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The impacts of short-term foot massage on mean arterial pressure of neurosurgical patients hospitalized in intensive care units

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ABSTRACT

Aims: Short term foot massage helps regulate the vital signs of patients who are hospitalized for long periods of time in intensive care units. The purpose of this study was "to examine the immediate impacts of short-term foot massage on mean arterial pressure among neurosurgical patients hospitalized in intensive care units".

Methods: This quasi-experimental study was conducted in 2013 on 78 patients who had been conveniently recruited from the intensive care units of Imam Reza (PBUH) Hospital, Kermanshah, Iran. Patients were equally and randomly assigned to the experimental and the control groups. Study data were collected by using a demographic questionnaire and a blood pressure data sheet which were completed through observation, interviewing, and physiologic measurement. Mean arterial blood pressure was measured both five and one minutes before the intervention. Then, the feet of each patient in the experimental group were massaged for five minutes and mean arterial pressure was re-measured one and five minutes afterward. The $SPSS_{16}$ was used for calculating the measures of descriptive statistics and conducting the paired- and the independent-samples t tests.

Results: In the experimental group, mean arterial blood pressure decreased significantly both one minute (93.23±14.16; p=0.005) and five minutes (89.76±13.66; p<0.005) after the study intervention. However, within-group comparison revealed that means arterial blood pressure did not change significantly in the control group after the intervention.

Conclusions: Foot massage is effective in decreasing mean arterial pressure and giving patients a sense of calmness.

Keywords: Short-term foot massage, Intensive care unit, Neurosurgery, and Mean arterial pressure.

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1. Introduction

The environment of intensive care unit (ICU) is potentially stressful to patients due to either noises of equipment and devices and 24-hour lighting or lack of significant stimulations such as touch and communication [1 and 2]. In such an environment, patients not only show psychological symptoms of anxiety, but also may develop physical problems. Disorientation to time and place which is highly prevalent in ICU is affected by factors such as sensory overload or deprivation. Sensory overload and deprivation are so severe among intensive care patients that about 75% of them experience sensory perception disorders. Studies showed that the incidence of disorders such as delusion and hallucination among intensive care patients, particularly those undergoing neurosurgeries, is up to 30%–40% [3–5].

Among intensive care patients, the ones who undergo neurosurgeries are more at risk for developing physiologic complications due to their chronic conditions. Neurosurgeries are palliative, diagnostic, and therapeutic operations performed on central or peripheral nervous system. Such surgeries prolong patients' hospital stay which subsequently heightens the risk for developing infections, increases healthcare costs, and thereby creates a vicious cycle with more severe chronic and stress for patients [5–8].

Changes in the physiologic function of the body are associated with changes in vital signs [1–4] such as temperature, heart rate (HR), blood pressure (BP), and respiratory rate (RR). Normally, vital signs fluctuate during the day and also during the courses of health and illness. Therefore, monitoring and documenting them at the time of admission can provide a basis for subsequent comparisons [1 and 2]. Normal vital signs show normal functioning of the cardiovascular, respiratory, nervous, and endocrine systems. Any factor which affects physiologic parameters has actually affected the aforementioned systems which is of greater importance to patients hospitalized in ICU as well as patients with brain and nerve injuries [1–3 and 14].

Using medications for managing health problems are usually associated with side effects such as nausea, vomiting, muscular weakness, urinary tract infection, venous stasis, and increased healthcare costs. These side effects highlight the necessity for using other therapies for managing stress and anxiety [1–3]. Consequently, the use of complementary therapies is increasing worldwide. Studies conducted by clinical nurses in the United States, Canada, Australia, Britain, and Palestine showed that 68%–70% of patients use these therapies. Complementary therapies include a wide range of techniques such as soft music, guided imagery, therapeutic touch, acupuncture, homeopathy, massage therapy and so on [1 and 9–11].

One of the commonest complementary therapies and nursing procedures is massage therapy [1 and 7]. The benefits of massage include, but not limited to, reduced fatigue and anxiety, whole body and muscular relaxation, increased endorphin production, better sleep quality, relief of pain and muscular cramp, heightened sense of well-being, behavior reinforcement, and reduced need for sedation [3, 5, 12, 13, and 15]. However, studies have reported conflicting findings about the effectiveness of massage therapy. For instance, Hattan et al. (2002) and reported that massage therapy had no significant effect on vital signs, particularly oxygen saturation [19] while Holland and Pokorny (2001) found that it significantly decreased HR and RR as well as diastolic and systolic BP [20]. Moreover, Hayes and Cox (1999) reported that foot massage significantly affected physiologic parameters such as HR, RR, and BP while it had no significant impact on body temperature and arterial oxygen saturation [8]. Cambron et al. (2006) also found a significant decrease in systolic BP by 1.8 mmHg and a significant increase in diastolic BP following massage therapy [21]. Rahmani Anaraki et al. (2001) conducted a study on 25 patients having a mean

