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Surgical Preoperative Fasting Duration Effects on Postoperative Insulin Resistance Index and Glucose Levels in Patients Undergoing Neurosurgery

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ABSTRACT

This study was designed to examine the effect of preoperative fasting duration on postoperative insulin resistance and glucose levels in patients who underwent brain and neurosurgery. This descriptive quantitative study was conducted between April 2023 and October 2023 in the Department of Brain and Neurosurgery at Bursa Uludağ University Health Practice and Research Center. The study population consisted of patients who had undergone surgery in the Department of Brain and Neurosurgery at Bursa Uludağ University Health Practice and Research Center within the past year, while the sample consisted of 171 patients who met the study criteria. The Individual Characteristics Form was used as the data collection tool. The obtained data were analyzed using the free trial version of Statistical Package for Social Sciences for Windows 25.0. Descriptive statistical methods (number, percentage, min-max values, median, mean, and standard deviation) were used to evaluate the research data. The normality of the data was examined using the Kolmogorov-Smirnov test. The Mann–Whitney U test was used for comparisons between the two groups. Spearman's correlation was applied to examine the relationships between variables. Looking at the descriptive characteristics of the patients, 61.4% were female, the average age was 52.38±14.92, and the average body mass index was 27.32±4.86. It was determined that 69% of the patients participating in the study did not smoke, and 78.9% had undergone surgery before. When patients were evaluated according to their medical diagnoses, 52.6% had undergone spinal surgery, 76% had undergone open surgery, and 93.6% had undergone surgery under general anesthesia. The average fasting duration after liquid food before surgery was 15.26±2.87 hours, the average fasting duration after solid food was 16.79±3.05 hours, the mean blood glucose level was 118.24±36.28, and the average insulin resistance index was 3.43±2.97. In conclusion, this study evaluated the effect of preoperative fasting duration on postoperative insulin resistance and glucose levels in patients.

Keywords: Preoperative Fasting, Insulin Resistance, Brain and Neurosurgery

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Beyin ve Sinir Hastalıkları Cerrahisi Hastalarında Ameliyat Öncesi Açlık Süresinin Ameliyat Sonrası İnsülin Direnci İndeksi ve Glikoz Düzeyine Etkisinin İncelenmesi

ÖZET

Bu araştırma, beyin ve sinir cerrahisi ameliyatı olan hastaların, ameliyat öncesi açlık sürelerinin ameliyat sonrasında insülin direncine ve glikoz düzeyine etkisini incelemek amacıyla planlandı. Nicel araştırma türlerinden tanımlayıcı tipte planlanan bu çalışma, Nisan 2023 – Ekim 2023 tarihleri arasında Bursa Uludağ Üniversitesi Sağlık Uygulama ve Araştırma Merkezi Beyin ve Sinir Cerrahisi bölümünde gerçekleştirildi. Araştırmanın evrenini Bursa Uludağ Üniversitesi Sağlık Uygulama ve Araştırma Merkezi Beyin ve Sinir Cerrahisi bölümünde son bir yıl içinde ameliyat olan hastalar oluştururken, çalışma kriterlerine uygun olan 171 hasta örneklemini oluşturdu. Araştırmada veri toplama aracı olarak Bireysel Özellikler Formu kullanıldı. Elde edilen veriler free trial version of Statistical Package for Social Sciences for Windows 25.0 programı kullanılarak analiz edildi. Araştırma verileri değerlendirilirken (sayı, yüzde, min-maks değerleri, medyan, ortalama, standart sapma) tanımlayıcı istatistiksel metotlar kullanıldı. Verilerin normalliği Kolmogrov-Smirnov testi ile araştırıldı. İki grup karşılaştırmalarında Mann Whitney U Testi kullanıldı. Değişkenlerin ilişkilerini incelemek için Spearman korelasyonu uygulandı. Hastaların tanıtıcı özelliklerine bakıldığında; % 61.4' ünün kadın, yaş ortalamasının 52.38±14.92, beden kitle indeksi ortalamasının 27.32±4.86 olduğu belirlendi. Araştırmaya katılan hastaların %69' unun sigara kullanmadığı, %78.9'unun daha önce ameliyat olduğu belirlendi. Hastalar tıbbi tanılarına göre değerlendirildiğinde %52.6'sının spinal cerrahi geçirdiği, % 76'sının açık cerrahi olduğu ve %93.6'sının genel anestezi altında ameliyat olduğu saptandı. Hastaların ameliyat öncesi sıvı gıda sonrası açlık süresi ortalamasının 15.26± 2.87, katı gıda sonrası açlık süresi ortalamasının ise 16.79± 3.05 olduğu, kan glikoz düzeyi ortalamasının 118.24± 36.28 olduğu ve insülin direnci indeksi ortalamasının 3.43± 2.97 olduğu saptandı. Sonuç olarak bu araştırma, hastaların ameliyat öncesi açlık sürelerinin ameliyat sonrası insülin direncine ve glikoz düzeylerine etkisini değerlendirmektedir.

