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The Impact of Pediatric Perioperative Fasting on Intraoperative Parameters and Postoperative Period Quality

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THE IMPACT OF PEDIATRIC PERIOPERATIVE FASTING ON INTRAOPERATIVE PARAMETERS AND POSTOPERATIVE PERIOD QUALITY

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Aos meus pais, pela retaguarda constante e incondicional de amor, carinho e incentivo. Por todas as vezes que sofreram com os meus desafios de forma ainda mais intensa do que eu. Por me mostrarem que com dedicação e trabalho, nada é inatingível. Isto nunca seria possível sem vocês.

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Resumo

Introdução: As recomendações europeias que concernem o jejum foram recentemente atualizadas para uma regra de 1-3-6 horas (para líquidos claros, leite materno e outros líquidos e sólidos, respetivamente) com vista a melhorar o jejum pré-anestésico das crianças, atenuando assim os seus efeitos nefastos e respetivas consequências metabólicas e hemodinâmicas.

Objetivos: O nosso principal objetivo foi analisar a duração do jejum pediátrico pré-operatório, comparando-o com as recomendações preconizadas e avaliando simultaneamente o seu efeito em parâmetros intraoperatórios e na qualidade do pós-operatório.

Materiais e Métodos: O estudo obteve aprovação prévia pelo Hospital e respetiva Comissão de Ética. Estudo prospetivo, observacional, que incluiu todos os pacientes pediátricos com cirurgias eletivas agendadas entre Fevereiro – Abril de 2022 no Centro Hospitalar Universitário do Porto. Os dados foram colhidos de registos clínicos, entrevistas e monitorização anestésica, até às 24 horas após a cirurgia. Avaliou-se o impacto do jejum na glicemia, frequência cardíaca e pressão arterial no início da anestesia, assim como em parâmetros pós-operatórios. A análise estatística foi efetuada com recurso ao *IBM Statistical Package for the Social Sciences.*

Resultados: 196 crianças foram incluídas na análise. A mediana de tempo de jejum pré-operatório foi de 9,48 horas para líquidos e de 11,08 horas para sólidos, enquanto a mediana de tempo de reintrodução foi de 2,00 horas para líquidos e de 2,60 horas para sólidos. A mediana dos tempos de jejum e de reintrodução foi significativamente maior em doente submetidos a cirurgia de manhã ($p < 0.001$). O jejum para sólidos foi mais reduzido em doentes de ambulatório, quando comparados com doentes internados ($p = 0,002$), sendo os tempos de reintrodução inferiores em ambulatório tanto para líquidos como para sólidos ($p < 0,001$).

Foi identificada uma correlação negativa entre a variação da pressão arterial sistólica no início da anestesia e o tempo de jejum para sólidos ($p = 0,043$). A pressão arterial sistólica no início da anestesia foi significativamente inferior no período da manhã, quando comparada com a tarde ($p = 0,009$). A glicemia no início da anestesia não apresentou nenhuma relação significativa com os tempos de jejum, apesar de esta ter sido significativamente maior no período da manhã ($p = 0,001$). Ambas as variações das pressões arteriais sistólica e média foram significativamente mais baixas em pacientes com jejum para sólidos igual ou superior a 10 horas ($p = 0,009$ e $p = 0,004$, respetivamente).

Discussão: Os tempos de jejum em pacientes pediátricos submetidos a cirurgias no nosso Centro Hospitalar ultrapassam largamente os timings recomendados. A duração do jejum para sólidos aparenta ter impacto significativo nas pressões arteriais sistólica e média, estando a duração mais longa do jejum relacionada com a ocorrência de hipotensão.

Palavras-chave: *anestesia, pediátrica, jejum, perioperatório*

Abstract

Introduction: European guidelines recently updated fasting recommendations to a 1-3-6 hours rule (for clear fluids, breast milk and other fluids and food, respectively) to improve children's extended fasting prior to anesthesia, attenuating its nefarious metabolic and hemodynamic consequences.

Objectives: Our main goal was to analyze the duration of pediatric preoperative fasting, comparing it to preconized guidelines and evaluating its impact on intraoperative parameters and postoperative quality.

Methods and Materials: Study was approved by Hospital Board and Ethical Committee. Prospective, observational study, including all consecutive pediatric patients scheduled for elective surgeries between February – April 2022 at *Centro Hospitalar Universitário do Porto*. Data collected from clinical records, interviews and anesthetic monitoring up to 24h after surgery. Fasting impact was evaluated on glycemia, heart rate and blood pressure at the beginning of anesthesia and postoperative parameters. Statistical analysis was conducted using IBM Statistical Package for the Social Sciences.

Results: 196 children were included in the analysis. The median fasting periods were 9,48 hours for clear fluids and 11,08 hours for solids. The median time for fluids reintroduction after surgery was 2,00 hours, whereas for solids it was 2,60 hours. The median duration of fasting and reintroduction times was significantly longer in patients submitted to surgery in the morning ($p < 0.001$). Fasting for solids was lower in outpatients when compared to inpatients ($p = 0,002$) with reintroduction times being shorter in outpatients for both fluids and solids ($p < 0,001$).

A negative correlation was found between systolic blood pressure variation at the beginning of anesthesia and fasting times for solids ($p = 0,043$). Systolic blood pressure at the beginning of anesthesia was statistically lower in the morning than in the afternoon ($p = 0,009$). Blood glucose at the beginning of anesthesia had no significant relationship with fasting times although it was significantly higher in the morning period ($p = 0,001$). Both systolic and mean blood pressure variations were significantly lower in patients who fasted for solids for 10 or more hours ($p = 0,009$ and $p = 0,004$, respectively).

