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The Effects of Visceral Manipulation on Blood Glucose Levels in Diabetes Mellitus: A Pilot Study Targeting Liver and Pancreas

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Abstract

This study aims to evaluate the acute and continuous effects of Visceral Manipulation (VM) targeting the liver and pancreas on random blood glucose (RBG) levels in diabetes melitus patients. Diabetes Melitus is commonly treated with long-term pharmacological therapies to control blood glucose levels. However, these treatments may cause adverse side effects, indicating the need for safer and effective non-pharmacological approaches. A quasi-experimental study was conducted involving 10 patients with diabetes mellitus receiving physiotherapy at Physio Clinic Makassar. Visceral Manipulation targeting the liver and pancreas was administered three times per week for one week. Random blood glucose levels were measured before and after each session using a glucometer, and data were analyzed using paired t-tests and Friedman tests. VM targeting the liver and pancreas effectively reduces RBG levels in diabetes mellitus patients, demonstrating both acute and continuous effects. These findings suggest VM as a promising non-pharmacological intervention for diabetes management. Further studies with larger sample sizes, using control design, and longer follow-up are recommended to confirm these results.

Keywords: Osteopathic Physicians; blood glucose; liver; pancreas.

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1. Introduction

Diabetes is a chronic condition that significantly impacts global health. This disease occurs when the pancreas cannot produce enough insulin or when the body cannot effectively utilize insulin, leading to elevated blood glucose levels, known as hyperglycemia. Prolonged increases in blood glucose can result in serious complications, including damage to nerves, blood vessels, the heart, and kidneys[1]. According to data from the International Diabetes Federation, over 540 million people worldwide suffer from diabetes projected to rise to 643 million by 2030 [2, 3]. Diabetes treatment often involves pharmacological interventions, such as the continuous administration of hypoglycemic agents. However, long-term use of these medications can lead to various side effects, including digestive disorders, the risk of hypoglycemia, and impaired liver and kidney function [4]. Therefore, there is an urgent need to explore safe and effective non-pharmacological treatment approaches for managing this condition. One potential approach to consider is Visceral Manipulation (VM), an osteopathic technique that focuses on the internal organs from a mechanical perspective. This technique aims to address organ dysfunction, improve organ motility and mobility, and enhance tissue rhythm [5]. The pancreas, which plays a crucial role in regulating blood sugar levels through the production of glucagon and insulin, becomes a relevant target for this approach [3]. Not only the pancreas but other studies also show good benefits from VM that targets the liver organ [6, 7]. Previous research related to osteopathic manipulative treatment (OMT) has demonstrated a reduction in sympathetic nervous system activity and an increase in parasympathetic nervous system activity [8]. The sympathetic nervous system activity in the liver stimulates the release of glucose into the bloodstream, while parasympathetic activity enhances glycogen synthesis and suppresses glucose production, potentially lowering blood glucose levels [9]. However, to date, research examining the effects of VM on the pancreas and liver, as well as its impact on reducing blood glucose levels in diabetes patients, remains very limited. Given the importance of the pancreas and liver in glucose metabolism, this study becomes crucial in addressing these questions. Therefore, the researchers are motivated to conduct a study focusing on the influence of VM on the pancreas and liver in lowering blood glucose levels in diabetes patients, with the hope of contributing to the development of safer and more effective alternative therapies in the future.

2. Material and Methods

2.1 Patients and Setting

The population in this study consisted of diabetes patients undergoing physiotherapy three times a week at the Physiotherapy from March to April 2024, coinciding with the Ramadan fasting schedule. Sampling was conducted using total sampling techniques. Data from patients who were absent from the experiment during the study period were excluded and not analyzed. This research employed a Quasi-Experimental Design utilizing total sampling. Initially, there were 13 respondents; however, only 10 respondents' data were ultimately analyzable. Informed consent was obtained under experiments involving human subjects. The Ethics Committee approved this study (Ethics Code: 867/UN4.18.3/TP.01.02/2024).