Anahtar Kelimeler: Ameliyat Öncesi Açlık, İnsülin Direnci, Beyin ve Sinir Cerrahisi

1 Introduction

The preparation process before surgical intervention includes gastrointestinal, physiological, psychological, and legal preparations (Brady et al., 2003). Restriction of oral intake, an important step in this process, is referred to in the literature as "Nil Per Os" (NPO), meaning "nothing by mouth after midnight" (Søreide et al., 2005). The practice of NPO came to prominence in the 1800s after a patient died from aspirating stomach contents, and since then, the rule of fasting for at least eight hours before surgery has become widespread (Smith et al., 2011). However, prolonged fasting creates physiological, psychological, and metabolic stress for patients (Crenshaw and Winslow, 2008). Today, recommendations regarding fasting duration have changed to balance surgical safety and patient comfort. The American Society of Anesthesiologists (ASA) recommends a fasting period of two hours for clear liquids and six hours for light meals before surgery, and recent guideline updates also emphasize the importance of evidence-based perioperative nutrition practices and the use of carbohydrate-containing clear liquids to reduce metabolic stress (ASA, 2017; Joshi et al., 2023). However, studies have reported that, on average, patients remain without water for 12 h and without solid food for approximately 13.5 h prior to surgery (Feldheiser et al., 2016). This can disrupt the metabolic balance in surgical patients and lay the groundwork for postoperative complications.

In healthy individuals, blood glucose levels range between 70 and 100 mg/dl, and the elevated glucose level after eating returns to normal within two hours (Cebeci, 2020). However, during surgical stress, increased secretion of cortisol, catecholamines, and glucagon reduces insulin sensitivity, leading to hyperglycemia (Desborough, 2000). Since surgeries create acute stress, the metabolic rate increases, insulin resistance develops, and the recovery process is adversely affected (Thorell et al., 1999; Nygren et al., 2006). The unpredictability of operating room scheduling also causes patients to fast for longer than necessary. In particular, because of the variability in scheduled operation times for neurosurgery patients, the fasting period can be further prolonged. Zhu et al. reported that actual fasting durations were significantly longer than instructed fasting durations; in particular, the difference for solid food was approximately 3.5 hours in elective surgical patients (Zhu et al., 2021). These findings indicate that, in current surgical practices, patients have their oral intake stopped from midnight, and NPO durations exceed the limits specified in the guidelines (Bredy et al., 2003).

