Fasting Blood Tests Might Not Be Necessary Before Elective Orthopedic Surgery

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Research

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Abstract

Background

To assess the clinical implications of the use of non-fasting rather than fasting blood tests before elective orthopedic surgery and to contribute to the fast-track surgery.

Method

We studied 305 patients (aged 18-83 years) who underwent elective orthopedic surgery at the orthopedic center of the First Affiliated Hospital of Guangzhou University of Chinese Medicine. Fresh blood samples were obtained from 151 individuals who had fasted (fasting $\geq$ 8 h) and from 154 individuals who had not fasted. Standard hospital assays were used on all samples to measure the complete blood count (CBC, leukocyte (WBC), hemoglobin (HGB), platelet (PLT)), basic blood chemistry tests (serum sodium (Na), serum potassium (K), serum chlorine (Cl), blood calcium (Ca)), inflammatory markers (C-reactive protein (CRP), erythrocyte sedimentation rate (ESR)), coagulation function tests (prothrombin time (PT), international normalized ratio (INR), activated partial thromboplastin time (APTT), plasma fibrinogen (PFIB)), liver function tests (aspartate aminotransferase (AST), alanine aminotransferase (ALT)), and kidney function tests (creatinine (CRE), urea nitrogen (BUN)). Besides, we also analyzed the average length of stay and the cost of inpatient care between two groups in our departments.

Results

The results of the complete blood count (CBC), basic blood chemistry tests (Na, K, Cl, Ca), inflammatory markers (CRP, ESR), coagulation function tests (PT, INR, APTT, FIB), liver function tests (AST, ALT), and kidney function tests (CRE, BUN) were not significantly different between the fasting and non-fasting groups ($P \geq 0.05$). However, the blood glucose levels in the non-fasting group were 0.4 mmol/L greater than those in the fasting group. The average hospital days were decreased from 7.5 days to 6.5 days while the cost of inpatient care was reduced approximately 10%.

Conclusions

Our study recommends the routine use of non-fasting blood tests before elective orthopedic surgery which is helpful in implementing the fast-track surgery.

Contributions To The Literature

1. It seems not necessary that apply fasting blood test before elective orthopedic surgery.
2. We have found that the outcomes of fasting blood tests were similar to non-fasting, and they had no statistical significance.
3. A review of the case revealed that non-fasting blood collection would likely reduce the patient's hospitalization costs and shorten the length of stay.

Reporting Standards

The Consolidated criteria for reporting qualitative research (COREQ) was applied to our research.

Data analysis:

1. Number of data coders: 0
2. Description of the coding tree: No.
3. Derivation of themes: The theme was identified in advance.
4. Software: SPSS 17.0
5. Participant checking: No.

Reporting:

1. Quotations presented: We have recorded the participants' hospitalization code.
2. Data and findings consistent: There were consistency between the data presented and the findings
3. Clarity of major themes: Major theme was clearly presented in the findings.
4. Clarity of minor themes: There wasn't a description of diverse cases or discussion of minor themes.

1 Background

Blood testing plays a major role in infection identification as well as the assessment of general state of health before the surgery. In our clinical practice, blood samples were conventionally obtained in the next morning after the admission. Interestingly, evidence is lacking that fasting is superior to non-fasting when evaluating the infection risk and the function of organs. Emerging evidences showed non-fasting testing has been widely used in measuring the lipid profile^[1]. However, blood tests from non-fasting or not before elective surgery are still not well understood. Here, we would like to compare the changes in blood testing from non-fasting to fasting to facilitate our clinical practice and benefit patients.

2 Methods

2.1 Participants

In this study, we included a total of 305 hospitalized patients who were scheduled for surgery aged 18-83years. This study was approved by the First Affiliated Hospital of Guangzhou University of Chinese Medicine (GUCM) and by the hospital's ethical committee.

The 305 participants were randomly divided into two groups, namely a non-fasting group with 154 individuals and a fasting group with 151 individuals. The age and sex ratios of the two groups were similar (Table 1): The average age of the non-fasting group was 52, while the average age of the fasting group was 54; the percentages of males and females in the non-fasting group were 46.75% (72) and 53.25% (82), while in the fasting group they were 46.05% (70) and 53.95% (82).

All participants underwent the same blood tests. The 151 fasting group participants had fasted before the tests were performed, while the 154 non-fasting group participants had not fasted.

