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Boosting Blood Flow: How Warm Compress Helps Manage Blood Pressure in Type 2 Diabetes

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ABSTRACT

Patients with diabetes can affect cardiac output, such as blood pressure dysfunction. Changes in insulin resistance and hyperglycemia can lead to blood pressure dysfunction and increased cardiac output problems. Warm compresses affect macrovascular function and impact blood pressure in patients. This study analyzed the effectiveness of warm compresses in reducing blood pressure in type 2 DM patients with decreased cardiac output problems. The study used a case report method. Warm compresses were applied for three days, for 2 hours per day, using a warm water sack placed on the abdomen at 40-42°C. Blood pressure was measured before and after the intervention. Results showed that after 3 days, there was a reduction in blood pressure, with an average decrease of 16.667 mmHg in systolic and 6.667 mmHg in diastolic pressure. Warm compresses effectively reduce blood pressure in patients with cardiac output problems. Nurses can apply warm compress therapy as a simple intervention to improve blood pressure in patients with decreased cardiac output.

Keywords: Type 2 diabetes mellitus, Thermoregulation, Decreased cardiac output, Warm compress

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I. INTRODUCTION

Type 2 Diabetes Mellitus (Type 2 DM) can cause complications like heart disease (Ma et al., 2022). Globally, cardiovascular problems are experienced by 32.2% of Type 2 DM clients (Annose et al., 2024; Yun & Ko, 2021). Research in Ethiopia found that the prevalence of cardiovascular problems in Type 2 DM clients was 42.51% (Regassa et al., 2021). For clients with DM, the risk of cardiovascular problems such as heart failure increases twice (Kenny & Abel, 2019). Changes in insulin resistance and the emergence of hyperglycemia will cause heart disease (Ma et al., 2022). Fat

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accumulation in Type 2 DM clients will cause insulin resistance in the heart and also dysfunction in blood pressure (Jia et al., 2018; Sun et al., 2019). Increased blood pressure will cause problems with cardiac output (King & Lowery, 2023).

Metabolism abnormality in type 2 DM clients is related to the vascular system, causing changes in endothelial cells and resulting in changes in blood vessel permeability, resulting in cardiovascular disease (Lotfy et al., 2017). In Type 2 DM clients, changes in glycemic status can increase risk factors related to heart problems and accelerate coronary and systemic atherosclerosis (Palazzuoli & Iacoviello, 2022). The presence of insulin resistance and hyperglycemia is also considered to be able to increase levels of free fatty acids and growth factors, which cause an imbalance in demand and supply in cardiomyocytes, in addition to the production of Reactive Oxygen species (ROS), which will cause apoptosis in cardiomyocytes cells and endothelium (Roy et al., 2020; Scioli et al., 2020). In diabetic clients, increased blood pressure can occur due to autonomic nervous system disorders caused by mitochondrial and endoplasmic reticulum dysfunction in cardiomyocytes (Sudo et al., 2022). Interference of increased blood pressure and heart failure will cause problems with cardiac output (King & Lowery, 2023).

Heat-related therapy is considered to have an impact on reducing the risk of cardiovascular disorders based on the increased induction of endothelial function, which results in changes in blood vessel shear stress, which will affect blood flow to the heart (Brunt & Minson, 2021; Cheng et al., 2019). Blood vessel shear stress is the mechanical friction force exerted by blood on the artery walls, which is influenced by the speed and viscosity of the blood relative to the diameter of the artery (Brunt & Minson, 2021). Heat-related interventions can affect blood pressure and blood vessel function in adult clients with cardiovascular problems (Pizzey et al., 2021). The administration of local heat to clients with blood pressure problems due to autonomic dysfunction has also shown an increase and maintenance of blood pressure due to cardiovascular responses to heat stimulation (Okamoto et al., 2021). Heat therapy can also affect the left ventricular ejection fraction (LVEF) and reduce systolic and diastolic blood pressure in clients (Ye et al., 2020).

This study aims to assess the effectiveness of warm compress therapy on blood pressure in Type 2 DM patients with decreased cardiac output problems in the

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Anthurium Medical Ward, dr. Soebandi Hospital of Jember. By investigating this intervention, the study hopes to offer a practical solution to manage blood pressure and cardiac health in diabetic patients, filling a gap in current treatment strategies.

2. METHODS

This research uses the case report method. The patients in this study were type 2 diabetes mellitus patients hospitalized in Anthurium Medical Ward at dr. Soebandi Hospital of Jember. The inclusion criteria were being diagnosed with type 2 DM, having chronic complications, being able to communicate well, being older than 18 years old, and being willing to participate in the study. Exclusion criteria were the insufficient mental capacity to consent and having a physical disability such as deaf and speech impaired. This study provides warm compress intervention to improve blood pressure in patients and analyzes the pre and post-blood pressure results in patients. A warm compress was applied in warm water zak with a temperature of 40-42°C and carried out for three days (21 November 2023 - 23 November 2023) with a period of 2 hours (12.00-14.00 WIB) for each session. Blood pressure was measured directly before and after the warm compress intervention.

