ISSN: 2474-9206

Research Article

Journal of Anesthesia & Pain Medicine

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

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Submitted: 2024 Oct 09; **Accepted**: 2024 Nov 21; **Published**: 2024 Dec 27

Citation: Goncalves, A. R., Pestana, I., Brandao, M. I., Duarte, S., Pina, P., Machado, H. (2024). The Impact of Paediatric Perioperative Fasting on Intraoperative Parameters and Postoperative Period Quality. *J Anesth Pain Med, 9*(4), 01-09.

Abstract

Introduction: *In 2022, European guidelines updated fasting recommendations to a 1-3-6-hour rule to reduce fasting durations in pediatric patients submitted to anaesthesia.*

Aim: *Our main goal was to confirm the duration of pediatric preoperative fasting, evaluating its impact on perioperative variables.*

Methods: *Prospective, observational single-centre study, including all consecutive pediatric patients scheduled for elective surgeries during two months. Data were collected perioperatively and follow up was made until 24h postoperative. The impact of fasting duration was evaluated specifically in glycemia, heart rate and blood pressure.*

Results: *One hundred and ninety sixt children were included. Median fasting periods for clear fluids and solids were 9,48 and 11,08 hours, respectively. The median time for fluid reintroduction after surgery was 2,00 hours, whereas for solids was 2,60 hours. Median duration of fasting and reintroduction of oral intake was significantly longer in patients submitted to surgery in the morning (p<0.001). Systolic blood pressure variation at the beginning of anesthesia was negatively correlated with fasting times for solids (p=0,043). Systolic blood pressure at the beginning of anesthesia was statistically lower in the morning (p=0,009). Glycemia had no significant relationship with fasting times and it was significantly higher in the morning (p=0,001). Both systolic and mean blood pressure variations were significantly lower in patients who fasted for solids for more than 10 hours (p=0,009 and p=0,004, respectively).*

Conclusions: *Fasting times for paediatric patients submitted to surgical procedures at our hospital 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: Anaesthesia, Paediatrics, Fasting, Perioperative Care

Brief Points:

'What is already known on this topic'

- Fasting is essential for prevention of aspiration during anaesthesia procedures;
- Fasting guidelines were recently updated to a 1-3-6 hours regimen in order to reduce its detrimental effects in pediatric patients submitted to anesthetic procedures.

'What this paper adds'

- Compliance to fasting instructions should be evaluated in paediatric centres, observed times could be much more extended than recommended ones;
- Prolonged fasting seems to be associated with systolic hypotension at the beginning of anaesthesia.

1. Introduction

Ensuring preoperative fasting is a basic anaesthetic principle that aims to reduce the risk of pulmonary aspiration. Guidelines towards paediatric anaesthesia in Europe have recently established a 1-hour rule for clear fluids fasting (defined as water with or without sugar, pulp-free juice, tea or coffee) and a 3-hour rule for breast milk fasting prior to anaesthetic 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 current recommendations are founded upon an expanding consensus at the global level advocating a transition toward a more liberal clear fluids policy considering the detrimental effects of prolonged fasting and g the residual incidence rates of pulmonary aspiration [3-9]. These guidelines are supported by studies of gastric emptying physiology within the pediatric population, mainly employing ultrasound and magnetic resonance techniques.

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 with fasting instructions and, in children scheduled for morning surgeries, the reluctance to wake children up for night-time feeding. This ultimately results in a prolonged duration of fasting times which is associated with evident detrimental consequences regarding metabolic and haemodynamic parameters, apart from verbal manifestations of discomfort, hunger and thirst [8-12]. Furthermore, both intra- and postoperative complications - namely hypoglycemia, hydroelectrolytic imbalances, postoperative nausea and vomiting, impaired consciousness, anxiety and dehydration - can occur as a result of the previously mentioned systemic changes [13]. Hence, the reduction of fasting periods can exert a beneficial impact on both the catabolic and proinflammatory states induced by the surgical procedure [14].

It is estimated that a 2 hours clear fluid fasting recommendation can correspond to an accurate fasting time of over 10 hours, with studies proving that under stricter protocols, these times can be reduced, largely benefiting the patient [12,15-19].

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 more cautiously, even if gastrointestinal function has not resumed [4,20].

In an attempt to monitor current practice at our centre and improve the quality of provided care, the primary aim of this study was to analyse the duration of perioperative fasting within our institution, as well as its impact on metabolic and hemodynamic intraoperative parameters and postoperative recovery period.

2. Methods

2.1. Ethical Considerations

This study was preceded by an official approval from the Hospital Board and Ethical Committee. Written informed consent from legal representatives (and adolescents, if 16 years of age or older) was obtained. Confidentiality and anonymity were ensured through the entire process.