2.2 Laboratory analyses

Standard hospital assays were used on fresh blood samples to measure the levels of serum sodium, serum potassium, serum chlorine, blood calcium, plasma fibrinogen, C-reactive protein, blood glucose, aspartate aminotransferase, alanine aminotransferase, creatinine and urea nitrogen, as well as the numbers of leukocytes and platelets, amount of hemoglobin, prothrombin time, international normalized ratio, activated partial thromboplastin time, and erythrocyte sedimentation rate.

2.3 Stay hospital and cost

We estimated the hospitalization days and cost of the two groups of patients, and to the data which obtained had carried on the statistical analysis, drew a series of corresponding conclusions.

2.4 Statistical analysis

The data from the preoperative tests and patients' age were analyzed with independent sample t-tests by SPSS 17.0 statistical software. The differences between groups were analyzed by t-test, and $P < 0.05$ was statistically significant.

3 Results

3.1 Laboratory analyses

Table 2 shows the measurement results of the two groups. The mean amount of K was 4.01 ± 0.29 mmol/L in non-fasting individuals and 4.00 ± 0.32 mmol/L in fasting individuals, and the difference between two groups was not significant ($P > 0.05$). The Na level was 140.94 ± 2.38 mmol/L in the non-fasting group and 140.99 ± 2.12 mmol/L in the fasting group, and the difference was also not significant ($P > 0.05$). The Cl level was 103.30 ± 2.50 mmol/L and 103.20 ± 2.28 mmol/L in the non-fasting group and the fasting group, respectively. In the non-fasting and fasting groups, respectively, the Ca level was 2.31 ± 0.12 mmol/L and 2.31 ± 0.13 mmol/L, the WBC was $7.00 \pm 1.75 \times 10^9/L$ and $7.01 \pm 2.27 \times 10^9/L$, the HGB was 134.17 ± 12.83 g/L and 131.86 ± 16.21 g/L, the PLT was $245.66 \pm 59.71 \times 10^9/L$ and $232.61 \pm 60.94 \times 10^9/L$, the PT was 11.06 ± 0.82 seconds and 11.00 ± 0.92 seconds, the INR was 0.90 ± 0.07 and 0.89 ± 0.07 , the APTT was 26.32 ± 3.45 seconds and 26.43 ± 3.46 seconds, the plasma fibrinogen FIB was 2.89 ± 0.74 g/L and 2.76 ± 0.71 g/L, the CRP was 5.40 ± 5.85 mg/L and 5.20 ± 5.53 mg/L, ESR was 14.94 ± 10.13 mm/h and 14.74 ± 10.56 mm/h, the AST was 22.28 ± 9.55 μ/L and 21.48 ± 9.86 μ/L , the ALT was 20.56 ± 13.89 μ/L and 21.76 ± 14.53 μ/L , the CRE was 75.85 ± 15.86 $\mu\text{mol/L}$ and 79.44 ± 16.99 $\mu\text{mol/L}$, and the BUN was 5.25 ± 1.34 mmol/L and 5.53 ± 1.73 mmol/L. All the above differences between the two groups were not significant ($P > 0.05$). In other words, fasting had no observable impact on the results of the blood tests. The one exception was blood glucose (GLU), which was 5.80 ± 1.51 mmol/L in non-fasting individuals and

5.40±0.99 mmol/L in fasting individuals, and the difference between the two groups was statistically significant ($P<0.05$). However, it could be that the difference was due to the response to normal food intake. Therefore, we believe that the difference in GLU was also unremarkable.

In addition, we generated histograms of the data stratified by gender to show the differences between the two groups according to gender (Figures 1-18). It is clear that the results between the non-fasting and fasting groups were similar in individuals of the same gender, with the exception of the GLU levels.

3.2. Stay hospital and cost

Table 3 shows the hospitalization days and cost of the two groups. The mean amount of hospitalization days were 11.09±0.39 days in non-fasting individuals and 16.34±0.55 days in fasting individuals, and the difference between two groups was obviously significant ($P=0.05$). The cost was 63.35.94±2.25 thousand yuan in the non-fasting group and 102.03±3.01 thousand yuan in the fasting group, and the difference was also significant ($P=0.05$).

We generated histograms of the data to show the differences between the two groups (Figures 19-20). It is clear that the results between the non-fasting and fasting groups were significant difference.

4 Discussion

Comparing the non-fasting and fasting blood before elective surgery, we found no significantly different among the important indicators to orthopedics surgery. Although we found blood glucose (GLU) levels in non-fasting individuals were 0.40 mmol/L greater than those in fasting individuals, that difference is unlikely to result in the effect on surgery.