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age of 36 years in order to evaluate the effects of back massage on physiological parameters among intensive care patients. They monitored and documented parameters such as HR, BP, RR, and oxygen saturation before, during, and after a five-minute back massage and found that HR, RR, and mean arterial pressure (MAP) decreased during and after massage and oxygen saturation increased only after it ($p<0.001$) [7]. Imanishi et al. (2009) also reported the effectiveness of massage therapy in alleviating anxiety and noted that further studies are needed for confirming their findings [34]. Sherman et al. (2009) also noted that massage is effective in alleviating severe to moderate chronic pain for short period of time [35].

Complementary therapies are helpful for improving patients' conditions and easing them in ICUs [16 and 28-29]. However, the effectiveness of massage therapy is doubtful due to limited studies in this area. Therefore, this study was done to examine the immediate impacts of short-term foot massage on MAP among neurosurgical patients hospitalized in ICUs.

2. Methods

This was a clinical trial study whose population comprised all patients who had undergone neurosurgeries in 2013 and were subsequently hospitalized in the ICUs of Imam Reza (PBUH) Hospital, Kermanshah, Iran. Considering a mean HR of 78.7 and 88.6 beats per minute respectively in the experimental and the control groups, a standard deviation of 15.4 [4], a confidence level of 0.95, and a power of 0.80, the minimum sample size for each study group was determined to be 39.

The formula for sample size calculation:

$$N= \{[Z\ (1-\alpha/2) +Z\ (1-\beta)]^2\}\times\{S_1^2+S_2^2\}\times 2/\ \{M_1-M_2\}^2$$

$$N= \{[1.96+0.84]^2\}\times(15.4^2)\times 2/\ [88.6-78.8]^2= 39$$

Accordingly, 87 eligible patients were recruited conveniently and assigned to the study groups randomly. The selection criteria were being hospitalized in ICU, undergoing neurosurgery, having normal plantar reflex and a Glasgow Coma Scale (GCS) score of 8–15, and experiencing neither acute orthopedic problem in the ankle, musculoskeletal disorders, multiple sclerosis, Guillain Barreths syndrome, diabetes mellitus, nor conditions affecting the nervous system. Participants were excluded if they received intravenous opioid or non-opioid analgesics, needed medications which could affect BP and HR, or developed vascular disorders in feet, skin problem in the ankle, deep vein thrombosis, disseminated intravascular coagulation, delirium or severe psychological problems which affected intrpersonal relationships, and cardiovascular diseases which influenced physiologic parameters. We attempted to recruit patients who were hemodynamically stable.

A seven-item demographic questionnaire and a BP datasheet were used for data collection. The demographic questionnaire was filled out through either interviewing patients or their family members or referring to patients' medical records. The items of the BP datasheet were systolic and diastolic BP as well as MAP at the first and the fifth minutes before and the first and the fifth minutes after massage therapy. The datasheet was completed through observation and physiologic measurement. Blood pressure was measured by an electronic bedside sphygmomanometer (Micro Life, Switzerland) which had been calibrated by using an Alp K2 mercury sphygmomanometer. This electronic device automatically calculated and showed MAP value.

The study intervention was implemented by the first author for male patients and a trained female researcher assistant for female patients. We referred to the study setting each day once it was not too crowded (i.e. between 15:00 and 17:00), recruited eligible patients, obtained consent either from them or their family members, and started the study intervention.

Primarily, patients' BP was measured and MAP was calculated both five and one minute before starting massage therapy (T1 and T2, respectively). Then, ankle-to-toe foot massage

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therapy was provided to patients in the experimental group for five minutes. Each foot was massaged for 2.5 minutes. The therapist (i.e. the first author or the female research assistant) rubbed baby oil into his/her hands and started massaging while the intended patient was placed in supine position with a pillow under the feet and the head of bed was elevated 30 degrees. Massage therapy was provided in four steps as follows. First, patient's foot was held with one hand while the toes were pointed straight up and then, the spaces between ligaments of the feet were gently pressed by using the thumb. Second, the foot was held with one hand while the other hand was gently rubbed on the sole from the heel toward the bottom of the toes. Third, the toes were separately stretched to left and right and bent forward and backward. Fourth, the toes were held by using the thumb and other fingers and were rotated externally.

The other foot was then massaged by employing the same techniques. Finally, BP was measured in the study groups both immediately and five minutes after massage therapy (T3 and T4, respectively).

Patients in the control group received no massage therapy.

The study data were presented via tables of frequency distribution. Moreover, the paired- and the independent-samples t tests were done for respectively within-group and between-groups comparisons. The SPSS software (v. 16.0) was employed for data management and analysis.