2.2. Study Design and Sample

The current investigation was designed as an observational, prospective single-center study carried out during two months. All consecutive paediatric patients (0 – 18 years) scheduled for elective surgical procedures under anaesthesia were considered eligible, regardless of the surgical specialty or ASA physical status classification system (ASA PSCS) after patients or legal representatives agreed to participate and written consent was signed.

Children submitted to emergent surgeries and with planned postoperative Intensive Care Unit (ICU) admission were not eligible. Pediatric cases with cancelled surgeries, unanticipated postoperative admissions to the ICU or those who did not respond to the mandatory 24-hour inquiry were excluded from the study.

2.3. Data Collection

Data were collected during the preoperative, intraoperative, and postoperative periods through the examination of clinical records and interviews conducted with the patient and/or legal representatives. The considered variables encompassed the following:

- Demographic data: age, sex, weight (kg), height (cm), ASA PSCS (1-4);
- Data regarding perioperative fasting: fasting for clear fluids and solid/non-clear fluids and time of resumption of oral intake for clear fluids and solid/non-clear fluids (hh:mm)

- Surgical and anaesthetic data: prior anaesthesia appointment, surgical specialty, type of anaesthesia, anaesthesia times, peripheral blood glucose at beginning of anaesthesia (mg/dL), heart rate (HR) (first value; beats per minute), blood pressure (BP) (systolic, mean, diastolic, first values; mmHg; previous to or after induction), postoperative nausea and vomiting prophylaxis;
- Data concerning post-anaesthetic care unit (PACU): duration of stay, postoperative nausea and vomiting (PONV), complications, 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) [21];
- Data from 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 data, participants received a written survey comprising eight questions to be completed within 24 hours following inpatient surgery. Outpatients, on the other hand, were contacted by phone 24 hours after surgery.

2.4. Data Analysis

Data were analysed using the SPSS Statistics® (IBM®), version 26.0 for macOS.

A descriptive analysis of the variables was made using mean, standard deviation (SD), median, percentile (25th/75th), minimum (min.) and maximum (max.) values, as adequate. Continuous variables were tested for normality with the Kolmogorov-Smirnov Test of Normality. Mann Whitney U, Kruskal Wallis tests, independent samples t-test and ANOVA test were applied as adequate. Pearson and Spearman's correlations were used to measure the strength of association.

Categorical variables were evaluated based on their absolute frequency and percentage and Chi-square test and Fisher exact test were used to assess statistical significance.

Solely blood pressure measurements after anaesthetic induction were considered towards the analysis to diminish bias. To minimise bias referring to hemodynamic parameters, values were normalised according to age, and variation of HR and BP according to mean value for age was calculated and considered towards the following comparative analysis [22].

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

3. Results

Out of the 296 candidates considered suitable for participation, 196 were deemed eligible for subsequent analysis, while the remaining

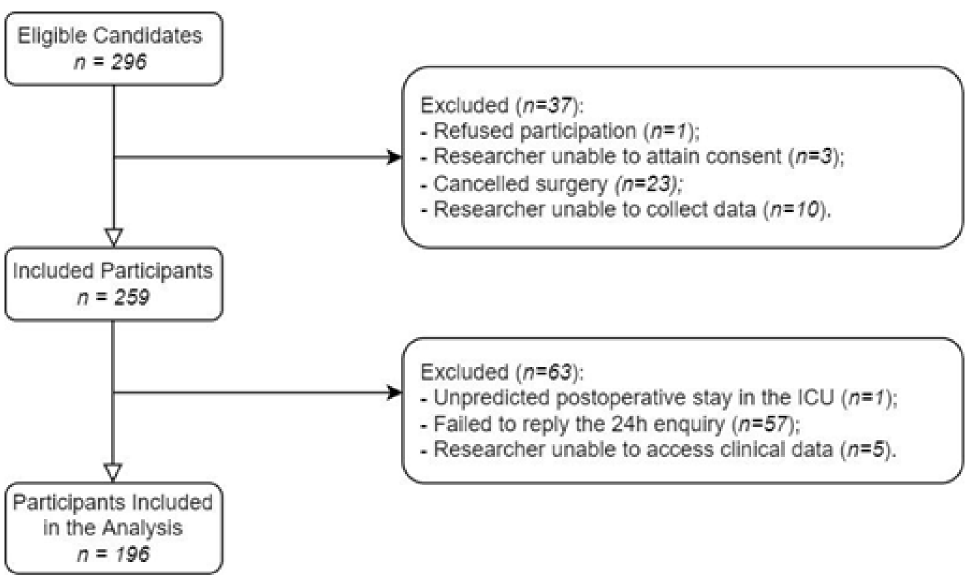

Figure 1: Selection Process Flowchart

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

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

Demographic Data						
Sex		Male			Female	
N= 196 (%) (100%)		133 (67,9%)			63 (32,1%)	
ASA Physical Status Classification System	1	2		3	4	
N = 196 (%) (100%)	114 (58,2%)	72 (36,7%)		8 (4,1%)	2 (1,0%)	
	N	Median	Percentiles 25	75	Minimum	Maximum
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 1: Demographic Data