Discussion: Fasting times for pediatric patients submitted to surgical procedures at our hospital center largely surpass currently endorsed timings. Solid fasting duration appears to have significant impact on systolic and mean blood pressure, with longer fasting durations being related to the occurrence of hypotension.

Keywords: *anesthesia, pediatric, fasting, perioperative*

List of Abbreviations

ASA | American Society of Anesthesiologists
ASA PSCS | American Society of Anesthesiologists Physical Status Classification System
BP | Blood Pressure
CHUPorto | *Centro Hospitalar Universitário do Porto*
CICA | *Centro Integrado de Cirurgia de Ambulatório*
CMIN | *Centro Materno-Infantil do Norte Dr. Albino Aroso*
ENT | Ears, Nose and Throat
ESAIC | European Society of Anaesthesiology and Intensive Care
HR | Heart Rate
ICBAS | Instituto de Ciências Biomédicas Abel Salazar
ICU | Intensive Care Unit
Max. | Maximum
Min. | Minimum
OR | Operation Room
PACU | Post-Anesthetic Care Unit
PES| Polyelectrolyte Solution (without glucose)
PoliG| Polyelectrolyte Solution with 5% Glucose
PONV | Postoperative Nausea and Vomiting
Reintrod. | Reintroduction
SD | Standard Deviation

Index

Table List

Figure List

Introduction

Ensuring preoperative fasting has been a concern for anesthesiologists as the failure to its compliance portrays a significant and long-standing known risk for pulmonary aspiration of gastric content. Various scientific guidelines regarding this particular subject have been emitted by national and international authorities, namely the European Society of Anaesthesiology and Intensive Care (ESAIC) and its American counterpart, the American Society of Anesthesiologists (ASA), to name a few, and, throughout the years, updates were made keeping up with current knowledge, leading to the implementation of changes in clinical practice. The standing guidelines towards pediatric anesthesia in Europe have recently established a 1-hour rule for clear fluids fasting (defined as water with or without sugar, pulp-free juice and tea or coffee) and a 3-hour rule for breast milk fasting prior to anesthetic induction in healthy children, having dethroned the previously set 6-4-2 hours rule for preoperative fasting regarding solid food, breast milk and clear fluids, respectively. [1–4]

The latest recommendations and suggestions are based on a preceding increase in worldwide consensus regarding a change towards a more liberal clear fluids policy, with supporting gastric emptying physiology studies being carried out in pediatric population (mainly resorting to ultrasound and magnetic resonance techniques), having taken into account the nefarious effects of prolonged fasting and given the residual incidence rates of pulmonary aspiration and decurrent complications, with consequences generally not being further than the need for extended monitoring.[3–9] The presence of an underlying disease does not appear to affect gastric emptying; hence the majority of comorbidities do not have a specific set of fasting adjustments; however, on this matter, only suggestions were made in the current guidelines, and it is noted that clinical sense should prevail on any decision. The same rationale should be applied to medication and environmental factors. [3,4,7,10,11]

Despite previous recommendations, the main problem deriving from fasting times lies in its noncompliance – this arises mainly from the unpredictability of surgical admission time, the overall anxiety to comply to fasting instructions and, in children with scheduled morning surgeries, the reluctance to wake children up for night-time feeding - which ultimately results in a prolonged duration of fasting associated with evident detrimental consequences regarding metabolic and hemodynamic parameters, apart from actual verbal manifestations of discomfort, hunger, thirst and identifiable behavioral deviations.[8,12] Furthermore, both intra and postoperative complications - explicitly hypoglycemia, hydroelectrolytic imbalance, nausea and vomiting, altered state of consciousness, anxiety and dehydration - can occur as a result of the previously mentioned systemic changes, which can ultimately cause an unfavorable response to surgical trauma itself.[13] These negative metabolic effects occur in pediatric age overall, yet they

are often exacerbated in younger children. The physiological explanation for this effect lies with the diminished capacity to store glycogen, both in the hepatic and muscular reserves, which culminates in an accelerated installation of hypoglycemia and consequently, ketosis. Moreover, the combination of stress hormones' release and the reduction of insulin levels, due to both fasting and the surgery itself, can increase peripheral insulin resistance postoperatively, leading to longer hospital stays.[10] Therefore, shortening the fasting period can positively influence both the catabolic and proinflammatory status arising from the surgical act itself.[14] It is estimated that a 2h clear fluid fasting rule can represent an accurate fasting time of over 10 hours, with studies proving that under stricter protocols, these times can be reduced, largely benefiting the patient.[12,15–18]

Numerous recent publications have exposed the considerable occurrence of this situation, regardless of the known benefits that stem from its practice, and some of these studies exploit how caregivers' knowledge and comprehension of the matter can influence the adherence to the given instructions regarding appropriate fasting times.[5,19] Furthermore, previous studies have reported that children themselves identify thirst and hunger as major issues causing discomfort in the perioperative period.[18] In accordance with these reports of children and caregivers' complaints, the prospect of introducing a light breakfast up to 4 hours prior to anesthetic induction is being taken into consideration, in an attempt to ensure greater well-being in this context, resorting to clear, consistent and detailed local protocols, albeit some arguments have been raised against this practice, particularly concerning a possible misinterpretation of the definition of "light breakfast".[3]

As to postoperative feeding, it is recommended that early, yet, per request, oral feeding should be initiated in healthy patients, particularly liberal fluid administration, with solids being introduced in a more cautious manner, even if gastrointestinal function has not resumed.[3,20]

In an attempt to monitor current procedures at our hospital center and further improve the quality of provided care, the primary aim of this study was to both analyze the duration of preoperative fasting in our institution and adhesion to current guidelines, alongside its impact on metabolic and hemodynamic intraoperative parameters, apart from relating it to the individual quality of the postoperative recovery period. At last, depending on the achieved results and taking into account all available evidence, it is our goal to make recommendations and optimize pediatric preoperative fasting procedures and quality of care in our hospital center.