The client in this study was a 60-year-old woman. The client is a housewife from the Madurese tribe with the Muslim religion. The client was diagnosed with Type 2 DM, emergency HT, hypoglycemia, and Heart Failure. Clients come to dr. Soebandi Hospital of Jember on 17/11/2023 with complaints of being unconscious and having uncontrolled Type 2 DM.

The client's general condition when the assessment was carried out was weak, and the client's vital signs were also obtained: blood pressure was 140/90mmHg, and heart rate was 110x/minute. Respiratory rate: 22x/minute and temperature 36.6°C, the patient's Random glucose testing (RGT) is 176. The client also had a chest x-ray examination on 11/17/2023, which showed LVEF 65%, cardiomegaly, and cephalization. The results of blood component examinations on clients also show high levels of Troponin I. High levels of Troponin I can be associated with increased blood pressure in clients, which causes increased afterload values and subendocardial ischemia (Maheshwarappa & Rai, 2022).

3. RESULTS

The client has a nursing diagnosis of unstable blood glucose levels associated

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with insulin resistance marked by RGT 11/18/2023: 336, RGT 11/19/2023: 245, RGT 11/20/2023: 176. In addition, the client experienced problems related to decreased cardiac output associated with afterload change marked by increased blood pressure and fatigue, LVEF 65%. The third diagnosis in the client is Anxiety associated with situational crisis marked by restlessness and increased blood pressure.

In this study, interventions given to clients based on the Indonesia Nursing Intervention standards were Heart Care (I.02075). Additional intervention given is a warm compress to overcome the problem of increased blood pressure.

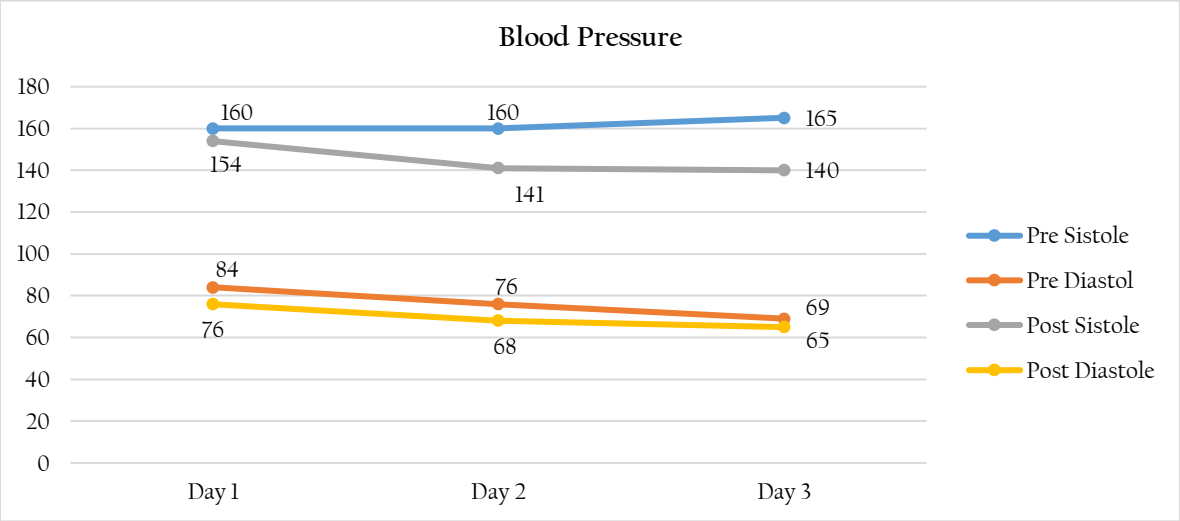

Figure 1. Blood Pressure Values in Pre-Post Intervention

Based on Figure 1, the observations related to the intervention of giving warm compresses show a decrease in post-intervention blood pressure every time. On the first day of systolic blood pressure, there was a decrease of 6mmHg; on the second day, there was a decrease of 19mmHg; on the third day, 15mmHg. On the first day, diastolic blood pressure decreased by 8mmHg; on the following day, there was a decrease by 8mmHg, and on the last day, by 4mmHg.