In recent years, Enhanced Recovery After Surgery (ERAS) protocols, which have rapidly become widespread in surgical care, support preoperative oral carbohydrate intake and aim to reduce the negative effects of prolonged fasting (Liu et al., 2019; Senapathi et al., 2022). Recent systematic reviews and meta-analyses have also emphasized the importance of evidence-based perioperative nutrition protocols and highlighted that the implementation of ERAS protocols in neurosurgical patients remains limited and requires further clinical evaluation (Şanlı et al., 2025; Choudhary et al., 2025). However, the applicability of these protocols remains limited in patients undergoing brain and neurosurgery procedures. Extended fasting periods lead to depletion of glycogen stores, increased insulin resistance, and disruption of metabolic balance (Bredy et al., 2003; Nygren et al., 2006).

This study was conducted to determine the effect of preoperative fasting duration on postoperative insulin resistance index and glucose levels in patients undergoing brain and neurosurgery.

2 Methodology

2.1 Type of Research

This descriptive study examined the effect of preoperative fasting duration on postoperative insulin resistance index and glucose levels in patients undergoing brain and neurosurgery.

2.2 Research Location and Time

The study was conducted at the Department of Brain and Neurosurgery, Bursa Uludağ University Health Practice and Research Center, between April 2023 and October 2023.

2.3 Sample and Sampling Method

The study population consisted of patients who underwent surgery in the Department of Neurosurgery at Bursa Uludağ University Health Practice and Research Center in the past year. The study sample included 171 patients who met the inclusion criteria determined from this population. The inclusion criteria were as follows: age > 18 years, undergoing elective surgery, receiving general anesthesia, able to communicate, and having preoperative and postoperative blood glucose levels measured. The exclusion criteria were as follows: undergoing emergency surgery, having a diagnosis of diabetes, using insulin or oral antidiabetic drugs, and having incomplete data.

2.4 Data Collection Tools

In this study, the Individual Characteristics Form, prepared by the researcher in line with the literature, was used as the data collection tool. This form includes questions aimed at determining the patients'sociodemographic and clinical characteristics. The form contains variables such as age, sex, body mass index, smoking status, history of previous surgeries, type of surgery, type of anesthesia, fasting duration, and pre- and postoperative glucose levels.

2.5 Data Collection

The research data were obtained by reviewing the patients' file records during the preoperative and postoperative periods. The patients' fasting durations were obtained from nursing observation forms and patient statements. Blood glucose levels and insulin resistance were obtained from laboratory records. The insulin resistance index (HOMA-IR) values were obtained directly from routine laboratory reports, where they were calculated automatically using fasting glucose and fasting insulin measurements. The researcher recorded the data using a standard data collection form.

2.6 Ethical Considerations

Approval for the study was obtained from the Bursa Uludağ University Faculty of Medicine Clinical Research Ethics Committee (decision dated 21.03.2023 and numbered 2023-6/16). Participants were informed about the study, and it was stated that participation was based on voluntariness, and written consent was obtained. This study was conducted in accordance with the principles of the 1964 Declaration of Helsinki. The identities of the participants were kept confidential, and the data were used only for scientific purposes.

2.7 Statistical Analysis

The data obtained were analyzed using SPSS Statistics for Windows 25.0 (free trial version). Descriptive statistical methods (number, percentage, minimum–maximum values, median, mean, and standard deviation) were used to evaluate the research data. The distribution of the data was assessed using the Kolmogorov–Smirnov test. The Mann-Whitney U test was used for comparisons between groups, and Spearman's correlation analysis was applied to examine the relationships between variables. Statistical significance was set at $p<0.05$.

3 Results

The participants' average fasting durations following liquid and solid food intake were 15.26±2.87 hours and 16.79±3.05 hours, respectively. The mean glucose level was 118.24±36.28 mg/dL, and the mean insulin resistance index was 3.43±2.97.

Table 1 presents the demographic and clinical characteristics of the patients included in the study. The mean age of the patients was 52.38±14.92 years, and 61.4% were female. Most of the patients underwent open surgery (76.0%) and received general anesthesia (93.6%). The mean body mass index was 27.32±4.86.