Materials and Methods

Ethical Considerations

This study was preceded by an institutional authorization of the hospital center's Education, Training and Research Department (*Departamento de Educação, Formação e Investigação* – DEFI), the Clinical Investigation Department (*Departamento de Investigação Clínica*), the President of the Hospital Center's Administration Board and the Ethical Committee of *Centro Hospitalar Universitário do Porto* (CHUPorto) and *Instituto de Ciências Biomédicas Abel Salazar* (ICBAS), whose approval was conceded prior to data collection [reference number 2021.296(242-DEFI/250-CE)].

Both caregivers and patients were notified and informed about the nature and primary aim of this investigation, besides being given an informative leaflet, containing a straightforward explanation of the study's rationale and that also allowed means of contact between the participants and the supervising health professionals, in case any clarifications were needed. Legal representatives were warranted that no unnecessary procedures besides the ones required for surgery were performed to attain data for this study and were granted the possibility of either not participating or withdrawing from the study at any given time.

Written informed consent of legal representatives (and adolescents, if 16 years of age or older) was attained to perform this observational study, regardless of the absence of interference with the decurrent procedures associated with the anesthetic and surgical acts or assessments and with no further procedures being carried out.

Confidentiality and anonymity were ensured during the entire process.

Study Design and Sample

The current investigation was designed as an observational, prospective study that included all consecutive children within pediatric age (0 – 18 years of age) who were scheduled for elective anesthetic and surgical procedures carried out between 25th February 2022 and 1st April 2022 at *Centro Materno-Infantil do Norte Dr. Albino Aroso* (CMIN) and *Centro Integrado de Cirurgia de Ambulatório* (CICA), both part of *Centro Hospitalar Universitário do Porto*, regardless of the surgical specialty or ASA physical status classification system (ASA PSCS) and these were included in the study once patients and legal representatives agreed to participate and written consent was signed.

Children submitted to emergent surgeries and with predicted postoperative Intensive Care Unit (ICU) admission were not included.

In those included in the study, children with canceled surgeries, unpredicted postoperative period admission in the ICU or children who failed to reply to the compulsory 24h inquiry were excluded.

Data Collection

Data were collected before, during and after the surgery, resorting to the consultation of clinical records, interviews with the patient and/or legal representatives and surgical monitorization, all of which was documented anonymously in a previously developed individual checklist, in which the following variables were considered:

- Demographic data: age, sex, weight (kg), height (cm), ASA PSCS (1-4) (Appendix 1), comorbidities;
- Data related to perioperative fasting: liquid fasting (hh:mm of last clear fluid intake), solid fasting (hh:mm of last solid/non clear fluid meal), time of restoring diet after surgery for clear fluids (hh:mm), time of restoring diet after surgery for solids/ non clear fluids (hh:mm);
- Surgical and anesthetic data: prior anesthesia appointment, operation room (CMIN/CICA), surgical procedure, surgical specialty, type of anesthesia; anesthesia induction (inhalational/intravenous); anesthesia times (starting time, end time and duration), peripheral blood glucose at beginning of anesthesia (mg/dL), heart rate (HR) (first value; beats per minute), blood pressure (BP) (systolic, mean, diastolic, first values; mmHg; previous to or after induction), fluids during the procedure (type and volume, mL), nausea and vomiting prophylaxis;
- Data related to the post-anesthetic care unit (PACU): duration of permanence in PACU, immediate postoperative nausea and vomiting (PONV), other immediate post-operative occurrences/complications, PACU maximum postoperative pain and at discharge (numeric visual scale [0-10-points] if 7 years old or older; Evendol scale [0-15 points] if younger than 7 years old). (Appendixes 2 and 3);
- Data related to pre and postoperative periods: PONV (yes/no), pre and postoperative irritability (yes/no), pre and postoperative headaches (yes/no), parental anxiety (0–10-point scale), parental satisfaction (0-10-point scale), postoperative pain (0-10-point scale).

For postoperative related data, participants were given a written survey with 8 questions, developed by the researcher, to fill in at 24 hours after surgery and to be returned afterward to the infirmary's nurse in charge, for inpatient surgery, whereas outpatients were contacted via

phone call, also at 24 hours after surgery, in which they were asked the same questions as the written ones. These included the previously mentioned data related to postoperative period.

Data Analysis

Data were analyzed using the SPSS Statistics® Data Analysis Software (IBM®), version 26.0, for macOS and version 27.0 for Windows.

A descriptive analysis of the variables was made using mean, standard deviation (SD), median, percentile (25^{th}/75^{th}), minimum (min.) and maximum (max.) values, as adequate. Continuous variables were tested for normality with the Kolmogorov-Smirnov Test of Normality. For ordinal and continuous variables without normal distribution, Mann Whitney U and Kruskal Wallis tests were applied; the independent samples t-test and ANOVA test were applied to continuous variables with normal distribution.

Categorical variables were evaluated based on their absolute and relative frequencies and respective percentages and both Chi-square test and Fisher exact test were used to access for statistical significance.

Pearson and Spearman's correlations were used to measure the strength of association between quantitative variables.

Solely blood pressure measurements after anesthetic induction were considered towards the analysis to diminish any chance of bias. To minimize bias in the collected data referring to hemodynamic parameters, values were normalized according to age, and variation of HR and BP according to mean value for age was calculated and considered towards the following comparative analysis.[21]

A confidence interval of 95% was considered for this study. The level of statistical significance was considered to be $p < 0,05$.

