

VALSALVA MANEUVER TO DECREASE PAIN INTENSITY DURING ARTERIOVENOUS FISTULA INSERTION IN HEMODIALYSIS PATIENTS

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Abstract

AV fistula allows external vascular access for hemodialysis patients. Because hemodialysis patients experience puncture wounds and stabbing pain approximately 300 times a year, development of methods to decrease pain intensity are of great importance. Some techniques, such as the Valsalva maneuver, are known to reduce pain. This study aims to assess the effect of the Valsalva maneuver on decreasing the intensity of AV fistula pain in patients receiving hemodialysis. The quasi-experimental research of pre and post without control applying consecutive sampling to get as many as 63 respondents. Pain intensity was measured by using the Numerical Pain Rating Scale (NPRS). The Valsalva maneuver was performed during insertion of the AV fistula needle for 16–20 seconds. The results showed significant differences in pain intensity between before and after the intervention with the difference in mean that is 1.35 (SD= 0.54), $t= 19.70$, $p= 0.001$. The Valsalva maneuver is effective in reducing the pain of AV fistula insertion because it stimulates the vagus nerve to induce an antinociceptive effect. Nurses are highly recommended to teach the Valsalva maneuver to patients undergoing routine hemodialysis.

Keyword: AV fistula, hemodialysis, pain intensity, Valsalva maneuver

Abstrak

Pemberian Teknik Manuver Valsalva terhadap Penurunan Intensitas Nyeri Penusukan Arteriovenous Fistula pada Pasien Hemodialisis. Arteriovenous (AV) fistula merupakan akses vaskuler eksternal pasien hemodialisis. Pasien hemodialisis mengalami luka tusuk dan nyeri akibat penusukan sekitar 300 kali setahun sehingga perlu diberi tindakan untuk membantu mengatasinya. Beberapa teknik diketahui dapat menurunkan nyeri seperti teknik Valsalva manuver. Penelitian ini bertujuan menilai efek teknik Valsalva manuver terhadap penurunan intensitas nyeri penusukan AV fistula pada pasien hemodialisis. Penelitian quasi eksperimen pre dan post tanpa kontrol menerapkan consecutive sampling untuk mendapatkan sebanyak 63 responden. Intensitas nyeri diukur menggunakan Numerical Pain Rating Scale (NPRS). Valsalva manuver dilakukan saat penusukan jarum AV fistula selama 16-20 detik. Hasil penelitian menunjukkan terdapat perbedaan signifikan antara sebelum dan sesudah intervensi dengan selisih mean yaitu 1,35 (SD= 0,54), $t= 19,70$, $p= 0,001$. Valsalva manuver efektif menurunkan nyeri penusukan AV fistula karena menstimulasi saraf vagus dalam menginduksi efek antinociceptif. Teknik Valsalva manuver sangat direkomendasikan kepada perawat untuk mengajarkan teknik ini pada pasien yang menjalani hemodialisis rutin.

Kata Kunci: AV fistula, hemodialisis, intensitas nyeri, Valsalva manuver

Introduction

Arteriovenous (AV) fistula is a type of surgery usually performed on the forearm that combines arteries and large veins to produce a fistula (Rosdahl & Kowalski, 2012). Patients receiv-

ing hemodialysis often feel the effects of using AV fistulas, which includes pain during needle insertion (Kaza et al., 2014). Pain during AV fistula insertion is a real problem among hemodialysis patients. Such patients may experience stress and pain over the course of multiple

pricking's in 1 year (Çelik et al., 2011). Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage (IASP, 2012).

The results of Silva, Rigon, Dalazen, Bissoloti, and Rabelo-Silva (2016) in Brazil revealed that 58.5% of patients receiving AV fistula cannulation experience moderate pain, 20% experience severe pain, and 11.5% experience mild pain. Bourbonnais and Tousignant (2012) demonstrated that 12% of patients complain about mild to moderate levels of pain during needle insertion and extraction.

The pain felt by patients undergoing hemodialysis generally occurs during needle insertion, calibration, or use of a long fistula needle bevel. Pain during AV fistula insertion is the most common complaint among patients receiving hemodialysis (Figueiredo, Viegas, Monteiro, & Poly-De-Figueiredo, 2008). Patients undergoing AV fistula insertion for hemodialysis twice a week experience pain each time the procedure is carried out (Kaza et al., 2014).

