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Review Article

Acute Care and Obese Children

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Abstract

Obesity is a multifactorial chronic disease, generally preventable and affecting children and adults. The aim of this review is to briefly discuss some topics related to obese children and adolescents in acute care settings. Conclusion: Obesity causes several changes in the child's body that may affect the clinical course in a serious illness situation, however many associations are still unclear and further studies are necessary.

Keywords: Obesity; Obese; Children; Acute; Care

Introduction

Obesity is a multifactorial chronic disease, generally preventable and affecting children and adults. It is an accumulation of adipose tissue, often due to excessive caloric consumption and lack of physical activity [1,2]. It has a global distribution and is a major public health problem. Obesity and overweight comprise about 1/3 of the world population [3] and the prevalence in children is increasing in the last 50 years [2].

Obese children and adolescents are more likely to become obese adults [2,4] and develop complications associated with obesity. For example, cardiovascular diseases that are the leading cause of death globally and have risk factors associated with childhood obesity [5].

The aim of this review is to briefly discuss some topics related to obese children and adolescents in acute care settings, such as pediatric intensive care units (PICUs) and emergency departments (EDs).

Mortality

Mortality data are important tools for assessing the impact of a given disease and for developing treatment plans. Childhood obesity is related to long-term mortality and reduced life expectancy between 5 and 20 years [6].

The literature is conflicting regarding the impact on mortality in urgent care settings [6,7]. In 2013 Bechard., *et al*. reviewed 21 studies in hospitalized children and only 10 showed any association between mortality and obesity [7] Retrospective studies only in PICUs do not associate mortality with obesity in children [8-11].

The relationship between body weight and mortality has a U-shaped curve (meaning higher mortality in obese and underweight) or a J-shape in adult patients and there is a hypothesis of similar distribution in children [11,12]. However, many studies with pediatric patients have excluded underweight patients and this hypothesis still needs further testing.

Some studies in adults have identified obesity as a protective factor for mortality and this has been called the obesity paradox [10]. In pediatric studies this hypothesis has not been proven [12,13].

Lenght of stay (LOS)

The medical costs over the life of an obese child are higher than with non-obese children [8,14]. Part of these costs occur during hospitalizations and several authors found a longer duration in hospitalizations of obese children [11,14-16], although some studies in PICU did not find an association of obesity and length of hospitalization [9,17].

Pharmacology

Knowledge about pharmacological properties and adequate drug doses is essential in emergency treatment [18]. Obesity generates physiological changes that can influence the distribution and action of a medication in several ways [19-21].

The pharmacokinetics of a drug is basically determined by the volume of distribution (Vd) and clearance, which will determine the dose of the drug and its interval [4]. The plasma level of the substance and the loading dose that is associated with Vd [20] normally increase in obesity due to the increase in body fat, extracellular body water, blood volume and cardiac output [18]. Clearance is associated with maintaining the amount of medication in the plasma and is related to metabolism and excretion. In obesity, clearance is increased by increased kidneys and renal blood flow and in the liver by increased blood flow and changes in liver function [18,19]. The characteristics of the drugs must be taken into account. Lipophilic drugs are well distributed in adipose tissue and have a high Vd, and suggested doses can be based on total body weight. Hydrophilic drugs should be based on the ideal body weight, due to the lower Vd and the potential risk of overdose [18].

Dosing errors are more frequent in obese patients [14] and underdose is more common than overdose. Such mistakes may lead to serious consequences and even death. One of the reasons for these errors being more frequent would be the usual form of the dose of medicines in pediatrics, which is that per kg of body weight or body surface are not valid for obese children [18,21]. The lack of adequate data for dose of drugs leads to off-label administration, which is associated with a high number of visits to emergencies due to adverse events related to medication [19].

The doctor in acute care should check if there is any information available about the medication that will be prescribed related to the use in obese children and what is the best scale to calculate their dosage [4]. As a general guideline for obese children over 40 kg, it is suggested to consider doses for adults and that the dose for pediatric patients should not exceed the maximum recommended dose for adults [19].

Respiratoy system

Obesity is a risk factor for the development of asthma [1]. Obese asthmatic children have a higher rate of visits to the emergency department, hospitalization and admission to the PICU [1,15]. These patients have a longer recovery time and tend to stay in the ICU longer [1,11,22,23] in addition to longer use of corticosteroids, bronchodilators and oxygen [1,15,24].

Airway management in obese children as well as obese adults can be challenging in an acute care setting. Adiposity can impair the visualization of structures during intubation [24]. Obese children are less likely to be classified as Mallampati I, which indicates better visualization of the oropharynx and is related to a lower probability of complications for intubation [25]. Obese children are reported to have difficulties with mask ventilation (when the provider needs to use both hands for ventilation) and a greater number of attempts during laryngoscopy [4]. However, there is no report with significant differences in the success of intubation when compared to non-obese children [25]. In any case, it is advised that the team should be prepared with training and material for difficult airways in the care of obese children.