Results

Two hundred and ninety-six candidates were considered suitable for participation. Data were collected from a total of 259 participants and 196 were considered towards the subsequent analysis, as the remainder of the participants were discarded based on the previously stated exclusion criteria after inclusion or due to the researchers' inability to collect either consent or particular data. One candidate refused to participate. The selection process is clarified in Figure 1.

According to Kolmogorov-Smirnov Test for Normality, only height appears to follow a normal distribution (p = 0,097), from all continuous variables analyzed.

Patient demographic characteristics are summarized in Table i. Patients were mainly male, with an ASA PSCS score of 1 and had a median age of 8 years old.

Table ii describes data related to both anesthetic and surgical data. Most patients were submitted to surgeries in an outpatient regimen and at CMIN.

The summarized information about perioperative fasting times is outlined in Table iii.

Table iv shows the comparison between both fasting and reintroduction (reintrod.) times per period, per surgical regimen, per OR and per the existence of a pre-anesthetic appointment, which revealed significant differences between some groups.

The median duration of fasting and reintroduction times for both clear fluids and solids was significantly longer for patients who were submitted to surgery in the morning in comparison to those operated in the afternoon.

As for surgical regimens, a significant difference was found only between solid fasting times and surgical regimens, with times being lower in outpatients; however, there also appears to be a tendency towards inferior fluid fasting times in this regimen. Reinstatement times were also significantly different between surgical regimens, with these being longer in the inpatients' group.

Both fluids and solids reintroduction times were significantly lower when the surgery took place at CICA. The distribution of preoperative fasting for both clear fluids and solids was found to be independent of operation room and also of the existence of a preoperative anesthetic appointment. No differences were encountered in either of the reintroduction times when considering the existence of a pre-anesthetic appointment.

In regard to surgical specialty, preoperative fluid fasting duration was lower in Stomatology surgeries, when compared to other surgical specialties; however, no difference was found when considering solid fasting times. Both fluids and solids were reintroduced earlier after Ophthalmology surgical procedures (p = 0,005 for fluids and p = 0,008 for solids), considering all surgical specialties.

Blood pressure variation values follow a normal distribution according to Kolmogorov-Smirnov Test for Normality (systolic: p = 0,082; diastolic: p = 0,200 and mean: p = 0,200); the same does not apply to heart rate variation values (p = 0,005).

To facilitate posterior comparisons between fasting times and intraoperative parameters, patients were allocated into two different groups for both fluids and solids fasting times – these were divided between under and over 8 hours (480 minutes) for clear fluids and under and over 10 hours (600 minutes) for solids, as this distribution allowed a similar number of participants in each group.

A negative correlation was found between systolic blood pressure variation and fasting times for solids (p = 0,043, coefficient = - 0,177), with this not being equally truthful for fluids (p = 0,681). No correlation was found between fasting times for fluids or solids and either mean (p = 0,917 for fluids and p = 0,061 for solids) or diastolic (p = 0,249 for fluids and p = 0,721 for solids) blood pressure variations. In addition, there was no identifiable correlation between general preoperative fluid and solid fasting times and blood glucose levels (p = 0,290 for fluids and p = 0,589 for solids) or heart rate variation (p = 0,121 for fluids and p = 0,163 for solids).

Both systolic and mean blood pressure variations were significantly lower in patients whose solid fasting was 10 or more hours. However, no such differences were found between both diastolic blood pressure variation and heart rate per fasting groups. Blood pressure variation and heart rate variation comparisons per fasting groups are described in Table vi. No statistical difference was found between medians of blood glucose across fluid (p = 0,373) or solid fasting groups (p = 0,394).

Blood glucose was greater in morning surgeries (p = 0,001) when compared to afternoon ones (morning median: 85,50 mg/dL versus afternoon median: 79,00 mg/dL). Statistically significant differences were found in systolic blood pressure variations when comparing surgical periods, with the latter being negative in the morning (- 4,38 ± 17,72 mmHg) and positive in the afternoon (4,32 ± 19,27 mmHg) (p = 0,009).

Taking into consideration pre and postoperative parameters, an identifiable correlation was found between longer solid fasting and time at PACU (p = 0,039), with the same not being verified for fluid fasting (p = 0,714). No other identifiable correlations were encountered between preoperative fluid or solid fasting and postoperative parameters - maximum pain at PACU (p = 0,706 for fluids and p = 0,453 for solids), nausea at PACU (p = 0,827 for fluids and p = 0,358), nausea in the subsequent 24h after surgery (p = 0.375 for fluids and p = 0,295 for solids), pre (p = 0,090 for fluids and p = 0,320 for solids) and postoperative headaches (p = 0,569 for fluids and p = 0,722), pre (p = 0,980 for fluids and p = 0,442) and postoperative irritability (p = 0,656 for fluids and p = 0,706 for solids), parental anxiety (p = 0,188 for fluids and p = 0,246 for

solids) or parental satisfaction (p = 0,545 for fluids and p = 0,601 for solids). No child vomited at PACU. For vomiting in the subsequent 24h after surgery, there was also no significant association between vomiting in the first 24h and longer fasting periods (p = 0.258 for fluids and p=0.553 for solids).