2.2 Experiment

In this study, the technique of Visceral Manipulation (VM) was targeted at two organs: the liver and pancreas. Each movement was performed in 8 sets with 3 repetitions. Each patient underwent an experiment involving the application of VM focused on the liver and pancreas, just prior to receiving conventional physiotherapy. The experiment was conducted over 3 sessions within one week, with one or two days of rest without therapy application.

2.2. 1Visceral Manipulation on The Liver

The patient is positioned in a side-lying position, turned to the left with both knees bent. The physiotherapist is positioned behind the patient during the application.

1. Frontal Plane

The hands of physiotherapist are positioned over the curvature of the ribs 7-10 on the right side of the patient. Then, apply pressure to the ribs and move the liver in a caudal-medial direction while increasing the pressure. At the end of the movement, provide vibration or mobilization with a rebound motion. After this, perform the opposite movement of the liver by moving the hands in a cranial-lateral direction.

2. Sagittal Plane

One hand of the physiotherapist is placed on the antero-inferior part of ribs 7-10, while the other hand is positioned facing postero-superior. Apply pressure to the ribs in an antero-inferior direction, while the other hand returns to its original position. Before retracting the hand to its starting position, ensure that the hand pushing antero-inferior has reached its maximum range.

3. Transversal Plane

Both hands of the physiotherapist are placed over ribs 5-6. One hand is positioned posteriorly, and the other anteriorly. Apply pressure to the ribs towards the liver and then rotate to the left (counterclockwise). One hand pulls backward while the other pushes forward to create a rotational movement. Hold this position and perform vibration and mobilization through small rebound movements.

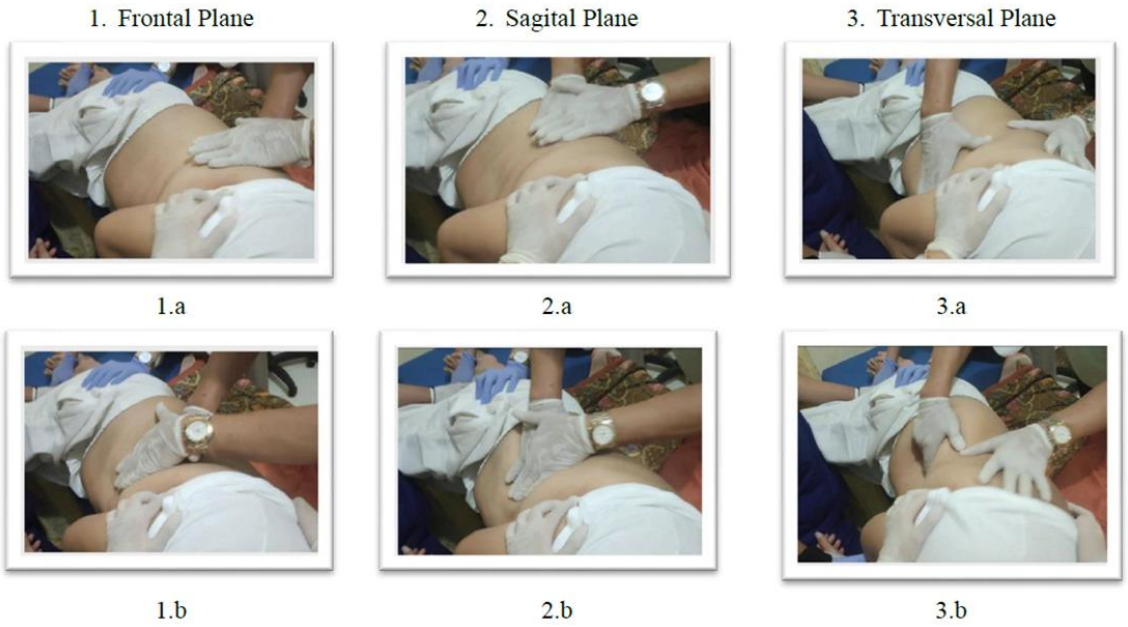

Figure 1: Visceral Manipulation on The Liver

2.2. 2 Visceral Manipulation on The Pancreas

The patient is positioned in supine lying with both knees bent. The physiotherapist is on the left side of the patient. The physiotherapist's left hand is placed over the head of the pancreas, while the right hand is positioned at the tail of the pancreas. Both hands are directed simultaneously along the longitudinal axis of the pancreas, then held in place. Afterward, return to the original position.