Table 2 describes both anaesthetic and surgical data. Most patients were submitted to surgeries in an outpatient regimen.

Anaesthetic and Surgical Data	N (%)
Type of Anaesthesia	196
Balanced	107 (54,6%)
Inhalational	35 (17,9%)
Combined	22 (11,2%)
Sedation	17 (8,7%)
Total Intravenous	15 (7,7%)
Pre-Operative Anaesthetic Appointment	196
Yes	154 (78,6%)
No	42 (21,4%)
Surgical Regimen	196
Outpatient	128 (65,3%)
Inpatient	68 (34,7%)
Surgical Specialty	196
Paediatric Surgery	92 (46,9%)
Ears, Nose and Throat (ENT)	33 (16,8%)
Stomatology	24 (12,2%)
Urology	18 (9,2%)
Orthopaedics	17 (8,7%)
Plastic Surgery	7 (3,6%)
Ophthalmology	5 (2,6%)
Surgical Period	192
Morning	102 (53,1%)
Afternoon	90 (46,9%)
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 2: Anaesthetic and Surgical Data

The summarised information about perioperative fasting times is outlined in Table 3.

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 value**
	N	**Median**	**Percentiles**		**N**	**Median**	**Percentiles**		
			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 value**
	N	**Median**	**Percentiles**		**N**	**Median**	**Percentiles**		
			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.	99	2,23	1,50	3,42	86	1,44	1,00	2,02	<0,001
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

Table 3: Perioperative Fasting Times and Comparison of Fasting Times

Table 4 illustrates the comparison of fasting and reintroduction times per surgical period, surgical regimen and the presence of a pre-anaesthetic appointment.

Intraoperative Parameters						
Total Sample						
	N	**Median**	**Percentiles**		**Minimum**	**Maximum**
			25	**75**		
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 Anaesthetic 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 Anaesthetic Induction						
Systolic	131	0,59 ± 19,03	- 2,00	- 46	54	173
Diastolic	131	- 15,04 ± 12,43	-15,00	- 44	18	78
Mean	131	- 6,15 ± 13,60	- 8,00	- 34	37	170
Diastolic	131	49,00	42,00	57,00	30	90
Mean	131	69,00	61,00	78,00	42	109

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

Table 4: Intraoperative Parameters and Comparison per Fasting Group

The median durations of fasting and reintroduction times for both clear fluids and solids were significantly longer for patients submitted to surgery in the morning as opposed to those who underwent afternoon procedures.

As for surgical regimens, a significant difference was found between solid fasting times and surgical regimens, with durations being shorter among outpatients; there also appears to be a tendency towards inferior fluid fasting times in this regimen. The presence of a preoperative anesthetic appointment did not result in any difference in preoperative fasting durations.

Timing of reintroduction of oral intake also exhibited significant variation between surgical regimens, with durations being lengthier in the inpatients' group.

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).

In order to facilitate subsequent comparisons between fasting times and intraoperative parameters, patients were categorized into two distinct groups for both clear fluids and solids fasting durations. These were divided delineated based on intervals of under and over 8 hours (480 minutes) for clear fluids and under and over 10 hours (600 minutes) for solids.

A negative correlation was found between systolic blood pressure variation and fasting times for solids (p=0,043, coefficient=-0,177), which was not statistically significant 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), diastolic blood pressure variations (p=0,249 for fluids and p=0,721 for solids) or heart rate variation (p=0,121 for fluids and p=0,163 for solids). Statistically significant differences were found in systolic blood pressure variations when comparing surgical periods, with the latter being lower in the morning (-4,38±17,72 mmHg) and higher in the afternoon (4,32±19,27 mmHg) (p = 0,009).

After dividing patients per fasting categories, namely under and over 8 or 10 hours for clear fluids and solids, respectively: 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. (Table 4).

Regarding blood glucose levels, no statistically significant 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 patients whose surgeries were performed in the morning (p=0,001) as compared to those carried out in the afternoon (85,50 mg/dL versus 79,00 mg/dL).