Discussion

These results demonstrate that children at our hospital center are fulfilling preoperative fasting times much longer than desired, corroborating the previously reported occurrence of this situation in other studies. It was found that the majority of patients have a mean duration of fluid fasting times that is four and a half times what is recommended (approximately 9 hours versus the practiced 2 hours at our hospital center) and the mean duration of solids fasting times that is almost twice the existing recommendation (11 hours versus 6 hours). This difference is even more substantial in comparison to the most recent 1-hour recommendation for fluid fasting. A clinical audit on perioperative caregivers' satisfaction, performed between February – March 2020 at our hospital center, also found prolonged fasting to be one of the most distressing complaints of children's caregivers submitted to elective anesthesia and surgery. It might have been important to enquire parents and participants about the given instructions about preoperative fasting, so as to understand if these extended times derive from hospital recommendations or if there is any influence of parents' beliefs and fears regarding anesthetic procedures and fasting. Furthermore, considering the observed diminished preoperative solid fasting times in outpatients, it is important to evaluate the hospital's fasting procedures, as to comprehend what is standard practice in our institution and if this is up to date with current knowledge.

The results have shown a negative correlation between systolic blood pressure variation and fasting times for solids, evidencing that longer fasting times tend to cause a reduction in systolic blood pressure. A possible explanation for this finding lies in dehydration associated with reduced intake. Furthermore, there were also significant differences found between both systolic and mean blood pressure variations between fasting groups (under and over 10 hours), proving once again that these tend to be considerably lower when prolonged fasting is practiced. These outcomes prove that impactful measures must be taken in order to substantially reduce fasting times and avoid the incidence of these complications at our hospital center.

Both fluids and solids' preoperative fasting times are significantly inferior in afternoon surgeries. This is probably justifiable considering that in children with predicted morning surgical time, who already sleep through the night, it can be difficult to manage food and fluid ingestion to avoid such long fasting periods, as parents are often reluctant to wake up their children in order to feed them. Perhaps individually adjusted times for fasting, in accordance with predicted surgical timing, can help parents to better manage this situation.

The maintenance of appropriate fasting times during daily practice is often difficult, as there is a certain unpredictability to the timing of each surgery, given cancellations or any unexpected delays. Therefore, to create sustainable differences in fasting times, surgical operation rooms

would require a much stricter organization, prioritizing younger children when establishing an order of entrance, as this population is theoretically more susceptible to complications. Moreover, and complementing the previous measure, in patients already admitted to hospital but whose surgery is not predicted to start in the following two hours after admission (perhaps one hour, considering the latest guidelines), a sugary clear fluid drink should be provided, with this measure contributing to children's well-being, apart from a valuable reduction in fasting times, in a controlled manner.[14]

Lower blood glucose levels were expected to be found in longer fasting times, yet no significant relationship was discovered. This could be related to our finding of higher blood glucose levels in patients submitted to surgery during the morning, which can possibly be associated with the circadian rhythm and decurrent cortisol secretion or even due to increased stress levels in these patients due to longer fasting times.[22] In addition, systolic blood pressure variation was significantly different in the afternoon surgical period (positive) when compared to the morning (negative), what might possibly result from lower fasting duration and perhaps less dehydration, which is consistent with the negative correlation found between longer fasting times and systolic blood pressure variation.

The present investigation encountered a few limitations. There were multiple patients forcingly excluded due to missing information, which has happened as inpatients often failed to deliver the written inquiry, whereas outpatients often did not answer the phone call at 24h following surgery, even though they were informed of its occurrence and agreed to cooperate. Furthermore, there were some discrepancies found in paper versus digital anesthetic records, as, for instance, actual data were not appropriately registered or the handwriting of anesthetists was difficult to perceive, with this conditioning the collected information and often leading to missing information. Taking into consideration the wide range of ages comprised in this study, it was found that some questions were sometimes difficult to adjust to different ages - as for example the matter of irritability being a significant alteration in younger children, yet it is not as valid for adolescents.

At this point, several issues have been presented in this study, for which some suggestions for improvement can be made, as this has served a secondary purpose as an informal clinical audit, allowing the opportunity to further improve the provided quality of care at our hospital center. Firstly, there should be stronger preoperative reinforcement about fasting times and particularly, the safety of shorter fasting times, to both caregivers and nursing staff, using straight-forward diagrams with time recommendations, apart from simple and visual leaflets with examples of clear fluid sugary drinks allowed. The hospital center could also look into strategies for improving surgical schedules, so as to reduce OR delays and booking changes,

which ultimately lead to increased fasting times. In this context, and if required, sugary clear fluids should be available for children to avoid prolonged fasting, certain that they are provided in a controlled environment and with prior approval being given by the anesthesiologist in charge. There is also room for improvement regarding the reinstatement of oral intake after surgery, as this procedure could also be optimized by making diet reintroduction available sooner, particularly in inpatient facilities, with nursing staff being sensitized to anesthesiologists' instructions for allowance of diet reintroduction.

Conclusion

In accordance with the primary aim of this study, it has been identified that pediatric patients submitted to surgical procedures in our hospital center are not following international recommendations towards preoperative fasting duration, with the results largely surpassing the currently endorsed timings.

It was identified that prolonged solid fasting appears to have a significant impact on blood pressure, particularly systolic, with longer fasting durations being related to the occurrence of hypotension. However, the same cannot be described regarding other intraoperative metabolic and hemodynamic parameters, such as blood glucose or heart rate.

Nonetheless, the fasting duration does not seem to affect the individual quality of the postoperative recovery period.

This study has clearly allowed the documentation of an important problem regarding the perioperative fasting in our hospital center, and it would be relevant to understand if these fasting times are isolated or if this is a regional or even national tendency. Implementation of strategies should be carried out to improve adherence to national and international guidelines, further improving children's perioperative care.

