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Original Research Article

Compensation for Preoperative Fasting in a Hospital that Occasionally Performs Pediatric Surgery: Experience of the Essos Hospital Center (Cameroon)

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Abstract: ***Background:*** One of the most important safety measures during the surgical procedure is preoperative fasting, which is defined as deprivation of food and liquid intake for the hours preceding anesthesia. The general objective of our study was to describe the means and methods of compensating for preoperative fasting in children under 15 years of age in a hospital that occasionally performs pediatric surgery. ***Patients and methods:*** This is an observational, prospective descriptive study that took place over a period of 12 months, in the anesthesiology department of the Essos Hospital Center. All children whose age was <15 years, operated during the above period were included in the study. The variables studied were: the characteristics of the study population, the indication for surgery, preoperative fasting, and the means of compensation for preoperative fasting. ***Results:*** During the survey period, 162 patients met our inclusion criteria. The median age was 5 years. The sex ratio was 1.8 in favor of the male gender. General anesthesia was the most practiced technique (96.3%), ENT surgery the most represented specialty (65.4%). The mean duration of the preoperative fast was 5.8 ± 1.9 hours. One third of the study population (31.48%) observed prolonged fasting. Holliday and Segar's rule was the compensation formula regularly used (96%), ringer's lactate solution (93.8%) represented the reference infusion solution. Fasting compensation began on the operating table in all cases. ***Conclusion:*** The respect and observance of the preoperative fasting in the pediatric population is a delicate and laborious step. The mastery of the anatomical, physiological and pharmacological particularities of the child constitutes the basis of pediatric anesthesia for a safe practice.

Keywords: Preoperative Fasting compensation, Pediatric Surgery, Essos Hospital Center.

INTRODUCTION

Preoperative fasting is defined as any oral deprivation of food and fluids prior to surgery [1, 2]. This is a safety measure that is decided before a scheduled surgery, to prevent the risk of inhalation. The preoperative fast aims to control gastric vacuity, decrease in gastric pH and decrease in tone of the lower esophageal sphincter [3]. The goal of preoperative fasting compensation is to maintain a balance between intake and loss of water, electrolytes and glucose in children. Many calculation rules concerning this care are described, for the child, in the literature. The most widespread in sub-Saharan Africa is that described in 1957 by Holliday MA and Segar WE [4]. The general objective of our study is to describe the methods of compensation for preoperative fasting in children under 15 years of age in a hospital that occasionally performs pediatric surgery.

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PATIENTS AND METHODS

This is an observational, prospective descriptive study which took place over a period of 12 months, from January 2021 to December 2021 in the anesthesiology department of the Essos Hospital Center in Yaounde (Cameroon). It's a high reference hospital, located in the political capital of Cameroon in central Africa. After approval by the ethics committee, the data was collected anonymously and used for exclusively scientific purposes. All children whose age was <15 years old, seen in anesthesia consultation for scheduled surgery and operated on during the above-mentioned period were included in the study. Data were collected from a non-participant observation grid. Non-participant observation made it possible to collect data on the means and methods of perioperative compensation for preoperative fasting. The data collected concerned the preoperative period, i.e. the 24 hours preceding surgery, the intraoperative phase, and the first 24 hours postoperatively. The variables studied were those related to the characteristics of the study population (age group, gender, ASA class, anesthetic technique), surgical indication, preoperative fasting, as well as those related to means and compensation methods for preoperative fasting. Preoperative fasting was said to be prolonged when its duration was greater than 6 hours. B66 infusion solution refers to a polyionic solution with a low concentration of glucose serum. The data collected were grouped and analyzed using the statistical analysis software Epi-infos 7 and SPSS 16.0.

RESULTS

During the survey period, 162 patients met our inclusion criteria for a total of 1205 patients operated on at the Essos-Yaounde Hospital Center during the same period, i.e. a frequency of 13.4%. The characteristics of the study population are shown in Table 1. The median age was 5 years with extremes ranging from 6 months to 14 years. The sex ratio was 1.8 in favor of the male gender. The participants mostly belonged to ASA class 1 (98.1%). General anesthesia was the most common anesthetic procedure (96.3%).