Table 1: *Distribution according to the demographic characteristics of the patients (N=171)*

Variables		**n**	**%**
Gender	Female	105	61.4
	Male	66	38.6
Smoking	Yes	53	31.0
	No	118	69.0
History of previous surgery	Yes	135	78.9
	No	36	21.1
Type of surgery	Open	130	76.0
	Laparoscopic	41	24.0
Type of anesthesia	General anesthesia	160	93.6
	Local anesthesia	1	0.6
	Sedative analgesia	7	4.1
	Nerve block	3	1.8
Medical diagnosis	Peripheral nerve surgery	4	2.3
	Spinal surgery	90	52.6
	Intracranial mass	24	14.0
	Intracranial hemorrhage	5	2.9
	Functional surgery	23	13.5
	Hydrocephalus	5	2.9
	Aneurysm	17	9.9
	Pituitary adenoma	3	1.8
Age (mean=52.38±14.92) (min 21- max 89)			
BMI (mean=27.32±4.86) (min 15- max 40)			

Regarding the general health status of the patients who participated in the study, 95.9% were informed about preoperative fasting, and 73.7% of these patients received this information from a nurse. It was found that 65.5% of the respondents did not know the reason for fasting. While it was determined that the last liquid food consumed by the patients before surgery was clear liquids (such as water, pulp-free fruit juice, light tea, plain coffee, mineral water) at a rate of 80.7%, the last solid food consumed was identified as a light meal (low-fat toast and tea, coffee, water) at a rate of 64.9%. In addition, 61.4% of the patients underwent IV hydration (Table 2). The patients' average total length of hospital stay was 4.89±6.99 days

Table 2: *Distribution of patients according to their preoperative general health status (n=171)*

Variables	N	%
Being informed about preoperative fasting		
Yes	164	95.9
No	7	4.1
Person who provided information about preoperative fasting		
Nurse	126	73.7
Physician	39	22.8
Knowing the reason for preoperative fasting		
Yes	59	34.5
No	112	65.5
Last consumed liquid before fasting		
Clear liquids (water, pulp-free juice, clear tea, plain coffee, mineral water)	138	80.7
Animal-based milk products (milk coffee, ayran)	33	19.3
Last consumed solid food before fasting		
Light meal (low-fat toast, tea, coffee, water)	111	64.9
Fatty or fried foods, meat	60	35.1
IV hydration administered preoperatively		
Yes	105	61.4
No	66	38.6
Length of hospital stay (days)	Mean = 4.89 ± 6.99	Min: 1 – Max: 55

The Mann–Whitney U test was conducted to determine whether postoperative blood glucose levels of the patients participating in the study differed significantly according to the type of last consumed liquid or solid food before surgery. The results showed that there were no significant differences in blood glucose levels based on type of last consumed liquid or solid food ($p > 0.05$) (Table 3).

Table 3: *Comparison of patients' blood glucose levels with preoperative last consumed liquid and solid food variables (N=171)*

			N	Mean	Z*	p
Blood Glucose Levels	**Pre-fasting Last Consumed Liquid Food**	Clear liquids (water, pulp-free juice, clear tea, plain coffee, mineral water)	138	85.38	-,333	,739
		Animal-based milk (milk coffee, ayran)	33	88.58		
	Pre-fasting Last Consumed Solid Food	Light meal (low-fat toast, tea, coffee, water)	111	86.42	-.152	,879
		Fatty or fried foods, meat	60	85.22		

*Mann Whitney U Test

According to the patient data included in the study, a statistically significant difference was found between the variable of the last solid food consumed before surgery and the insulin resistance index ($p<0.05$) (Table 4).