Figures and Tables

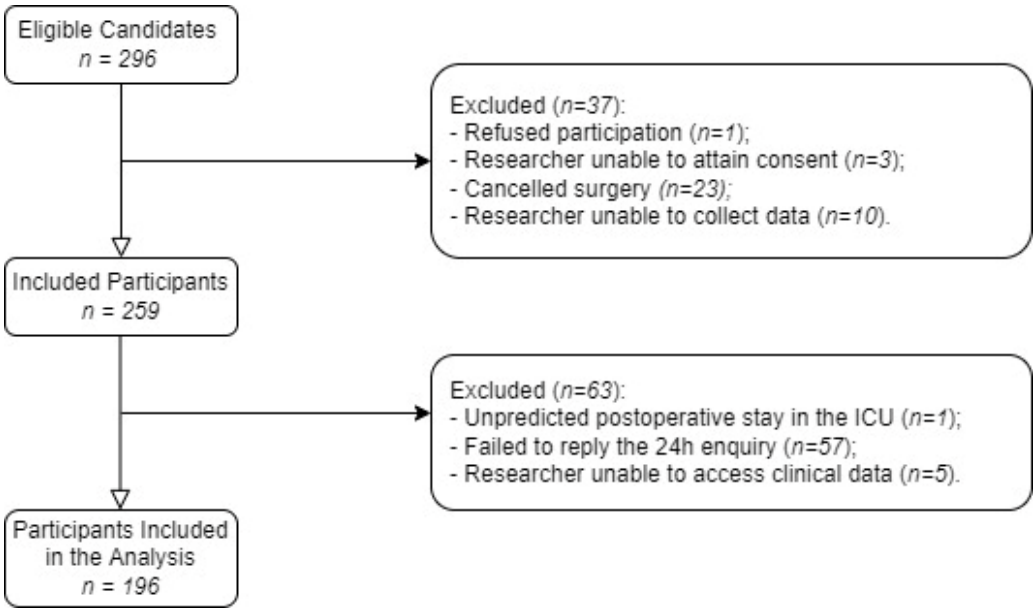

Figure 1 – Selection Process Flowchart

Table i - Demographic Data

Demographic Data	
	N (%)
Sex	196
Male	133 (67,9%)
Female	63 (32,1%)
ASA Physical Status Classification System	196
1	114 (58,2%)
2	72 (36,7%)
3	8 (4,1%)
4	2 (1,0%)

	N	*Median*	*Percentiles*		*Minimum*	*Maximum*
			25	*75*		
Age (years)	196	8,00	5,00	13,00	0,08	18,00
Weight (kilograms)	196	28,00	19,00	49,75	4,30	102,00

	N	Mean ± SD	Median	Minimum	Maximum
Height (centimeters)	151	131,56 ± 29,85	130,00	50,00	195,00

Table ii - Anesthetic and Surgical Data

Anesthetic and Surgical Data	
	N (%)
Type of Anesthesia	196
Balanced	107 (54,6%)
Inhalational	35 (17,9%)
Combined	22 (11,2%)
Sedation	17 (8,7%)
Total Intravenous	15 (7,7%)
Pre-Operative Anesthetic Appointment	196
Yes	154 (78,6%)
No	42 (21,4%)
Surgical Regimen	196
Outpatient	128 (65,3%)
Inpatient	68 (34,7%)
Operation Room (OR)	196
CMIN	124 (63,3%)
CICA	72 (36,7%)
Surgical Specialty	196
Pediatric Surgery	92 (46,9%)
Ears, Nose and Throat (ENT)	33 (16,8%)
Stomatology	24 (12,2%)
Urology	18 (9,2%)
Orthopedics	17 (8,7%)
Plastic Surgery	7 (3,6%)
Ophthalmology	5 (2,6%)
Surgical Period	192
Morning	102 (53,1%)
Afternoon	90 (46,9%)
Parents Present During Anesthetic Induction	182
Yes	155 (85,2%)
No	27 (14,8%)
Induction Type	182
Inhalational	82 (45,1%)

Intravenous	100 (54,9%)
Fluid Type	195
Polyelectrolyte Solution (without glucose) (PES)	156 (80,0%)
0,9% Sodium Chloride	25 (12,8%)
PES + Polyelectrolyte Solution with 5% Glucose (PoliG)	10 (5,1%)
Polyelectrolyte Solution with 5% Glucose	4 (2,1%)
Comorbidities	196
None Reported	122 (62,2%)
Neurological | Neurodevelopmental	17 (8,7%)
Respiratory | Allergic	11 (5,6%)
Uronephrologic	7 (3,6%)
Dysmorphias | Genetic | Malformations	3 (1,5%)
Endocrine | Metabolic	3 (1,5%)
Cardiovascular	3 (1,5%)
Psychiatric	1 (0,5%)
Multiple	29 (14,8%)
Nausea and Vomiting Prophylaxis	196
Yes	183 (93,4%)
Dexamethasone	172 (87,8%)
Ondansetron	154 (78,6%)
Metoclopramide	1 (0,5%)
No	13 (6,6%)

Table iii - Perioperative Fasting Times

Perioperative Fasting Times						
	N	*Median*	*Percentiles* 25	75	*Min.*	*Max.*
Fasting Time for Clear Fluids (hours)	193	9,48	6,50	12,32	2	23
Fasting Time for Solids (hours)	193	11,08	8,28	13,98	4	23
Fluids' Reintroduction Time (hours)	189	2,00	1,11	2,71	0,23	19,22
Solids' Reintroduction Time (hours)	181	2,60	1,50	4,29	0,27	27

