenting features and diagnostic criteria, and goes on to the treatment in a systematic manner. Management of hypoglycaemia is described according to the severity and the probable need for assistance. With regards to hyperglycaemic emergencies, this guidebook not only details the management of the primary metabolic abnormality, the correction of other electrolyte imbalances and fluid deficit is also described in detail. This provides an organized and all-inclusive management plan for all these conditions.

This novel compendium of metabolic causes of confusion provides a comprehensive reference tool in critical patient management, and aims to provide medical doctors with a focused and structured guide to deal with these conditions in an organized and proactive manner.

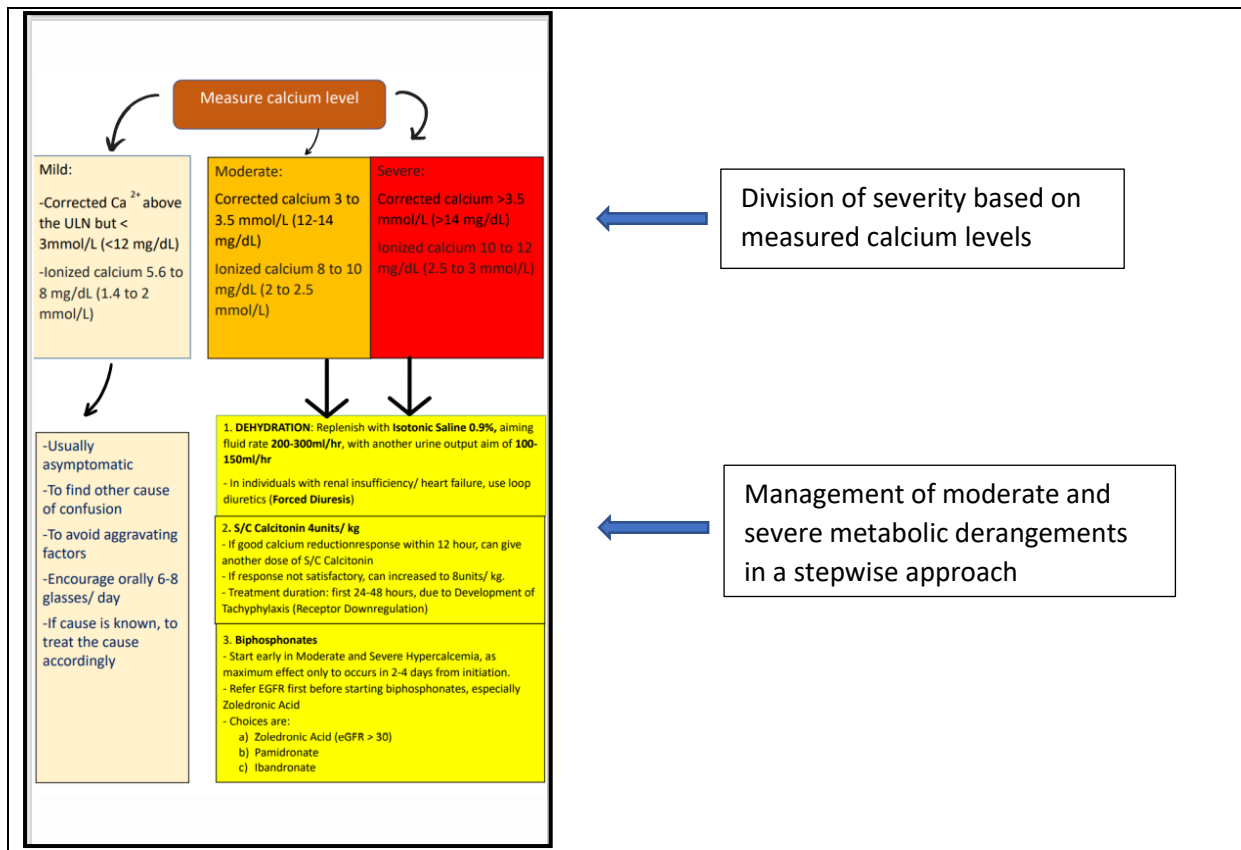


Figure 1. Approach to hypercalcaemia (A page from guidebook)