Figure 2: Visceral Manipulation on The Pancreas

2.3 Measurement of Random Blood Glucose Levels

Each patient undergoes an experiment involving Visceral Manipulation on the liver and pancreas three times over one week. Random blood glucose levels are measured before and after the application of Visceral Manipulation in the first, second, and third sessions, with each session separated by a 1 or 2-day rest period without therapy.

The random blood glucose levels measured before the application of the Visceral Manipulation technique in the first session are considered the baseline values. Random blood glucose levels are measured using a glucometer.

2.4 Statical Analysis

All data were analyzed using Statistical Product and Service Solutions (SPSS) software. Normality testing was conducted using the Shapiro-Wilk test. The comparison of data before and after Visceral Manipulation in the first session was analyzed using the paired T-test. For the second and third sessions, the data were analyzed using the Friedman test.

3. Results

A total of 13 respondents were registered in this study; however, only data from 10 individuals could be analyzed. The remaining 3 respondents were classified as dropouts because they did not complete the study.

Table 1: Respondent Characteristics

Respondent Characteristics	N	Percentage	Mean±SD
Gender			
Male	3	30%	
Female	7	70%	
Age (Year)	10		57±11.6

Among the 10 respondents, there were 3 (30%) male patients and 7 (70%) female patients. The average age of the respondents was 57±11.6 years. This data indicates that the majority of diabetes patients are female and belong to the elderly age group (Table 1).

Table 2: Acute Effects of Visceral Manipulation Application

Meeting	Random Blood Sugar Levels (Mg/dL)		*P Value*
	Before Visceral Manipulation (Mean ±SD)	After Visceral Manipulation (Mean ±SD)	
Session 1	191±74.7	177±61.8	P<0.001
Session 2	184±86.4	160±73.2	P<0.016
Session 3	162±61.5	149±59.3	P<0.005

Notes: SD, Standar Deviation. Analyzed via the paired sample t-test, $^{*}p$-value <0.05

The levels of Random Blood Glucose significantly decreased in each session: Session One (191±74.7 mg/dL to 177±61.8, P=0.001), Session Two (184±86.4 to 160±73.2, P=0.016), and Session Three (162±61.5 to 149±59.3,

P=0.005). This data indicates that the application of Visceral Manipulation has a significant effect on the acute reduction of Random Blood Glucose levels (Tabel 2).

Table 3: Continous Effect of Visceral Manipulation

Random Blood Sugar Levels (Mg/dL)				
Baseline (Mean ±SD)	After Visceral Manipulation Session 1(Mean ±SD)	After Visceral Manipulation Session 2(Mean ±SD)	After Visceral Manipulation Session 3(Mean ±SD)	*P Value*
191±74.7	177±61.8	160±73.2	149±59.3	P<0.019