Table 1. Daily Pre-Post Blood Pressure

Date	Pre (12.00)	Post (14.00)
21 November 2023	160/84 mmHg	154/76 mmHg
22 November 2023	160/74 mmHg	141/68 mmHg
23 November 2023	165/69 mmHg	140/65 mmHg

Table 1 shows that a trend of decreasing blood pressure from the pre-measurement (12:00) to the post-measurement (14:00) each day. This could

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indicate the effectiveness of an intervention or treatment between these time points. The systolic and diastolic pressures both show a decline, particularly on November 22 and 23, where the reductions are more pronounced.

Table 2. Pre-Post Blood Pressure Difference

Variabel	Day 1	Day 2	Day 3	Mean
Pre-Post Sistol Difference	-6	-19	-25	-16.667
Pre-Post Diastol Difference	-8	-8	-4	-6.667

Based on Table 2, the results showed that after 3 days of intervention, there was a decrease in blood pressure with a mean value of 16,667mmHg for systolic and 6,667mmHg for diastolic blood pressure. Therefore, this shows that giving warm compresses can reduce blood pressure in clients by reducing cardiac output.

4. DISCUSSION

The results of the research that has been conducted show that there is a decrease in patient blood pressure after being given a warm compress intervention for 2 hours. In the systolic pressure variable, there was a decrease on the first day of 6mmHg, on the second day there was a decrease of 19mmHg, on the third day 15mmHg and the average decrease was 16,667 mmHg. Apart from that, the client's diastolic blood pressure decreased on the first day by 8mmHg, on the following day there was a decrease by 8mmHg and on the last day by 4mmHg and the average decrease during the 3 days of intervention was 6,667 mmHg.

In other research, a decrease in the client's systolic and diastolic pressure after being given heat therapy was identified at 3.94 and 3.88 mmHg (Pizzey et al., 2021). This is due to the shear stress pattern in the endothelium cells, which will cause increased induction of endothelium function (Cheng et al., 2019). Vascular shear stress is the mechanical friction force exerted by blood on the arterial wall, determined by the velocity and viscosity of the blood relative to the diameter of the arterial vessel (Brunt & Minson, 2021). Temporal changes in blood flow due to heat stress occur significantly during sweating events (Cramer et al., 2022).

The effect of heat therapy has also been identified as having impacts such as increasing cardiac output, peripheral vasodilation, increasing anterograde vascular shear stress, and reducing blood pressure after or during heat therapy (Cheng & MacDonald, 2019). This existing heat therapy triggers the thermoregulation center in the hypothalamus to trigger

vasodilation and increase skin blood flow (Brunt & Minson, 2021).

However, during the warm compress therapy intervention, the client also received therapy in the form of enoxaparin injection as an anticoagulant 2 x 0.6 cc and Amlodipine 10mg 1-0-0, Bisoprolol 1.25mg 1-0-0 as a beta blocker, Valsartan 160mg 1-0-0 as an angiotensin receptor blocker. In this study, warm compress intervention was given before the peak concentration of the drug. This is intended to anticipate the impact of existing confounding factors.

5. CONCLUSION

Warm compress therapy effectively reduces blood pressure in Type 2 DM patients with decreased cardiac output. The intervention resulted in significant decreases in both systolic and diastolic blood pressures over three days. This suggests that warm compress therapy, as a non-pharmacological intervention, can improve cardiovascular function by enhancing blood flow and reducing vascular resistance, making it a promising approach for managing blood pressure in these patients.

However, the existing literature on thermoregulatory interventions like warm compresses for blood pressure regulation in diabetic patients remains limited. Although this study controlled for the influence of concurrent medications by applying the warm compress before the peak concentrations of prescribed drugs, further research is necessary to eliminate other potential confounding variables. Long-term studies will be crucial to assess the sustainability of warm compress therapy's effects on blood pressure in Type 2 DM patients with cardiac output problems.

Randomized controlled trials will be essential to confirm these findings and solidify the role of warm compress therapy as a clinical intervention for managing blood pressure in Type 2 DM patients. By addressing the gaps in the current literature, future studies could provide robust evidence to support the widespread application of this simple, non-invasive treatment in clinical practice.

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AUTHOR CONTRIBUTIONS

Izdihar Javier Wardika was responsible for conceptualization,

methodology, formal analysis, original draft writing, supervision, and project administration. Nur Widayati contributed to data curation, article screening, data extraction, manuscript review and editing, and visualization. Akhmad Zainur worked on methodology, formal analysis, manuscript review and editing, and visualization. Iwan Setiawan contributed to data curation, manuscript review and editing, and visualization.

CONFLICT OF INTEREST

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

DATA AVAILABILITY STATEMENT

The data supporting the findings of this study are available upon reasonable request from the corresponding author. Restrictions apply to the availability of these data due to privacy and ethical concerns. Data are not publicly available due to participant confidentiality and consent agreements but may be shared for research purposes with appropriate permissions.

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