Table 4: *Comparison of patients' insulin resistance indexes with preoperative last consumed liquid and solid food variables (N=171)*

			N	Mean	Z*	p
Insulin Resistance Indexes	**Pre-fasting Last Consumed Liquid Food**	Clear liquids (water, pulp -free juice, clear tea, plain coffee, mineral water)	138	82.55	-1,863	,062
		Animal-based milk (milk coffee, ayran)	33	100.42		
	Pre-fasting Last Consumed Solid Food	Light meal (low-fat toast, tea, coffee, water)	111	80.08	-2.128	**,033****
		Fatty or fried foods, meat	60	96.96		

*Mann Whitney U Testi ** p<0,05

As shown in Table 5, no statistically significant correlation was found between fasting duration after liquid intake and blood glucose levels (r=-0.009, p=0.908) or between fasting during after solid intake and blood glucose levels (r=0.109, p=0.157). However a weak but statistically significant positive correlation was observed between fasting duration after liquid intake and insulin resistance index (r=0.193, p=0.011) as well as between fasting duration after solid intake and insulin resistance index (r=0.227, p<0.001). These finding indicate that longer fasting duration was associated with higher insulin resistance index values.

Table 5: *The relationship between fasting duration after liquid and solid foods and blood glucose levels and insulin resistance indices*

		Fasting Duration After Liquid Intake	Fasting Duration After Solid Intake
Blood Glucose Levels	Spearman r	-,009	.109
	p	.908	.157
Insulin Resistance Indexes	Spearman r	.193*	.277**
	p	.011	.000

*Correlation is significant at $p < 0.05$ level. **Correlation is significant at the $p < 0.01$ level.

4 Discussion

This study was conducted to determine the effect of preoperative fasting duration on postoperative insulin resistance index and glucose levels in patients undergoing brain and neurosurgery. The findings obtained from the research were discussed by comparing them with the current data in the literature. The average age of the patients who participated in the study was 52.38±14.92, 61.4% were female, 80.1% were married, 69.1% did not smoke, and 78.9% had previously undergone a surgical procedure. These results are in line with similar studies showing that the average age of surgical patients generally concentrates in the middle age group and that the proportion of female patients is high (Brady et al., 2003; Demirel and Ak, 2024). In addition, it has been indicated that a large proportion of patients undergoing brain and neurosurgery have a history of chronic diseases and may be prone to preoperative metabolic imbalances (Nygren et al., 2006).

In this study, the average preoperative fasting duration after liquid food intake was 15.26±2.87 hours, and after solid food intake, it was 16.79±3.05 hours. These durations are considerably longer than the limits recommended by the American Society of Anesthesiologists (ASA, 2017), which are two hours for liquids and six hours for solids. The 2023 American Society of Anesthesiologists practice guideline update is a modular update and specifically focuses on topics not addressed in the previous guideline, including ingestion of carbohydrate-containing clear liquids with or without protein, chewing gum, and pediatric fasting duration (Joshi et al., 2023). The literature also indicates discrepancies between the planned and actual fasting times in surgical patients, with the planned duration often being exceeded (Smith et al., 2011; Zhu et al., 2021). Brady and colleagues emphasized that prolonged fasting is particularly due to changes in operating room scheduling, delays in surgery sequences, and the continuation of traditional practices. Prolonged fasting can lead to negative outcomes, such as thirst, dry mouth, fatigue, hypoglycemia, anxiety, and patient dissatisfaction (Brady et al., 2003). Recent evidence has shown that patients with longer fasting duration experience more pain and anxiety (İster et al., 2025). In addition, a significant positive correlation has been reported between preoperative anxiety level and preoperative solid food fasting and fluid fasting times (Kirtil and Aydın, 2025).

In this study, the effect of preoperative fasting duration on glucose levels was examined; the mean glucose level was 118.24±36.28 mg/dL, and no statistically significant difference was found between the timing of last liquid and solid food intake and glucose level. However, the data showed a tendency for glucose levels to decrease as the fasting period lengthened. Studies in the literature also report that fasting durations are generally long, and that in some studies, a weak but significant relationship has been found between fasting duration and glucose levels (Demirel and Ak, 2024; Rızalar et al., 2019; Ertem and Savcı, 2023). This situation paves the way for the development of hyperglycemia in patients and increases the risk of postoperative complications. The severity of surgical stress, patient's physiological reserve, and duration of fasting are factors that directly affect glucose balance.