Table 1: Sociodemographic characteristics of the study population

Variables	Number (n)	Percentage (%)
Gender		
Male	105	64,8
Female	57	35,2
Total	162	100
Age group		
<29 days	-	-
[29 days to 6 months]	-	-
]6 months to 2 years]	21	12,9
]2 years to 4 years]	84	51,8
]4 years to 10 years]	42	25,9
]10 years to 14 years]	15	9,3
Total	162	100
ASA classification		
ASA 1	159	98,1
ASA 2	3	1,9
Total	162	100
Anesthetic technique		
General anesthesia	156	96,3
Spinal anesthesia	6	3,7
Total	162	100

The age group of 2 to 4 years was the most represented in our sample (51.2%). Otorhinolayngological surgery (ENT surgery) was the most practiced (65.4%), tonsillectomy represented 82.1% of this activity. All the parents of children declared having received oral explanations relating to the instructions of the young preoperative during the preanaesthetic consultation. These instructions were transcribed in the anesthesia file in all cases. The mean duration of the preoperative fast was 5.8 ± 1.9 hours. One third of the study population (31.48%) observed prolonged fasting (Figure 1).

Table 2: Distribution of children according to surgical indication

Indication for surgery	Number (n)	Percentage (%)
Obstructive sleep apnea Syndrome/enlarged adenoids	87	53,7
Inguinal hernia	12	7,4
Inguino-scrotal hernia	12	7,4
Esophageal foreign body	9	5,5

Indication for surgery	Number (n)	Percentage (%)
Cryptorchidism	6	3,7
Superinfected parotid cysts	6	3,7
Acute cholecystitis	5	3,1
Umbilical hernia	6	2,4
Tongue base flange	4	2,5
Forearm scar correction	1	1,9
Left femur fracture	3	1,9
Right humerus fracture	3	1,9
Lateral ventral hernia	3	1,9
malformative hydrocephalus	2	1,2
Bilateral seromucous otitis	2	1,2
Shortening of the right Achilles tendons	1	0,6
TOTAL	**162**	**100**

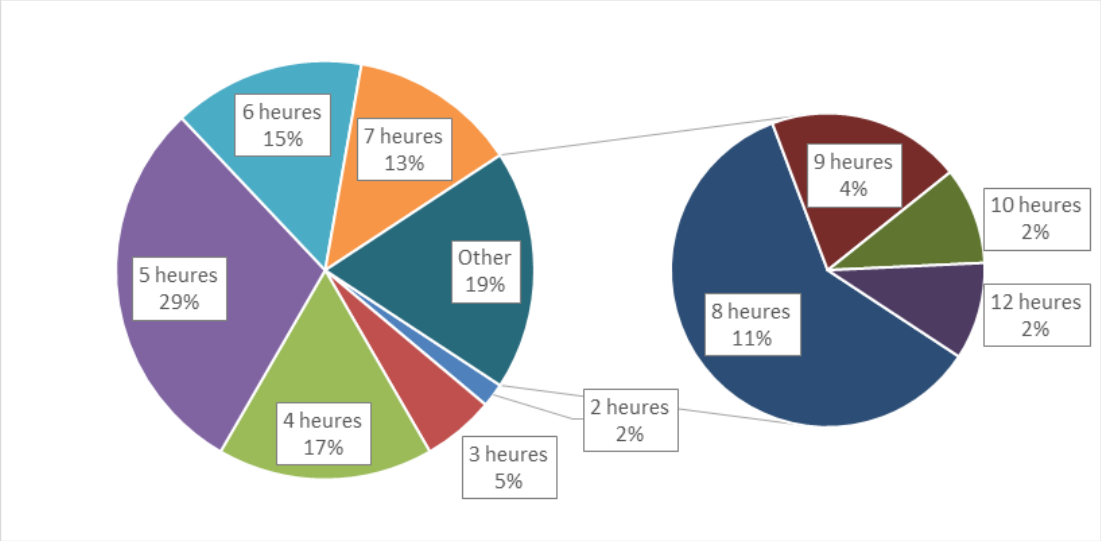

Figure 1: Distribution of patients according to the duration of the preoperative fast

Holliday and Segar's rule was the single most used calculation formula for preoperative fasting compensation in pediatric surgery at the Essos hospital center (96%). Ringer's lactate (93.8%) was the infusion solution frequently used to compensate for preoperative fasting in children in our sample (table 3). Compensation for preoperative fasting began in the operating room for all study participants and continued in the postoperative period in 96% of cases (n=146).