Repeated AV fistula insertion may affect the psychological state of hemodialysis patients and increase their fear and anxiety (Alhani, Shah, Anoosheh, & Hajizadeh, 2010). Hansen and Streltzer (2005) reported that pain can cause emotional disturbances, depression, anxiety, and mood disorders. Harris et al. (2012) demonstrated a relationship between pain perception in hemodialysis patients and anxiety, depression, sleep disorders, quality of life, and mortality.

Techniques are needed to overcome the pain of recurrent AV fistula insertion so that patients can accept the procedure with ease and maintain their quality of life (Çelik et al., 2011). Nurses usually carry out two approaches to reduce the pain of AV fistula insertion in hemodialysis patients, namely, pharmacological and nonpharmacological approaches (Suren et al., 2013). The Valsalva maneuver is a nonpharmacological technique that can be performed to reduce

the pain of AV fistula insertion (Sundaran, Khan, Bansal, & Jyotsana, 2016).

The Valsalva maneuver involves forced expiration for 16–20 seconds while the glottis (mouth and nose) is covered (Engstrom & Martin, 1998; Kumar et al., 2016). Mashhadi and Loh (2011) showed that many patients can withstand pain by holding their breath and closing their glottis, which can trigger the Valsalva maneuver, during needle insertion.

A previous research including 98 respondents showed that the average pain score of the Valsalva maneuver group is 1.5 (SD= 1.2) while the average pain score of the control group is 3.1 (SD= 1.9); the difference in results between groups was significant ($p < 0.001$, $z = 4.23$; Basaranoglu et al., 2006). Another research confirmed that administration of the Valsalva maneuver significantly reduces the intensity of AV fistula insertion pain ($p < 0.001$) compared with the control group. Valsalva maneuver performed for 16–20 seconds during venous insertion can reduce the incidence and severity of pain (Suren et al., 2013).

Sensory nerves from various organs, such as the oropharynx, upper digestive tract, stomach, and chest cavity, transmit information along the vagus nerve to the solitary tract. The vagus nerve also carries nociceptor fibers along this pathway. The Valsalva maneuver increases intrathoracic pressure and causes activation of baroreceptors, which stimulate vagus nerve stimulation. As a result of vagus nerve stimulation, antinociceptive effects are induced (Liporace et al., 2001).

Previous studies applied the Valsalva maneuver to reduce pain in patients with cannulation or intravenous and spinal puncture. Mohammadi, Pajand, and Shoeibi (2011) in their research used Valsalva maneuvers to reduce spinal puncture pain. Sundaran et al. (2016) showed that Valsalva maneuvers could be performed to reduce pain in patients with intravenous puncture. Suren et al. (2013) performed Valsalva mane-

urers in venous puncture patients. In the present study, the Valsalva maneuver was performed on hemodialysis patients undergoing weekly AV fistula insertion. The advantages of administering the Valsalva maneuver to reduce the pain of AV fistula insertion include ease of operation, patient operability, low cost, and absence of side effects (Davtalab, Najji, & Shahidi, 2016).

The Valsalva maneuver may be expected to reduce the pain of AV fistula insertion by directly increasing patient comfort during hemodialysis and indirectly reducing patient anxiety. Thus, the researcher is interested in assessing the effectiveness of the Valsalva maneuver in decreasing pain intensity during AV fistula insertion in hemodialysis patients.

Methods

This study features a type of research is quantitative with a pre-post quasi experimental design without control that intervenes one treatment group without comparison group (Dharma, 2015).

The appropriate number of samples for this study was determined by using power analysis. The number of samples obtained from a power of 0.8, effect size of 0.5, and α of 0.05 were 63 respondents. The participants in this study were patients receiving routine hemodialysis at RSU Haji Adam Malik Medan. The sampling technique in this study was consecutive sampling. Consecutive sampling is a technique in which all individuals who meet and fulfill the criteria are selected until the desired number of respondents is reached (Dharma, 2015).

The inclusion criteria of this study were as follows: 1) patients undergoing routine hemodialysis twice a week; 2) age over 18 years; 3) no pain in other areas of the body when AV fistula insertion is performed; 4) no analgesic or sedative use within 6 hours before hemodialysis; 5) AV fistula cannulation can be done from time to time; 6) no history of heart di-

sease, glaucoma, or increased brain pressure and no eye surgery over the last few days; 7) no redness or bruising in the area of fistula insertion.