3. Results

More than half of the patients in the experimental group (56.4%) had an age of 60–89 years while in the control group, patients' age was mainly 30–89 years (92.4%). Most of the patients were female (53.8%) and married (88.5%). More than half of the patients in the experimental and the control groups were respectively male (53.8%) and female (61.5%; Table 1).

Most of the patients in both study groups received oxygen therapy through simple face mask (46.2%) or were intubated and received mechanical ventilation by using the Synchronized Intermittent Mandatory Ventilation (SIMV) mode (32.1%; Figure 2). Moreover, the patients in both groups had undergone surgeries mainly for compact disc implantation (26.9%) or intracranial hemorrhage (ICH) (21.8%; Figure 3). The most common type of surgeries in the experimental and the control groups were respectively for ICH (23.1%) and disc implantation (38.5%).

The length of hospital stay for most of the patients in both study groups (97%) was 1–10 days. Non-intubated patients received oxygen therapy mainly at a rate of 4–6 liters per minute (35%) while the concentration of oxygen for intubated patients was mainly 20%–40% (23%). The concentration of oxygen for patients who did not receive oxygen therapy was considered to be 21%. The GCS score of most patients in the experimental and the control groups was respectively 8–10 and 13–15 (51.2% vs. 61.5%; Table 1).

The results of the independent-samples t test illustrated that both at T1 and T2, the mean of MAP in the control group was significantly lower than the experimental group ($p=0.002$ and 0.008, respectively). As only during-massage MAP variations are clinically important, the pre-massage differences between the groups were not considered as clinically significant. After massage therapy, the difference between the study groups was significant neither at T3 nor at T4 ($p>0.05$; Table 2). However, the paired-samples t test revealed that in the experimental group, MAP at T3 and T4 was significantly lower than respectively T1 ($p=0.005$) and T2 ($p<0.005$) whereas in the control group, the difference between T1 and T3 as well as between T2 and T4 regarding the mean of MAP were not statistically significant (Table 3).

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Table 1: Study participants' demographic and clinical characteristics

Variables		Experimental		Control	
		N	%	N	%
Age	10–29	6	15.3	3	7.6
	30–59	11	28.3	18	46.2
	60–89	22	56.4	18	46.2
Gender	Female	18	46.2	24	46.2
	Male	21	53.8	15	53.8
Marital status	Married	34	78.2	35	89.7
	Single	5	12.8	4	10.3
Length of hospital stay	1–9 days	37	94.8	39	100
	10–19	1	2.56	0	0
	20–29	1	2.56	0	0
The rate of oxygen therapy for non-intubated patients (Liter per minute)	4–5	12	70.5	16	72.7
	6–7	4	23.8	6	27.3
	8–10	1	5.8	0	0
The concentration of oxygen therapy for intubated patients	21%–40%	20	43.4	8	50
	41%–60%	10	43.4	5	31.2
	61%–80%	3	13	3	18.7
Level of consciousness (GCS score)	8–10	20	51.2	11	28.2
	11–13	4	10.2	4	10.3
	13–15	15	38.4	24	61.5

4. Discussion

The purpose of this study was to examine the immediate impacts of short-term foot massage on MAP among neurosurgical patients hospitalized in ICUs [21–26]. Study findings revealed that short-term foot massage significantly decreased MAP. This is congruent with the findings of the previous studies. For instance, Hayes and Cox (1999) made a quasi-experimental study in a hospital located in London in order to assess the immediate effects of foot massage and reported a significant decrease in MAP during massage therapy ($p>0.005$). This finding can be attributed to the alleviation of stress and anxiety. The population of this study was heterogeneous [8] while the population of patients in our study was homogeneous. In another quasi-experimental study, Holland and Pokorny (2001) investigated the effects of three-day slow stroke back massage on physiologic parameters of 24 patients aging, on average, 71.8 years who were hospitalized in a rehabilitation setting. Their findings indicated that diastolic and systolic BP decreased significantly during the three days of their intervention. Although Holland and Pokorny (2001) studied elderly patients [20], patients participating in our study were of different ages. Imanishi et al. (2009) also found that MAP significantly decreased across the

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three measurement time-points, i.e. ten minutes before as well as ten and 30 minutes after foot massage [34]. Moreover, Haji Hosseini et al. (2006) reported that massage was effective in significantly decreasing diastolic and systolic BP in the second and the third days after its administration [4].

Post-White (2003) also evaluated the effect of massage and found that it reduced diastolic and systolic BP in patients receiving chemotherapy [36]. Torabi et al. (2012) found that foot reflexology massage before angiography significantly reduced post-angiography diastolic and systolic among patients who were hospitalized in coronary care unit [30]. All of the aforementioned studies had been conducted on conscious patients while patients participating in the present study had different levels of consciousness.

