Indian Journal of Pediatrics (November 2023) 90(11):1061–1064
https://doi.org/10.1007/s12098-023-04742-2

EDITORIAL

Anemia in Severe Acute Malnutrition: Ten Steps of Management Need to be Fine-Tuned

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Received: 15 April 2023 / Accepted: 19 June 2023 / Published online: 12 July 2023

Introduction

Malnutrition remains an important public health problem due to its associated high morbidity, mortality and serious long-term consequences [1]. Children with severe acute malnutrition (SAM) i.e., children with weight for length/ height less than -3SD and/ or mid upper arm circumference (MUAC) less than 115 mm in children 6–59 mo and/ or bilateral pitting pedal edema of nutritional origin are at maximum risk of adverse health outcomes and death [2].

As per UNICEF/ World Health Organization (WHO)/ World Bank Group Joint Child Malnutrition estimates, 144 million (21.3%) under 5 children are stunted, 47 million (6.9%) under 5 children are wasted and 38.3 million (5.6%) under 5 children are overweight in 2019 worldwide [3]. India is one of the countries with very high prevalence of severe acute malnutrition. As per National Health and Family Survey-5 estimates, 7.7% of children aged 6–59 mo in India are suffering from severe acute malnutrition (SAM) at any point of time [4]. As nutrition features strongly in the sustainable development goals (SDG) with SDG target 2.2 aiming "end all forms of malnutrition by 2030" including achieving by 2025, the internationally agreed targets on stunting and wasting in children under 5 y of age, we need to look for areas where changes are needed [5].

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Anemia in Children with Severe Acute Malnutrition

Anemia is a common clinical problem in children with SAM. Children with SAM have several co-morbidities/ complications. These include pneumonia, acute diarrhea/ gastroenteritis, sepsis and anemia. In recent studies on hospitalized children with SAM, pneumonia occurred in 27.8 to 39%, diarrhea in 26.5 to 61% while anemia was observed in 73.5% to 90% [6–10]. True, all grades of anemia do not lead to immediate threat of life, which complications such as pneumonia or gastroenteritis will pose. However, severe anemia has also been reported as a very frequent co-morbidity. Thakur et al. reported severe anemia in 67% of children and transfusion requirement in 25% children with SAM [6]. Similar high prevalence of severe anemia (24–70%) has been reported by others [8, 10–13]. Presence of moderate to severe anemia in SAM children with pneumonia, diarrhea, malaria etc. is likely to further increase risk of mortality.

Wagnew et al. in a study from Ethiopia, reported that SAM children with anemia had more than two times higher hazard ratio for death [14] while Roy et al. from Bangladesh reported 4.2 times odds of death in SAM children with anemia compared to those without anemia [15]. Gavhi et al. compared adjusted odd's ratio (aOR) of several factors for mortality in children with SAM. They observed that presence of hypoglycemia had highest aOR (12.5) while aOR for MUAC <11.5 cm, presence of poor appetite and anemia were 3, 2.7 and 2.5 respectively [16].

There are several factors which influence the recovery in cases with SAM. Presence of edema, age of the patients, presence of diarrhea and other infections and anemia are known determinants of recovery. A study by Gebremedhin et al. from Ethipoia concluded, compared to younger children, those above 24 mo were three times more likely to recover from SAM while those with diarrhea were 78% less likely to recover. Presence of anemia also had negative effect with anemic children being 36% less likely to recover

[17]. Another study reported significant longer hospitalization duration in anemic SAM children. In this study also, SAM children without anemia had 1.36 times more chance of recovery [18].

Ten Steps of Management for Children with Severe Acute Malnutrition Requiring Inpatient Care

The WHO in the year 1999 published guidelines for the management of children with SAM. The guidelines provide 'Ten Steps' for management of children with SAM which takes care of their common metabolic and physiological changes, also known as reductive adaptations [19]. Substantial reductions in mortality rates have been achieved by modifying treatment, taking into account the physiological and metabolic changes occurring in severe malnutrition. In the International Centre for Diarrhoeal Disease Research, Bangladesh, after the introduction of a standardized protocol, based on the WHO guidelines, fatality rate decreased to 9% and subsequently to 3.9% from an earlier 17%. In South Africa as well, the mortality rate decreased from 30–40% to less than 15% [20].