Comparison of Fasting Times per Surgical Period									
	Morning				*Afternoon*				*P*
	N	*Median*	*Percentiles*		*N*	Median	*Percentiles*		*value*
			25	*75*			*25*	*75*	
Fasting Time for Clear Fluids (hours)	99	11,92	9,98	13,30	90	6,88	5,07	8,56	<0,001
Fasting Time for Solids (hours)	99	13,00	11,58	14,42	90	8,40	7,28	10,20	<0,001
Fluids' Reintrod. Time (hours)	99	2,23	1,50	3,42	86	1,44	1,00	2,02	<0,001
Solids' Reintrod. Time (hours)	93	3,00	2,00	4,78	84	1,80	1,14	3,56	<0,001
Comparison of Fasting Times per Surgical Regimen									
	Inpatient				*Outpatient*				*P*
	N	*Median*	*Percentiles*		*N*	Median	*Percentiles*		*value*
			25	*75*			*25*	*75*	
Fasting Time for Clear Fluids (hours)	65	10,72	6,94	13,00	128	8,39	5,69	12,00	0,074
Fasting Time for Solids (hours)	66	12,75	10,48	14,27	127	10,28	7,87	13,50	0,002
Fluids' Reintrod. Time (hours)	67	2,60	2,00	4,03	122	1,50	1,00	2,10	<0,001
Solids' Reintrod. Time (hours)	60	3,38	2,59	5,32	121	2,00	1,14	3,54	<0,001
Comparison of Fasting Times per OR									
	CMIN				*CICA*				*P*
	N	*Median*	*Percentiles*		*N*	Median	*Percentiles*		*value*
			25	*75*			*25*	*75*	
Fasting Time for Clear Fluids (hours)	121	9,40	6,83	12,55	72	9,88	5,53	12,00	0,642
Fasting Time for Solids (hours)	122	11,23	8,73	14,04	71	10,97	7,60	13,70	0,227
Fluids' Reintrod. Time (hours)	119	2,18	1,50	3,33	86	1,43	1,00	2,00	<0,001

Solids' Reintrod. Time (hours)	112	2,79	1,96	4,53	69	1,73	1,00	3,78	0,001
Comparison of Fasting Times per Pre-Anesthetic Appointment									
	Yes				*No*				*P value*
	N	*Median*	*Percentiles*		*N*	Median	*Percentiles*		
			25	*75*			*25*	*75*	
Fasting Time for Clear Fluids (hours)	151	8,67	5,75	12,42	42	10,26	7,36	11,94	0,266
Fasting Time for Solids (hours)	152	11,23	8,19	13,99	41	10,97	8,56	13,89	0,969
Fluids' Reintrod. Time (hours)	150	2,00	1,08	2,76	39	1,72	1,15	2,42	0,367
Solids' Reintrod. Time (hours)	142	2,60	1,50	4,45	39	2,60	1,40	4,00	0,771

Table v - Intraoperative Parameters

Intraoperative Parameters						
	Total Sample					
	N	*Median*	*Percentiles* *25*	*75*	*Minimum*	*Maximum*
Blood Glucose (mg/dL)	173	81,00	74,00	90,00	40	111
Heart Rate (beats per minute)	182	92,00	78,00	105,00	51	173
Heart Rate Variation (beats per minute)	182	1,00	-10,00	14,25	-39	78
Blood Pressure (mmHg) *After Anesthetic Induction*						
Systolic	131	95,00	87,00	109,00	65	170
Diastolic	131	49,00	42,00	57,00	30	90
Mean	131	69,00	61,00	78,00	42	109

	N	Mean ± SD	Median	Minimum	Maximum
Blood Pressure Variation (mmHg) *After Anesthetic Induction*					
Systolic	131	0,59 ± 19,03	- 2,00	- 46	54
Diastolic	131	- 15,04 ± 12,43	-15,00	- 44	18
Mean	131	- 6,15 ± 13,60	- 8,00	- 34	37

Table vi - Comparison of Hemodynamic Parameters Variation per Fasting Group

Comparison of Hemodynamic Parameters Variation per Fasting Group								
Blood Pressure Variation per Fasting Group								
Clear Fluids Fasting								
	Clear Fluids Fasting ≥ 8h				*Clear Fluids Fasting < 8h*				*P value*
	N	*Mean ± SD*			*N*	*Mean ± SD*			
Systolic BP Variation	64	0,28 ± 19,34			67	1,36 ± 19,46			0,751
Mean BP Variation	64	-6,45 ± 13,45			67	-6,23 ± 13,70			0,925
Diastolic BP Variation	64	-13,90 ± 11,70			67	-16,61 ± 12,87			0,215
Solid Fasting									
	Solids Fasting ≥ 10h				*Solids Fasting < 10h*				*P value*
	N	*Mean ± SD*			*N*	*Mean ± SD*			
Systolic BP Variation	73	-3,04 ± 18,59			58	5,79 ± 19,28			0,009
Mean BP Variation	73	-9,31 ± 12,42			58	-2,40 ± 14,20			0,004
Diastolic BP Variation	73	-16,14 ± 12,56			58	-14,16 ± 12,22			0,368
Heart Rate Variation per Fasting Group									
Clear Fluids Fasting									
	Clear Fluids Fasting ≥ 8h				*Clear Fluids Fasting < 8h*				*P value*
	N	*Median*	*Percentiles*		*N*	Median	*Percentiles*		
			25	*75*			*25*	*75*	
Heart Rate Variation	101	2,00	-7,50	15,00	79	-10,00	-14,00	9,00	0,077
Solid Fasting									
	Solids Fasting ≥ 10h				*Solids Fasting < 10h*				*P value*
	N	*Median*	*Percentiles*		*N*	Median	*Percentiles*		
			25	*75*			*25*	*75*	
Heart Rate Variation	112	2,00	-7,00	12,75	68	-2,00	-12,00	15,0	0,255