Table 3: Distribution of the type of infusion solution according to the surgical specialty

Surgical specialty	Types of infusion fluids						TOTAL	
	Ringer lactate		Ringer lactate 1%+GS 10%		Serum saline 0.9%			
	n	%	n	%	-	-	n	%
ENT surgery	100	61.7	8	4.9	-	-	**108**	**66,7**
Digestive Surgery	44	27.2	-	-	-	-	**44**	**27,2**
Orthopedic surgery	8	4.9	-	-	-	-	**8**	**4,9**
Neurosurgery	-	-	-	-	1	1,2	**1**	**1,2**
TOTAL	**152**	**93,8**	**8**	**4,9**	**1**	**1,2**	**162**	**100**

DISCUSSION

In pediatric anesthesia, the intake of infusion solutions must take into account the age of the child, his state of hydration, the duration and intensity of the surgical procedure, but also the duration of the fast. preoperative. Maintenance fluid requirements in children were established in 1957 by Holiday and Segar and reassessed in 1988 by Lindhal [4, 5]. These requirements were calculated from the energy expenditure and the corresponding water requirements (166 mL of water for 100 kcal under halothane anesthesia, 100 mL of water for 100 kcal at rest). To these maintenance fluid requirements must be added the requirements created by surgery (2 mL kg-1 h-1 for mild trauma, 4 mL kg-1 h-1 for moderate trauma, 6 mL

kg-1 h-1 for severe trauma). Preoperative fasting compensation is established on the basis of maintenance requirements according to the duration of the fast for fluids. In the event of a prolonged fast, half of the water deficit will be compensated for in the first hour, and the other half over the following 2 hours. This preoperative fasting compensation rule was simplified by administering 25 mL kg-1 in the first hour in children under 3 years old, and 15 mL kg-1 in children over 4 years old [6, 7]. For the following hours, it is recommended to infuse with a flow rate of 4 mL kg-1 for maintenance needs, to which 2, 4 or 6 mL kg-1 h-1 will be added for minor or major trauma respectively, regardless of the weight of the child [6, 7].

The Essos hospital center is a hospital structure that occasionally practices pediatric surgery, i.e. there is no department reserved exclusively for the practice of pediatric surgery. Under these conditions, the practice of pediatric anesthesia, by non-paediatric anesthesiologists, deserves special observation, because this activity takes place in an inappropriate environment. During the survey period, 162 children, out of a total of 1,205, were operated on at the Essos hospital center for various reasons. The median age was 5 years; the sex ratio was in favor of the male gender. In the work carried out by Otiobanda GF *et al*., [8], relating to the practice of pediatric anesthesia at the university hospital center of Brazzaville, 180 children were operated on during the study period. The sex ratio was 1.85 in favor of the male gender, the mean age 5.4 ±0.69 years, 84.4% were of ASA class 1 and 2. The interventions programmed in this study concerned 147 children (81.7%). The pathologies were: digestive (53.3%), orthopedic (32.2%), urological (11.1%), neurosurgical (3.3%). General anesthesia was performed in 178 children (98.9%). Our results are similar to those of these authors. The different regions of sub-Saharan Africa share the same socio-economic and infrastructural realities, which allows easy comparison of the two studies. At the Essos hospital center, pediatric anesthesia represents a small percentage of operative activity, around 13%, which does not theoretically allow it to be separated from adult activity. This low rate could be explained by the existence of a hospital dedicated to mothers and children in the city of Yaounde, whose main mission is care dedicated to mothers and children, including surgical activities. This health unit absorbs most of the infant surgery in the city of Yaounde, making secondary that of the other health units attached. The average age of our study population is identical to that found by other African series [8-10]. Age is of paramount importance in pediatric anesthesia because it is a parameter that conditions the physiology and pharmacology of the child, and therefore the quantity and quality of infusion solutions. In our series, tonsil surgery was the most practiced activity, in children without any particular defects. The anesthetic technique was conditioned by the surgical indication. The technique of choice was therefore general anesthesia. Many authors also find a predominance of ENT surgery procedures in this age group. In sub-Saharan Africa, tonsillectomy represents more than half of the surgical activity of this specialty, in children <5 years [11, 12].