Before performing the research, the researcher first makes a research permit and research ethics number: 1282/X/SP/2017 from the Faculty of Nursing, University of North Sumatra, addressed to the research and development department of H. Adam Malik Hospital Medan. After obtaining a research permit from the research and development department, the letter was submitted to the head of the hemodialysis room at the H. Adam Malik Hospital in Medan.

This research involved a group of respondents and divided into two meetings. In the first meeting, the researcher identified respondents based on predetermined inclusion criteria. Thereafter, the researcher explained the research procedure and clarified that all respondents will experience AV fistula insertion without intervention at the first meeting and undergo the Valsalva maneuver before AV fistula insertion at the second meeting. The respondents were provided informed consent and were sought approval by the researcher. AV fistulas were inserted into the respondents by a hemodialysis nurse without intervention. After insertion, the researcher measured the pain of each respondent by using the Numerical Pain Rating Scale (NPRS).

At the second meeting, before AV fistula insertion, respondents were taught how to perform the Valsalva maneuver. Respondents were asked to cover their mouth and nose with their hand as tightly as possible and then encouraged to attempt maximum expiration. The Valsalva maneuver was first carried out for 16–20 seconds without pause, during which the respondent performed a maximum expiration of 5 seconds. After 5 seconds, the hemodialysis nurse inserted the AV fistula. During AV fistula insertion, the respondent continued to perform maximum expiration for 16 or 20 seconds. Thereafter, the researcher measured the pain of the respondents by using the NPRS.

Data collection was accomplished by collecting demographic data and using NPRS questionnaires. The results were recorded in a recording sheet.

The data were processed by using a computer program. The results were evaluated by using univariate and bivariate analyses. Univariate analysis was performed on respondent data, including age, sex, education, occupation, length of hemodialysis, and the duration of AV fistula use. Bivariate analysis using paired *t*-test was employed to evaluate the intensity of AV fistula insertion pain before and after the intervention.

Results

Normality of Data. The normality tests used were skewness and kurtosis. The normality test results obtained at the first meeting (without intervention) showed that the data are normally distributed with a skewness ratio/standard skewness of 1.91 and kurtosis ratio/standard kurtosis error of -0.49. At the second meeting (with application of the Valsalva maneuver), the data were also normally distributed with a

skewness/standard error skewness ratio of 1.81 and kurtosis ratio/standard kurtosis error of -0.12.

Respondent Characteristics. Approximately 39.7% of the respondents were aged between 56 and 65 years, 63.5% were male, 36.5% had a high school education or its equivalent, and 41.3% were self-employed. Approximately 50.8% of the respondents had undergone hemodialysis for 3–28 months and 60.3% had had an AV fistula installed for 2–23 months.

Frequency Distribution of Pain Intensity. Table 1 reveals that, at the first meeting, prior to receiving the intervention, 65.1% of the respondents experienced AV fistula insertion pain with moderate intensity (4–6). At the second meeting, after administration of the Valsalva maneuver, 55.6% of the respondents experienced AV fistula insertion pain with mild (1–3) intensity.

Average Pain Intensity. Table 2 shows that the average pain intensities of AV fistula insertion before and after intervention with the Valsalva maneuver are 4.87 (SD= 1.47; 95% CI) and 3.52 (SD= 1.29; 95% CI), respectively.

Table 1. Frequency Distribution of Pain Intensity Before and After Performing the Valsalva Maneuver (n= 63)

Pain Intensity	Valsalva Maneuver			
	Before		After	
	f	%	F	%
1–3 (Mild)	13	20.6	35	55.6
4–6 (Moderate)	41	65.1	28	44.4
7–10 (Severe)	9	14.3	0	0

Table 2. Average Intensity of Pain of AV Fistula Insertion Before and After Intervention (n= 63)

Intervention	Mean	SD
Before	4.87	1.47
After	3.52	1.29

Table 3. Differences in Intensity of AV Fistula Insertion Pain Before and After the Intervention (n= 63)

Intervention	Score difference Mean (SD)	t (p)	95% CI
Before-After	1.35±0.54	19.70 (0.001)	1.212–1.486

Difference in Pain Intensity Before and After Intervention. According to Table 3, the difference in average intensity of AV fistula insertion pain before and after the intervention is 1.35 (SD= 0.54) (95% CI), with a tcount = 19.70 greater than t-table with df = 62 is 1.99 (p= 0.001; CI= 1,212–1,486). These results reflect a significant difference in pain intensity during AV fistula insertion before and after application of the Valsalva maneuver to hemodialysis patients.