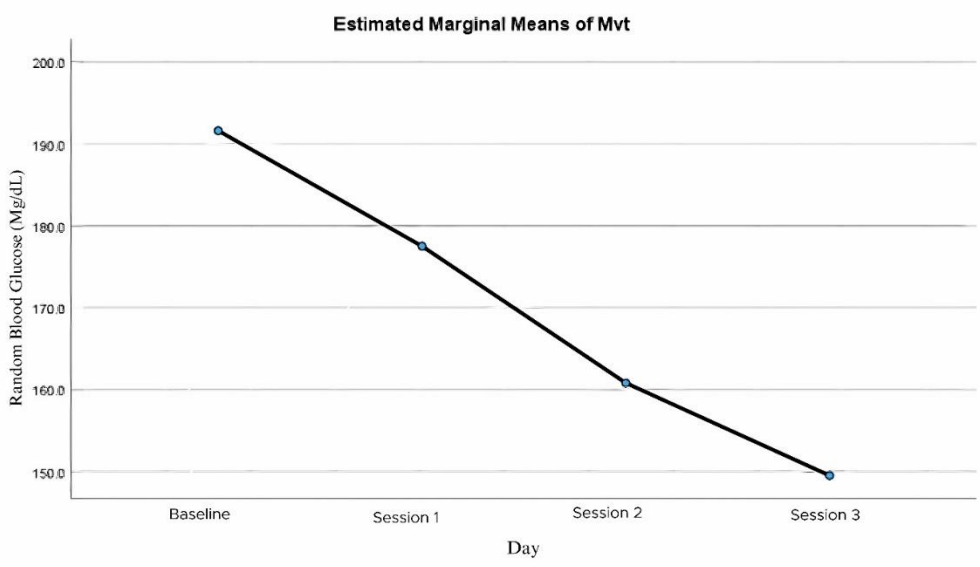

Figure 3: Graph of Random Blood Glucose Levels at Baseline and After Visceral Manipulation in Sessions One, Two, and Three

Notes: SD, Standar Deviation. Analyzed via The Friedman Test, $^{*}p$-value <0.05

Visceral Manipulation three times a week significantly decreased Random Blood Glucose levels compared to baseline values (P=0.019). These data indicate that Visceral Manipulation application has a continuous effect on decreasing Random Blood Glucose levels (Table 3 and Figure 3).

4. Discussion

Based on the frequency characteristics of the respondents, the majority in this study were female, with 7 individuals (70%), and the average age of the respondents was 57±11.6 years (Table 1). This data shows that the majority of diabetes patients are female and belong to the elderly age group. Several factors may explain the high prevalence of diabetes among females. One influential factor is sex hormone-binding globulin (SHBG), a protein produced by the liver that binds testosterone and estrogen, subsequently transported in an inactive form in the