To the best of our knowledge, blood tests before elective orthopedic surgery, such as complete blood count, basic blood chemistry tests, inflammatory markers, coagulation function tests, liver function tests, and kidney function tests, are conventionally measured in the fasting state, but no substantial evidence has demonstrated that fasting levels are superior to non-fasting levels for the assessment of the patient's general condition and the risks of conducting the operation. Accumulating evidences have indicated that non-fasting lipid testing is the new standard for cardiovascular risk assessment^[1]. In Canada, non-fasting complete lipid profile was adopted in Alberta in 2014. In 2015, the college of Family Physicians of Canada lipid guideline recommended the use of non-fasting profiles^[2]. According to the research by Steiner et al., the cholesterol screening results for a non-fasting group of children compared with the results for a similar fasting group resulted in small differences that are likely not clinically relevant^[3]. In addition, A large population studies performed in Copenhagen and Calgary found that lipid profiles at most change minimally in response to normal food intake in individuals in the general population and that non-fasting lipid profiles could accurately predict the risk of cardiovascular events^[4; 5]. Other high-quality studies found that plasma triglycerides increased only a maximum of 0.2 mmol/L after normal food intake compared with the fasting concentrations, while apolipoprotein B concentrations did not

change after normal food intake, and non-HDL cholesterol was also stable^[6]. According to Anette Varbo, the fluctuation of non-fasting triglycerides and cholesterol over 15 years was similar. In both women and men, stepwise increasing levels of non-fasting triglycerides were associated with increased risk of ischemic stroke^[7]. Nordestgaard and his collaborators also believed that fasting was not routinely required for the determination of a lipid profile^[8]. Anne Langsted et al. found that lipoprotein levels did not change in response to normal food intake but were minimally increased with increased levels of CRP. They concluded that the ability of elevated lipoprotein levels to predict ischemic heart disease and myocardial infarction in the general population was not affected by normal food intake or inflammation^[9]. Therefore, according to the results of our study, we can conclude that fasting is not necessary for preoperative blood tests.

In addition, non-fasting lipid testing eliminates the need of for patients in present to the hospital before eating or drinking in the morning. Patients can go for testing at any time of day, which may improve time to screening. According to the results of our study, we believe that patients scheduled for surgery could have blood tests performed in the non-fasting state. This would allow us to shorten the patients' hospitalization time and optimize the process in the hospital to achieve fast-track surgery. Fast-track surgery has been developed and has been documented to be successful decreasing the length of hospital stays, morbidity and the duration of convalescence across procedures^[10]. Scholars have proposed many methods to achieve fast-track surgery^[11-18], and it has been proven to have many advantages^[16; 19; 20]. We have verified there are no obvious differences in the results of preoperative blood tests between non-fasting and fasting individuals. Patients do not need to wait until the next morning to have blood tests performed, decreasing the amount of time they have to wait for operations, decreasing the number of days they spend in the hospital and lowering costs.

5 Conclusions

Our study found that the results of blood tests were not statistically significant except blood glucose, which indicates that non-fasting blood tests can be choose before elective orthopedic surgery without any adverse effect. Further, non-fasting blood tests has the advantages of shortening the length of hospital stay and reducing the cost of hospitalization. For the patient, non-fasting blood tests can simplify the procedure and enable blood to be drawn at any time of day. For the laboratory, it makes the distribution of the number of patients more evenly during the day and eliminates the need to ask patients who were non-fasting to return for a new visit. Above all, our study recommended the routine use of non-fasting blood tests before elective orthopedic surgery which is helpful in implementing the fast-track surgery.

7 List Of Abbreviations

CBC (Complete blood count), WBC (White blood cell), HGB (Hemoglobin), PLT (Platelet), Na (serum sodium), K (serum potassium), Cl (serum chlorine), Ca (blood calcium), CRP (C-reactive protein), ESR

(Erythrocyte sedimentation rate), PT (Prothrombin time), INR (International normalized ratio), APTT (Activated partial thromboplastin time), PFIB (Plasma fibrinogen), AST (Aspartate aminotransferase), ALT (Alanine aminotransferase), CRE (Creatinine), BUN (Urea nitrogen), GUCM (Guangzhou University of Chinese Medicine), GLU (blood glucose).

8 Declarations

8.1 Ethics approval and consent to participate

The informed consent of the patient was obtained orally in this study, and the exemption was granted by the First Affiliated Hospital of Guangzhou University of Chinese Medicine ethical committee because the human data involved were derived from preoperative blood test results and would not expose the patients' privacy. This work didn't involve collecting clinical data of children (age under 16 years old).

8.2 Consent for publication

Not applicable.