In the 'Ten Steps' of management of severe malnutrition, initial five steps address hypothermia, hypoglycemia, dehydration, dyselectrolytemia and infections. Sixth step is regarding supplementation for correction of micronutrient deficiencies. Micronutrients recommended to be supplemented include folic acid, zinc, copper and iron. Supplementation of iron comes with a warning that giving iron to start with may worsen the infection, hence iron supplementation to be started only when child

Table 1 Steps of SAM management: Fine-tuned to 11 steps

Steps		Stabilization Phase 1-3 d 3-7 d	Rehabilitation 2-6 wk
1	Treat /Prevent Hypoglycemia		
2	Treat /Prevent Hypothermia		
3	Treat & Prevent Dehydration		
4	Correct Electrolyte Imbalance		
5	Treat Infections		
6	Treat Severe Anemia		
7	Correct Micronutrient Deficiencies* Iron Supplementation	No Iron	Iron
8	Start Cautious Feeding		
9	Achieve Catch Up Growth		
10	Provide Sensory Stimulation & Structured Play Therapy		
11	Prepare for discharge & Follow-up		

*Investigate cause of moderate and severe anemia before starting supplementation and tailor therapy according to serum ferritin, vitamin B12, folic acid levels

has started gaining weight [19, 20]. The document includes recommendation for blood component therapy in children with severe anemia if hemoglobin (Hb) is less than 4 g/dl in children without cardiopulmonary compromise and <6 g/dl in presence of cardiopulmonary compromise. However, this recommendation gets overlooked as it is not highlighted in ten steps. Second issue is regarding duration of iron supplementation. For mild and moderate anemia, iron supplementation is recommended for 2 mo only. Work up for vitamin B12 deficiency and supplementation is not mentioned. Further, under the section on management of associated conditions, vitamin A deficiency, dermatosis, parasitic infestations, continuing diarrhea and tuberculosis is mentioned but anemia is not listed. In the section on assessing the cases who fail to respond, assessment for micronutrient deficiencies is listed. Anemia doesn't get mentioned here as well [19, 20].

Guidelines on in-patient management of SAM in children in India are largely based upon these WHO endorsed 'Ten Steps' [21–23]. Going by the current understanding of anemia in SAM as discussed above, we need to revisit the 'Ten Steps' of SAM management and include the following to address anemia better:

- First, though it is not stated as such but all cases with SAM who are hospitalized get a blood specimen drawn for estimation of serum electrolytes, kidney function test (KFT) and complete blood counts to address the first five steps. Hb report may be available within few hours. It may clearly be stated upfront that all hospitalized children with SAM should be assessed for severe anemia and transfusion is given if indicated. Going by the details in the guidelines, this is clearly intended though not stated as such. This step may be embedded as step six (Table 1).
- Second, there is a need to look for deficiencies of specific hematopoietic micronutrients (iron, folic acid and vitamin B12) at least in cases with moderate and severe anemia. Diagnostic facilities have significantly improved since the time these guidelines were initially published. Knowing about specific deficiencies will allow tailoring the therapy better. Deficiency of vitamin B12 among anemic children with SAM is prevalent in certain areas of our country [13, 24]. In such regions SAM children should be provided with therapeutic doses of vitamin B12 which will improve weight gain as well [25].
- Third, when the preparation of discharge from hospital is being discussed, Hb should be estimated and supplementation advised accordingly. Moreover, SAM children, particularly those with anemia at entry point should be advised to follow iron supplementation through Anemia Mukt Bharat as has been recommended in recent guidelines on anemia [26].
- Further, the duration of iron supplementation in anemic children should be 3–6 mo as replenishment of stores is also required. Many children do not attain normal Hb level with 3 mo' iron supplementation or management of SAM [25, 27]. The authors' group has recently reported persistence of anemia in SAM children even after 12 wk of supplementation of micronutrients [25]. Persistence of anemia in over 50% cases has been reported in earlier studies as well [28].

Since anemia in SAM is linked to increased mortality and poor recovery, it is advisable to strongly recommend looking for anemia in cases with failure of treatment.

To conclude, 'Ten Steps' provide an easy to follow protocol for management of SAM. Adherence to the protocol has led to substantial reduction in mortality due to SAM. However, as highlighted above, 'Ten Steps' have not adequately emphasized management of anemia in children with SAM. Now since these management guidelines are almost universally followed and have become standard of care of children with SAM, it is desirable that importance of adequately managing anemia and associated micronutrient deficiency in these children is also addressed as suggested.

Declarations

Conflict of Interest None.

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