Considering pre- and postoperative parameters, a correlation was found between longer solid fasting and time at PACU (p=0,039), which was not established for fluid fasting (p=0,714). No other identifiable correlations were encountered between preoperative fluid or solid fasting and postoperative parameters (p>0,05) – for maximum pain at PACU, nausea at PACU, nausea in the subsequent 24 hours after surgery, pre- and postoperative headaches, pre-and postoperative irritability, parental anxiety or parental satisfaction. There were no episodes of postoperative vomiting at PACU, for vomiting in the subsequent 24 hours after surgery, there was also no significant association between vomiting in the first 24 hours and longer fasting periods (p>0,05).

4. Discussion

Pediatric patients at our hospital center are exceeding the recommended preoperative fasting times by a considerable duration which is concordant to other studies. The mean duration of fluid fasting among patients at our center is 4.5 times longer than the recommended 2 hours and the mean duration of solid fasting times is nearly double the established 6-hour recommendation. This difference becomes even more significant when compared to the latest 1-hour recommendation for fluid fasting.

The results indicate a negative correlation between systolic blood pressure variation and fasting times for solids, demonstrating that prolonged fasting times tend to be associated with a decrease in systolic blood pressure. This could possibly be explained by dehydration associated with reduced intake. Significant differences were also observed in both systolic and mean blood pressure variations among fasting groups (under and over 10 hours), indicating that these tend to be substantially lower with prolonged fasting practices.

Preoperative fasting times for both fluids and solids are notably shorter for surgeries performed in the afternoon. This can be attributed to the challenge of managing food and fluid intake in children with predicted morning surgical times, particularly those who have already sleep at night., as parents are often reluctant to wake their children for feeding, contributing to these extended fasting periods. Perhaps implementing individually adjusted fasting times based on predicted surgical scheduling could help parents in managing this situation more effectively.

Achieving appropriate fasting times in daily practice can be challenging due to the inherent unpredictability associated with the timing of each surgery, including cancellations or unexpected delays. Therefore, to create persistent differences in fasting times, surgical operation rooms would require a stricter organisation, prioritising younger children when establishing an order of entrance, as this population is theoretically more susceptible to complications. Moreover, the provision of a sugary clear fluid drink could be implemented. This measure not only contributes to the well-being of children but also results in a valuable reduction in fasting times [14].

There were significant differences in systolic blood pressure variation between patients submitted to surgery in the afternoon surgical period (higher) when compared to those operated in the morning (lower). This finding may possibly result from lower fasting durations and perhaps less dehydration, which is consistent with the negative correlation found between longer fasting times and systolic blood pressure variation.

In addition, lower blood glucose levels were expected to be found in patients with longer fasting times, however, these patients had higher glucose levels. This result could be linked to the fact that cortisol secretion follows a circadian rhythm, with peak production in the morning. Increased stress-response among individuals with prolonged fasting times could also contribute to higher glucose levels in these patients [23].

5. Conclusion

It has been ascertained that pediatric patients undergoing surgical procedures at our hospital centre are not following international recommendations concerning preoperative fasting duration. The findings reveal that the observed fasting durations exceed the presently endorsed guidelines. Additionally, it has been noted that prolonged solid fasting appears to have a significant impact on blood pressure, specifically systolic pressure: extended fasting durations were associated with the occurrence of hypotension.

This study has documented a noteworthy issue concerning perioperative fasting. It would be pertinent to ascertain whether these fasting times are encountered only in our centre or indicative of a regional or even national trend.

The present investigation encountered certain limitations. Numerous patients were excluded due to missing information, as they did not respond to the 24-hour inquiry form. Furthermore, some questions proved challenging to adapt to different age groups, such as the assessment of irritability, which was more straightforward in younger children but less so in adolescents.

This study highlighted several issues that serve as an opportunity to modify current practice, namely by the implementation of more updated protocols and improve quality of care at our hospital centre.

Primarily, there should be heightened preoperative education regarding fasting times and the safety of shorter durations for both caregivers and nursing staff. This can be facilitated through explicit diagrams with time recommendations and visual leaflets providing examples of permissible clear fluid sugary drinks. The hospital center should also explore strategies to optimise surgical schedules, mitigating operating room delays and booking changes, which contribute to prolonged fasting times. In this context, sugary clear fluids should be made available for children to avoid prolonged fasting, ensuring they are provided in a controlled environment with prior approval from the attending anesthesiologist.

Furthermore, there is room for improvement in reinstating of oral intake after surgery. This process could be expedited, particularly in inpatient facilities, with nursing staff being sensitised to the instructions of anesthesiologists regarding diet reintroduction.

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