Ventilatory mechanics can be altered by excess adiposity, with reduced compliance of the chest wall and lungs, in addition to increased airway resistance [13,24]. Goh and collaborators evaluated general data from patients in the PICU and found no association between obesity and longer duration of mechanical ventilation [26]. On the other hand, a longer duration of mechanical ventilation in obese children has been reported in studies with specific groups of patients as victims of trauma and burns [15].

Cardiovascular system

Regarding inotropic support, the data are conflicting. A recent study in PICU patients, Davis., *et al*. reported less need for inotropic support in obese and overweight patients compared to children with normal weight [10]. Sharma., *et al*. found no differences in the

use of inotropes in children admitted to the PICU and divided into groups of low weight, normal weight, overweight and obese [11]. Peterson., *et al*. reported that obese children with sepsis are more likely to use extracorporeal membrane oxygenation (ECMO) [9].

Obese children are less likely to survive cardiopulmonary arrest in a hospital setting [15,17]. Donoso., *et al*. highlight the difference in characteristics of drugs used in cardiopulmonary resuscitation (CPR), such as adrenaline being water-soluble and with low Vd reaching high plasma levels, while amiodarone is highly fat-soluble and may require additional doses to reach therapeutic levels, thus suggested doses of CPR medications in children obese women should be reviewed [6]. Another point is to review doses of electrical therapy (electrical defibrillation and cardioversion), as well as chest compression techniques for obese children [6].

Obesity is a risk factor for deep vein thrombosis (DVT) in adult patients [26]. In a study on hospitalized children, Halvorson., *et al*. reported a higher risk for DVT in obese patients [26]. Treatment in obese children is also a subject that should be reviewed, considering that these patients need higher doses to reach anticoagulation levels [14,26]. Another point that requires attention is the lack of consensus guidelines for DVT prophylaxis in hospitalized obese children [14].

Infection

There is a pro-inflammatory state in obesity [13], characterized by an increase in pro-inflammatory cytokines (e.g. tumor necrosis factor alpha, interleukin-3 and interleukin-6) [6]. This condition of chronic inflammation is related to a lower immune reserve [6,9]. The inflammatory response of the obese patient is different from that of the non-obese and in obese animal models compared with non-obese [6,8].

The association between obesity and sepsis is not clear. Some studies have reported an increase in infections in obese patients who have suffered traumatic injuries [15] and worse progression during the Influenza A H1N1 pandemic [17]. However, in some reviews, the findings are inconclusive about obesity being a risk factor for infections in hospitalized patients [7]. This doubt also remains among patients admitted to the PICU. Bechard., *et al*. in a review involving data from 90 PICUs, identified a greater probability of acquiring hospital infection than non-obese patients [23]. In another recent article that evaluated patients with sepsis admitted to the PICU, there were no differences between the microbiological agent., LOS and mortality in obese and non-obese children [9].

Vascular access

The need of a vascular access in a pediatric acute treatment setting is not able to be doubted. Placement of vascular access in an obese child may require more skill from the provider and take more time [22]. Halvorson., *et al*. reviewed data from 94 PICUs in the United States and reported that obese children had a lower frequency of vascular devices at admission and a higher presence of these at discharge from the PICU, such findings may be associated with difficulties in placement of vascular access due to the anatomical characteristics of these children [16]. Another finding of this study was the higher prevalence of complications in obese children, with bleeding and mechanical complications being the most common [16].

Discussion

Despite the increasing prevalence in recent decades, the effects of childhood obesity in acute care settings is an emerging issue and many results can be conflicting [9]. There is still a lack of standardization for better comparisons between studies. The obesity criteria and the use of a weight-for-age chart and a body-mass index for age that contemplates different populations can help in these comparisons.

In adults, the effects of obesity are well described [18], but in children, there are few references about drug safety and efficacy, despite the increased prevalence of this condition in children [18-20]. There is little participation of obese children in clinical studies [19]. Thus, many data on doses are extrapolated from adult references [4,18,19]. Studies on the safety and efficacy of drugs in obese children and adolescents are needed to provide information that leads to a more accurate prescription in terms of doses and intervals.

This study aimed to make a brief discussion, with some topics of relevance in the daily routine of a pediatric acute care service. The main limitation of this study is that it was based mostly on general and retrospective studies. New studies, prospective and with more specific questions should help to clarify several doubts still present in relation to the short-term impact of obesity on children's health

Conclusion

The obesity epidemic increases the frequency of hospitalized obese children and the need for knowledge of its implications.

Obesity causes several changes in the child's body that can affect the clinical course in a serious illness situation, however many associations are still unclear and studies are needed in order to improve treatments offered by doctors in ED and PICU.

Conflict of Interests

The author has no conflicts relevants to this work.

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