Appendixes

ASA PS Classification	Definition	Adult Examples, Including, but not Limited to:	Pediatric Examples, Including but not Limited to:	Obstetric Examples, Including but not Limited to:
ASA I	A normal healthy patient	Healthy, non-smoking, no or minimal alcohol use	Healthy (no acute or chronic disease), normal BMI percentile for age	
ASA II	A patient with mild systemic disease	Mild diseases only without substantive functional limitations. Current smoker, social alcohol drinker, pregnancy, obesity (30<BMI<40), well-controlled DM/HTN, mild lung disease	Asymptomatic congenital cardiac disease, well controlled dysrhythmias, asthma without exacerbation, well controlled epilepsy, non-insulin dependent diabetes mellitus, abnormal BMI percentile for age, mild/moderate OSA, oncologic state in remission, autism with mild limitations	Normal pregnancy*, well controlled gestational HTN, controlled preeclampsia without severe features, diet-controlled gestational DM.
ASA III	A patient with severe systemic disease	Substantive functional limitations; One or more moderate to severe diseases. Poorly controlled DM or HTN, COPD, morbid obesity (BMI ≥40), active hepatitis, alcohol dependence or abuse, implanted pacemaker, moderate reduction of ejection fraction, ESRD undergoing regularly scheduled dialysis, history (>3 months) of MI, CVA, TIA, or CAD/stents.	Uncorrected stable congenital cardiac abnormality, asthma with exacerbation, poorly controlled epilepsy, insulin dependent diabetes mellitus, morbid obesity, malnutrition, severe OSA, oncologic state, renal failure, muscular dystrophy, cystic fibrosis, history of organ transplantation, brain/spinal cord malformation, symptomatic hydrocephalus, premature infant PCA <60 weeks, autism with severe limitations, metabolic disease, difficult airway, long term parenteral nutrition. Full term infants <6 weeks of age.	Preeclampsia with severe features, gestational DM with complications or high insulin requirements, a thrombophilic disease requiring anticoagulation.
ASA IV	A patient with severe systemic disease that is a constant threat to life	Recent (<3 months) MI, CVA, TIA or CAD/stents, ongoing cardiac ischemia or severe valve dysfunction, severe reduction of ejection fraction, shock, sepsis, DIC, ARD or ESRD not undergoing regularly scheduled dialysis	Symptomatic congenital cardiac abnormality, congestive heart failure, active sequelae of prematurity, acute hypoxic-ischemic encephalopathy, shock, sepsis, disseminated intravascular coagulation, automatic implantable cardioverter-defibrillator, ventilator dependence, endocrinopathy, severe trauma, severe respiratory distress, advanced oncologic state.	Preeclampsia with severe features complicated by HELLP or other adverse event, peripartum cardiomyopathy with EF <40, uncorrected/decompensated heart disease, acquired or congenital.
ASA V	A moribund patient who is not expected to survive without the operation	Ruptured abdominal/thoracic aneurysm, massive trauma, intracranial bleed with mass effect, ischemic bowel in the face of significant cardiac pathology or multiple organ/system dysfunction	Massive trauma, intracranial hemorrhage with mass effect, patient requiring ECMO, respiratory failure or arrest, malignant hypertension, decompensated congestive heart failure, hepatic encephalopathy, ischemic bowel or multiple organ/system dysfunction.	Uterine rupture.
ASA VI	A declared brain-dead patient whose organs are being removed for donor purposes			

** Although pregnancy is not a disease, the parturient' s physiologic state is significantly altered from when the woman is not pregnant, hence the assignment of ASA 2 for a woman with uncomplicated pregnancy.*

***The addition of "E" denotes Emergency surgery: (An emergency is defined as existing when delay in treatment of the patient would lead to a significant increase in the threat to life or body part)*

Appendix 1 - ASA Physical Status Classification System [23]

Appendix 2 - Visual Numeric Pain Scale [24]

Pontuação de 0 a 15. Valor limite para o tratamento: 4/15.
O recém-nascido deve ser observado por 30 segundos imediatamente após o procedimento.

					Analgesia ⇓					
Nome do paciente:	Sinal Ausente	Sinal Fraco ou transitório	Sinal Moderado ou presente cerca de metade do tempo	Sinal Forte ou presente durante quase todo o tempo	Avaliação na admissão:		Avaliação no seguimento e/ou após analgesia [c]			
					No repouso [a]: (R)	Durante o exame ou movimentação da criança (M) [b]	RM	RM	RM	RM
Verbalização ou vocalização	0	1	2	3						
Expressão facial	0	1	2	3						
Movimentação	0	1	2	3						
Postura	0	1	2	3						
Interação com o ambiente	Normal 0	Baixo 1	Muito Baixo 2	Ausente 3						
Observações	Total/15:									
	Data e horário:									
	Assinatura:									

[a] No repouso (R): observe a criança de uma distância, antes de realizar exame físico ou procedimento, no repouso, assegurando as melhores condições possíveis de segurança e conforto (por exemplo criança próxima aos pais ou quando ela estiver brincando).

[b] Durante exame ou mobilização (M): avaliar a dor durante o exame ou movimentação ou palpação de área dolorosa pelo médico ou enfermeiro.

[c] Reavaliar a dor regularmente após administração de analgésico: esperar 30 a 45 minutos se o analgésico for administrado por via oral ou retal, 5 a 10 minutos se for administrado por via intravenosa (IV). Anotar se a criança está em repouso (R) ou movimentação (M)

Appendix 3 - EVENDOL Pain Scale (Portuguese version). Version used with prior authorization from the authors.[25]

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