Discussion

Pain Intensity Before Intervention. The results of this study reveal that 65.1% of the respondents' experience pain intensity between 4–6 (moderate) during AV fistula insertion.

The findings of this work are in line with Kaza et al. (2014), who showed that, among 56 respondents who experienced AV fistula insertion pain, 62% experienced moderate pain intensity. Çelik et al. (2011) also found the same results in a group of 41 individuals, i.e., 48.8% of respondents in the group without intervention experienced moderate pain.

The results of this study demonstrated that the pain of AV fistula insertion at the first meeting without intervention is moderate in intensity with an average value of 4.87 (SD= 1.47). Arab, Bagheri-Nesami, Mousavinasab, Espahbodi, and Poursmail (2017) showed that the intensity of pain during AV fistula insertion before intervention is moderate with average values of 5.40 (SD= 1.75) and 5.54 (SD= 1.22) in the 2% lidocaine gel group and hegu point ice massage group, respectively.

Golda, Revathi, Subhashini, Mathew, and Indira (2016) revealed that the intensity of pain during AV fistula insertion before intervention is generally moderate with an average value of 6.3 (SD= 1.15). The data indicate that the average pain intensity felt during AV fistula insertion before the intervention is in the range 4–6 (moderate).

Pain Intensity After Intervention. Among 63 patients who underwent the Valsalva maneuver during AV fistula insertion, 55.6% experienced a decrease in pain intensity of 1–3 (mild) and 44.4% experienced pain between 4–6 (medium). In the research of Agarwal, Sinha, Tandon, Dhiraaj, and Singh (2005), with 25 respondents in each group with venous cannulation (control group), Valsalva maneuver, and ball. The results showed that in the Valsalva maneuver group, as many as 72% of patients experienced mild pain, which is better than the control group (44%) and the ball group (36%) (Agarwal et al., 2005).

Valsalva maneuvers can stimulate the vagus nerve through activation of the cardiopulmonary baroreceptor arch (Bennett, Hosking, & Hampton, 1976). Randich and Maixner (1984) reported that systems that control cardiovascular function are closely related to systems that modulate pain perception. Activation of the cardiopulmonary baroreceptor reflex or sinoaortic baroreceptor arch can induce antinociception.

Decreased pain due to AV fistula insertion in hemodialysis patients can be associated with activation of the cardiopulmonary baroreceptor reflex arc or sinoaortic baroreceptor arch caused by the Valsalva maneuver. Baroreceptor activation can stimulate the vagus nerve. Then, the activated vagus nerve delivers impulses to the nucleus of the solitarius tract. The solitary tract is the point of intersection between the afferent nerves of the vagus nervous system and the nociceptive pathways of the spinal lamina (Bruehl & Chung, 2004). A decrease in pain during AV fistula insertion occurs when the solitarius tract first receives an impulse of stimulation from the activation of the vagus nerve caused by administration of the Valsalva maneuver. At the same time, the pain stimulation delivered by the nociceptive nerve due to AV fistula insertion, which also passes through the solitary tract, is inhibited by impulses delivered by the vagus nerve. Thus, the pain felt by the patient decreases or disappears. This process is in accordance with gate control theory proposed by

Melzack and Wall (1965), which claims that only one impulse of stimulation can be accepted and perceived by the brain.

After application of the Valsalva maneuver, AV fistula insertion pain decreased to a mild intensity with an average value of 3.52 (SD= 1.29). Sundaran et al. (2016) found that the intensity of venous cannulation pain experienced by respondents in the Valsalva maneuver group is mild with an average value of 1.53 (SD= 0.63).

Difference in Pain Intensity Before and After Intervention. The results of the study reveal a decrease in pain during AV fistula insertion after administration of the Valsalva maneuver with an average decrease in pain intensity of 1.35. The pain of AV fistula insertion felt by the respondents before the intervention was of moderate intensity with an average value of 4.87; after administration of the Valsalva maneuver, mild intensity with an average value 3.52 was reported.