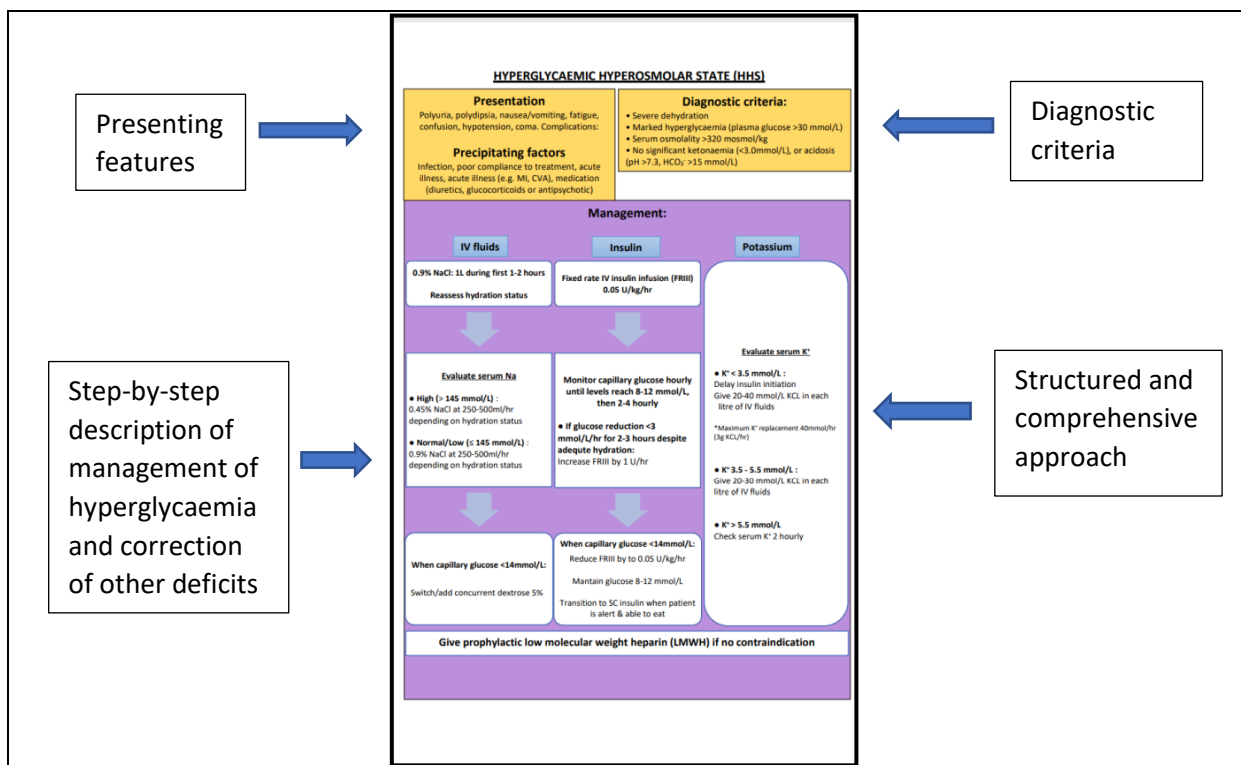


Figure 2. Approach to hyperglycaemic hyperosmolar state (A page from guidebook)

4. PRODUCT IMPACT/BENEFIT

The benefit of this guidebook will be evident in facilitating practicing doctors to manage patients in a prompt and systematic manner, which is vital to prevent complications and reduce mortality. This novel all-in-one concise and comprehensive manual to management of confusion due to metabolic causes is designed for use in emergency units, medical and general wards, as well as in intensive care units.

The benefit and usefulness of this product is targeted to be far beyond providing a valuable reference aid in acute medicine, it also aspires to drive a shift in mindset while treating patients, from the traditional and frequently reactive method to the more current, dynamic and pro-active approach, and to pave the way to better patient care.

5. CONCLUSION

This guidebook is a compendium of the more important metabolic derangements leading to confusion, with practical approach to management, aiming to aid health-care workers to recognize and deliver early and standardized treatment of these conditions. Being tailored to local specifications, this guidebook has the ability to be used in many hospitals and medical centers nationwide, with a huge potential for sustainability.

References

- Braun MM, Barstow CH, Pyzocha NJ (2015). Diagnosis and management of sodium disorders: hyponatremia and hypernatremia. *Am Fam Physician*. 2015, 91(5), 299-307
- Goltzman D (2022). Treatment of hypocalcemia. *UpToDate* (Wolters Kluwer Health) last update July 2022
- Gunturi S, Sadiq Mantargi MJ, Vigneshwaran E, Farid Ahmed MM, Dileep Krishna B V, Ahmed T (2021). Electrolytes imbalance and their clinical outcomes in the intensive care unit: A prospective, observational study. *Int J Health Allied Sci* 2021, 10, 17-22
- Ministry of Health Malaysia (2020). Practical Guide to Inpatient Glycaemic Care. Second edition May 2020
- Sterns RH, Hoorn EJ (2021). Treatment of hypernatremia in adults. *UpToDate* (Wolters Kluwer Health) last updated September 2021
- Turner J et al (2016). Emergency management of acute hypocalcaemia in adult patients. *Endocrine Connections* 5,G7. <https://doi.org/10.1530/EC-16-0056>