In this study, the average postoperative insulin resistance index was 3.43±2.97, and a significant relationship was detected between the duration of fasting and insulin resistance ($p<0.05$). This finding indicates that as the fasting period lengthens, the metabolic response intensifies, glycogen stores are depleted, and muscle protein breakdown accelerates. Nygren et al. and Brady et al. also reported that a prolonged fasting period increases the catabolic response, raises insulin resistance in the postoperative period, and delays recovery (Brady et al., 2003; Nygren et al., 2006).

In recent years, ERAS protocols implemented in surgical patients have aimed to reduce metabolic stress by supporting the intake of clear fluids containing carbohydrates before surgery (Yeşilyurt and Yeşilbakan, 2021; Wang et al., 2018). Studies in the literature reported that preoperative carbohydrate intake in neurosurgical patients accelerates postoperative recovery, reduces insulin resistance, and shortens hospital stay (Liu et al., 2019; Senapathi et al., 2022). The findings of this study are consistent with these results, showing that prolonged fasting periods in patients undergoing brain and neurosurgery negatively affect metabolic balance. In neurosurgery, a recent systematic review and meta-analysis concluded that preoperative carbohydrate loading is effective in improving postoperative patient outcomes and recommended that institutions support it by establishing guideline-based written protocols (Şanlı et al., 2025). In addition, a systematic review and meta-analysis comparing enhanced recovery after surgery protocol with conventional perioperative care in elective craniotomy has highlighted that implementation in neurosurgery remains under explored and that standard evidence-based guidelines are lacking (Choudhary et al., 2025).

5 Conclusions

According to the results of this study, as the preoperative fasting period increased, patients exhibited higher postoperative glucose levels and increased insulin resistance. This indicates that prolonged fasting enhances the metabolic response to surgical stress and negatively affects recovery during the postoperative period. These findings suggest that unnecessarily long preoperative fasting practices should be re-evaluated.

In line with these findings, fasting periods for surgical patients should be kept within the limits recommended by guidelines, surgical scheduling should be organized in a way that does not prolong fasting periods, and during the preoperative care process, nurses should inform patients about nutrition protocols. The adaptability of ERAS protocols for neurosurgical patients should be increased. In conclusion, it has been determined that prolonged preoperative fasting periods in neurosurgery patients negatively affect insulin resistance and glucose levels; therefore, fasting practices in the preoperative period should be regulated in terms of duration and content based on evidence-based approaches.

6 Declarations

6.1 Limitations

This study has some limitations that should be considered when interpreting the findings. First, the descriptive design of the study does not allow for establishing a causal relationship between preoperative fasting duration and postoperative insulin resistance or blood glucose levels. Therefore, the observed associations should be interpreted with caution. Second, the study was conducted in a single neurosurgery clinic, and the findings may not be generalizable to different surgical populations or healthcare settings with varying clinical practices. Future studies using prospective and controlled designs are recommended to better understand the metabolic effects of preoperative fasting duration.

6.2 Acknowledgements

There is no person or institution contributing to this research other than the authors. This study was produced from the master's thesis numbered 875452.

6.3 Funding source

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6.4 Competing Interests

There is no conflict of interest in this study.

6.5 Authors' Contributions

Define the contribution of each researcher named in the paper to the paper.

Author 1 (EGO): Contributed to the conception and design of the study, data collection, literature review, and drafting of the manuscript.

Author 2 EK: Contributed to the study design, supervision of data collection, data analysis and interpretation, critical revision of the manuscript for intellectual content, and final approval of the version to be published.

6.6 Ethical Approval

The study was approved by the relevant Ethics Committee, and all procedures were conducted in accordance with the ethical standards of the institutional research committee and the Declaration of Helsinki.

6.7 Informed Consent

Written informed consent was obtained from all participants prior to their inclusion in the study.

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