Paired *t*-test was used to determine differences in the intensity of AV fistula insertion pain before and after the Valsalva maneuver. The results of this test indicate the value of $t= 19.70$ is greater than the value of $t_{table}= 1.99$ and the value of $p= 0.001 < 0.05$. Thus, a significant difference in pain intensity of AV fistula insertion before and after the intervention of the Valsalva maneuver exists. Provision of the Valsalva maneuver can reduce the pain of AV fistula insertion in hemodialysis patients.

The results of this study are supported by Davtalab et al. (2016), who found a significant difference in intensity of insertion pain before and after administration of the Valsalva maneuver ($p= 0.001$). Agarwal et al. (2005) also demonstrated a significant decrease in pain intensity during intravenous cannulation by using the Valsalva maneuver ($p= 0.001$).

Sundaran et al. (2016) revealed that intervention with the Valsalva maneuver can reduce the pain of intravenous cannulation ($t= -2.053$, $p=$

0.045). Suren et al. (2012) showed a significant difference in pain intensity in the Valsalva group compared with the control group ($p < 0.05$).

Valsalva maneuvers can activate baroreceptors and induce nociceptors (Usichenko, Pavlovic, Foellner, & Wendt, 2004); they can also increase intrathoracic pressure by exhaling and closing the nose so that the glottis is closed for a period of time. These effects can cause increased blood flow, which results in a decrease in blood entering the thorax and activating baroreceptors (Mashhadi & Loh, 2011).

Baroreceptor activation can stimulate vagus nerve stimulation. The vagus nerve then delivers impulses to the nucleus of the solitarius tract. The nucleus tractus solitarius is the interface between the autonomic and sensory systems and the location of the first synapse in the baroreceptor reflex pathway. Nucleus tractus solitarius is the receiver of afferent input from the vagus nerve and spinal lamina associated with nociceptive processes (Bruehl & Chung, 2004).

Bruehl and Chung (2014) stated that stimulation of the nucleus solitarius tract in the pathway of pain regulation can induce antinociception. Antinociceptive stimulated by the solitary tract nucleus can be derived from direct and indirect efferent projections to the periaqueductal gray (PAG) and other brain structures such as the nucleus raphe magnus (NRM) and rostral ventrolateral medulla (RVM) are known to be involved in modulating the pain pathway.

In addition to the upper brain region, the projection of the solitary tract of the nucleus to the medulla coeruleus locus, which is also an important contributor to antinociception, is likely related to blood pressure, given that direct stimulation of this area gives rise to analgesia. The interconnection between the nucleus of the solitary tract and the coeruleus locus is very important in mediating non-opioid analgesia because the coeruleus locus is the main source of noradrenergic neurons in the neuraxis.

The results of this study confirm the validity of the research hypothesis, which states that the intervention of the Valsalva maneuver can reduce the intensity of AV fistula insertion pain in hemodialysis patients.

Previous studies have shown that Valsalva maneuvers are given to reduce pain in patients undergoing knee injection and spinal anesthesia. Abogamal (2016) showed that the Valsalva maneuver may be administered to patients undergoing knee injection. Kumar et al. (2016) indicated that Valsalva maneuvers could be performed in patients undergoing spinal anesthesia.

This study did not use a control group because of the limited time and number of samples in the research process.

Conclusions

In the first meeting, before administering the Valsalva maneuver, less than two out of three respondents experienced moderate-intensity pain during AV fistula insertion. However, in the second meeting, after administering the Valsalva maneuver for 20 seconds, over half of the respondents reported experiencing pain of only mild intensity.

The Valsalva maneuver is effective in reducing pain when inserting AV fistulas in hemodialysis patients. This conclusion is evidenced by the significant difference in pain intensity of AV fistula insertion before and after administering the Valsalva maneuver.

The Valsalva maneuver is highly recommended to be administered to patients undergoing AV fistula insertion. Provision of the Valsalva maneuver can help safety needs and reduce the level of safety when inserting an AV fistula into patients for hemodialysis. The technique is also very easy for patients to perform. The evidence obtained from the present study confirms that the Valsalva maneuver is effective in decreasing

ing fistula AV insertion pain when performed in hemodialysis patients.

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