bloodstream [10]. Increased levels of SHBG can indicate a risk of diabetes, as it has been found that women tend to have higher SHBG levels compared to men [11, 12]. Another factor is that body composition and fat accumulation contribute to gender-related diabetes risk [13]. A study measuring waist circumference as an index to evaluate abdominal fat proportion and leg muscle mass indicated that the ratio of abdominal fat to leg muscle mass is an independent factor affecting cardiovascular or metabolic diseases. Based on this, women experience a more significant increase in waist circumference with age compared to men [14]. The risk of diabetes itself increases with age due to the aging process, which triggers a decline in the function of pancreatic β-cells, the producers of insulin. Additionally, aging can lead to a 35% decrease in mitochondrial activity within muscle cells, resulting in increased fat in the muscles and insulin resistance [15]. Diabetes is a disease that arises not only from hormonal disturbances but also from lifestyle factors. An unhealthy lifestyle during youth, such as consuming high-sugar foods and beverages coupled with a lack of physical activity, may not show immediate disturbances. However, suppose this unhealthy lifestyle persists over time. In that case, it can lead to problems, including a decline in pancreatic function due to overexertion, resulting in hyperglycemia that becomes more pronounced with age [10, 12, 15]. This study demonstrates that the application of Visceral Manipulation (VM) has a significant effect on the acute reduction of random blood sugar levels (Table 2). Visceral manipulation addresses structural dysfunction issues, particularly of the fascia, which enhances proprioceptive communication within the body, thereby reducing pain and organ dysfunction [6]. The technique of visceral organ manipulation aims to resolve mobility and restriction issues in targeted organs, specifically the pancreas and liver, which may be dysfunctional and contribute to diabetes [5]. Visceral manipulation is a manual therapy technique involving direct skin contact, inducing microcirculation in the skin, increasing blood flow, activating the nervous system, and enhancing glucose utilization by muscle tissue, which in turn triggers a reduction in blood glucose levels [16]. Previous research on osteopathic manipulation has shown that it can increase parasympathetic nerve activity and decrease sympathetic nerve activity in organs [8]. The sympathetic nerve in the liver is known to stimulate the release of glucose into the bloodstream, while the parasympathetic nerve promotes glycogen formation and suppresses glucose production [9]. Thus, applying visceral manipulation to the liver can produce effects leading to acute reductions in blood sugar levels in diabetes patients. This study also demonstrated a continuous decrease in Random Blood Glucose levels during the first, second, and third sessions compared to baseline values (Table 3 and Figure 3). These results are supported by previous research indicating that osteopathic manipulation techniques, such as abdominal massage, can activate the signaling pathway of Sirtuin 1, encoded by SIRT1 [17]. SIRT1 is a protein that regulates glucose and lipid metabolism in the liver. Numerous studies have shown that SIRT1 can control insulin secretion in the pancreas and protect the function and quality of β cells. Additionally, SIRT1 in the liver is a key modulator of gluconeogenesis in response to fasting [18]. Normal β cells in the pancreas increase insulin secretion in conditions of insulin resistance; however, in individuals with diabetes mellitus, this response is impaired, leading to glucose tolerance issues [19]. SIRT1 functions to mitigate β cell dysfunction in the pancreas and enhance insulin secretion by increasing ATP production in β cells. This process blocks potassium channels and opens calcium channels, facilitating insulin secretion [20]. SIRT1 also plays a role in inflammatory responses, oxidative stress, and cellular metabolism regulation under various nutritional disturbances. The numerous biological processes in mitochondria and fatty acid oxidation regulated by the SIRT1 signaling pathway promote energy supply, which is essential for sustaining energy use during prolonged muscle contractions, thereby relating to insulin resistance [21]. Ultimately, this insulin resistance leads to hyperglycemia in individuals with diabetes

Reference [22]. Thus, the activation of SIRT1, which is involved in insulin resistance through osteopathic manipulation techniques, is crucial in addressing hyperglycemic conditions in diabetic patients. If applied continuously, this may positively impact the pancreatic function impaired by reduced β cell production in diabetes. Furthermore, abdominal massage is known to enhance the expression of other protein-coding genes involved in glucose metabolism, particularly in obese diabetic patients [23]. Unfortunately, this study did not measure biomarkers, so the biological mechanisms related to changes in Random Blood Glucose levels in diabetic patients remain unexplained. Finally, this study has several limitations that should be acknowledged. First, the small sample size and predominance of female participants limit the generalizability of the findings to the broader population of patients with diabetes. Second, the absence of a control or comparison group restricts the ability to attribute the observed reductions in random blood glucose levels solely to visceral manipulation intervention. Third, the random blood glucose was used as the primary outcome measure without assessing more stable glycemic indicators, such as HbA1c or fasting plasma glucose. Importantly, no biochemical biomarkers (e.g., SIRT1 expression, insulin levels, inflammatory markers, or autonomic activity parameters) were measured, limiting the ability to confirm the proposed biological mechanisms underlying the observed effects. Future studies with larger, controlled, and longitudinal designs incorporating biomarker assessments are warranted to strengthen the causal inference and clarify the physiological mechanisms.

5. Conclusion

Visceral manipulation has both acute and sustained effects in reducing random blood glucose levels. Therefore, the administration of visceral manipulation to the pancreas and liver may serve as a viable non-pharmacological intervention to address hyperglycemic conditions in individuals with diabetes. However, the appropriate dosage and underlying mechanisms need to be studied in the future.

6. Conflict of Interest

Professor Djohan Aras, one of the authors, is the owner of Klinik Physio Sakti, which served as the site for this study and where the research samples were collected. This affiliation is disclosed in the interest of full transparency. To mitigate potential bias, Professor Djohan Aras was not involved in the data analysis or interpretation. All other authors declare no competing interests.

7. Funding Statement

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