8.3 Availability of data and materials

Not applicable.

8.4 Competing interests

The authors declare that they have no competing interests

8.5 Funding

This work was financially supported by the National Natural Science Foundation of China (NSFC) (No. 81603641). None of the funding body played a role in the design of the study and collection, analysis, and interpretation of data and in writing the manuscript.

8.6 Authors' Contributions

PC and HW conceived and designed the experiments. DC and GZ wrote the manuscript. DC, GZ, ZD, QH and JY acquired the samples. LW, SJ and QZ analyzed the data. PC revised the manuscript. All authors read and approved the final manuscript.

8.7 Acknowledgements

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Tables

Table1 Characteristics of individuals in the non-fasting and fasting groups

Characteristics		Non-fasting	Fasting
n		154	151
Gender	Male (%)	72 (46.75%)	70 (46.05%)
	Female (%)	82 (53.25%)	82 (53.95)
Mean age in years (range)		52 (18-83)	54 (18-80)

Table 2 The measurement results of the complete blood count (CBC), basic blood chemistry tests (Na, K, Cl, Ca), inflammatory markers (CRP, ESR), coagulation function tests (PT, INR, APTT, FIB), liver function tests (AST, ALT), kidney function tests (CRE, BUN) and blood glucose levels between the fasting and non-fasting groups

Item	Non-fasting	Fasting	T value	P value
Years	52.20±16.00	54.45±14.73	-1.277	0.203
K	4.01±0.29	4.00±0.32	0.259	0.796
Na	140.94±2.38	140.99±2.12	-0.165	0.869
Cl	103.30±2.50	103.20±2.28	0.407	0.685
Ca	2.31±0.12	2.31±0.13	0.080	0.936
WBC	7.00±1.75	7.01±2.27	-0.070	0.945
HGB	134.17±12.83	131.86±16.21	1.381	0.168
PLT	245.66±59.71	232.61±60.94	1.891	0.060
PT	11.06±0.82	11.00±0.92	0.684	0.495
INR	0.90±0.07	0.89±0.07	1.644	0.101
APTT	26.32±3.45	26.43±3.46	-0.269	0.788
FIB	2.89±0.74	2.76±0.71	1.564	0.119
CRP	4.27±4.05	5.37±9.22	-1.355	0.176
ESR	15.58±10.26	13.37±12.27	1.709	0.088
GLU	5.80±1.51	5.40±0.99	2.729	0.007
AST	22.28±9.55	21.48±9.86	0.720	0.472
ALT	20.56±13.89	21.76±14.53	-0.737	0.462
CRE	75.85±15.86	79.44±16.99	-1.911	0.057
BUN	5.25±1.34	5.53±1.73	-1.583	0.114

Table 3 The hospitalization days and cost of the Non-fasting group and Fasting group

Item	Non-fasting	Fasting	P value
Days	11.09±0.39	16.34±0.55	<0.0001
Cost	63.35±2.25	102.03±3.01	<0.0001

Figures

Figure 1

The difference of K that contrast with fasting and non-fasting group.

Figure 2

The difference of Na that contrast with fasting and non-fasting group.

Figure 3

The difference of Cl that contrast with fasting and non-fasting group.

Figure 4

The difference of Ca that contrast with fasting and non-fasting group.

Figure 5

The difference of WBC that contrast with fasting and non-fasting group.

Figure 6

The difference of HGB that contrast with fasting and non-fasting group.

Figure 7

The difference of PLT that contrast with fasting and non-fasting group.

Figure 8

The difference of PT that contrast with fasting and non-fasting group.

Figure 9

The difference of INR that contrast with fasting and non-fasting group.

Figure 10

The difference of APTT that contrast with fasting and non-fasting group.

Figure 11

The difference of FIB that contrast with fasting and non-fasting group.

Figure 12

The difference of Glu that contrast with fasting and non-fasting group.

Figure 13

The difference of CRP that contrast with fasting and non-fasting group.

Figure 14

The difference of ESR that contrast with fasting and non-fasting group.

Figure 15

The difference of AST that contrast with fasting and non-fasting group.

Figure 16

The difference of ALT that contrast with fasting and non-fasting group.

Figure 17

The difference of CRE that contrast with fasting and non-fasting group.

Figure 18

The difference of BUN that contrast with fasting and non-fasting group.

Figure 19

The difference of hospitalization days that contrast with fasting and non-fasting group (* means $P < 0.05$).

Figure 20

The difference of cost that contrast with fasting and non-fasting group (* means $P < 0.05$).

Supplementary Files

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