The 4-2-1- rule of Holliday and Segar was the method for calculating the quantities of infusion solution for the compensation of preoperative fasting, for all children at the Essos hospital center. For the anesthesiologist, the fluid and electrolyte intakes concern all the operating periods. The aim of this treatment is to maintain a balance between the intake and loss of water, electrolytes and glucose. It is important to remember that there are some differences between newborns, children and adults in terms of physiology. The energy metabolism of the child is greater than that of the adult in relation to its weight. In the literature, different calculation rules concerning fluid and electrolyte intake in children have been described. The best known and widely taught in training programs in sub-Saharan Africa is that described by Holliday and Segar [4].

The choice of infusion solution to compensate for preoperative fasting in children is also a crucial element. A wrong choice can lead to dramatic complications. In our sample, ringer's lactate was the most commonly used infusion solution (93.8%), followed by ringer's lactate 1% serum glucose 10% (4.9%). Isotonic saline was the only solution used to compensate for preoperative fasting in neurosurgery. In a meta-analysis, Choong *et al*., demonstrated that the choice of solute could have a direct impact on children's serum sodium levels [13]. After a drastic selection on a panel of 104 studies, these authors demonstrated on 6 studies retained that the use of "hypotonic" solute versus "isotonic" solute significantly led to the development of hyponatremia with average variations ranging from from 2.3 to 12 $mmol.l^{-1}$ [13]. Way et al. have, moreover, demonstrated in a group of 286 anesthesiologists that the choices concerning solutes in pediatric anesthesia were not always as homogeneous as one might have thought for a pediatric practice [14]. The authors showed that at the time of the study, more than 60% of anesthesiologists were still using hypotonic solutions [14]. Reading these works allows us to remember that the intraoperative use of isotonic salt solution (ringer lactate type, B66) associated with the rule of Holliday and Segar can represent the best choice of infusion solutions in pediatric anesthesia. The advantage of B66 infusion solution compared to other non-sweetened crystalloids (0.9% saline or ringer's lactate) is the supply of glucose to the child. It has in fact been demonstrated that such a minimal glucose intake makes it possible, while theoretically reducing the risk of intraoperative hypoglycaemia, not to involve the alternate metabolic pathway of fatty acids while limiting the risk of occurrence of intraoperative hyperglycaemia. [15]. In France, a polyionic solution

containing 0.9% dextrose called "B66" was discontinued in 2015 [16]. In accordance with the practice carried out in many French centers, the Association of anesthesiologists resuscitators of French expression proposed an alternative solution to "solution of B66" which contains Ringer Lactate and 30% glucose serum, pending the marketing of adapted solutions [16]. The extension of this practice in many countries of sub-Saharan Africa is topical.

In our work, fasting compensation began on the operating room in the majority of children and ended in the postoperative period for short-term interventions. The reason is that the venous approach in children represents a challenge for the anesthetist with a failure rate of up to 50% [17], especially in children under 6 years old, obese, those in a critical situation or with an already highly stressed venous potential [18, 19]. In the operating procedures of the Essos hospital center, the placement of the peripheral venous line in children is ideally done in the operating room after induction with sevoflurane gas.

Prolonged fasting was observed in 1/3 of cases in the study population, without affecting the glycemic profile of children. Glucose is essential for the normal functioning of the brain. Glycemic dysregulation can be deleterious to the brain. The incidence of hypoglycemia at induction of anesthesia is low and usually the consequence of prolonged fasting [20-23].

CONCLUSION

Knowledge of the physiological, pharmacological and anatomical differences related to young age is a prerequisite for a safe practice of pediatric anesthesia. The compensation of young preoperative is an important step that requires rigor in the choice of means and methods of vascular filling. It remains a challenge for many anesthesiologists in sub-Saharan Africa. The compensation strategy must be initiated in the preoperative period and continue during the operative period. Holliday and Segar's formula remains convenient and easy to apply. The ideal infusion solution of choice is one that perfectly compensates for the fluid, electrolyte and metabolic needs associated with preoperative fasting. It should always be remembered that a child is not a miniature adult, therefore the excess or lack of compensation can be harmful for the child.

Conflicts of Interest: The authors declare no conflicts of interest.

Author Contribution

All authors contributed to the development and conduction of this manuscript. All authors have read and approved the final version of the manuscript.

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