Latifi et al. (2012) also undertook a study to assess the effects of hand and foot massage and found that their intervention significantly reduced diastolic and systolic BP both 60 and 90 minutes after Cesarean. The length of their study was greater than ours [31] while we aimed at investigating the immediate impacts of foot massage. Moreover, in a study to determine the effects of massage on hand pain

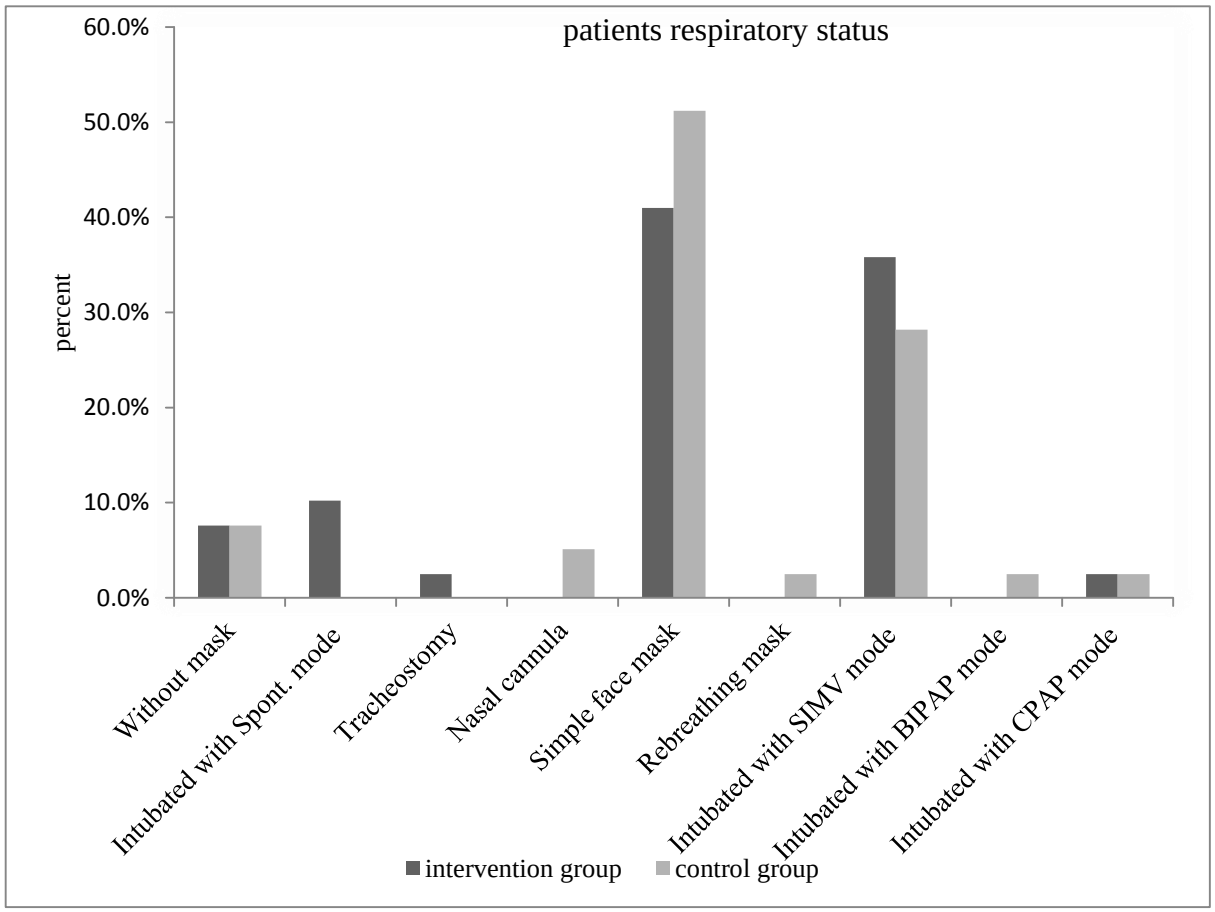

Diagram 1: Respiratory devices which had been used for the study participants

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Table 2: Between-groups comparison of MAP at the four measurement time-points

Group MAP	Experimental group	Control group	Between-group mean difference	The results of the independent-samples t-test
Five minute before massage therapy (T1)	96.61±14.65	85.28±15.83	2.34±2.53	p= 0.002 t=3.281
One minutes before massage therapy (T2)	83.33±22.72	82.05±23.46	2.43±2.39	p=0.008 t=2.237
One minute after massage therapy (T3)	81.12±22.10	82.23±22.32	2.26±2.27	p=0.073 t=1.82
Five minutes after massage therapy (T4)	79.15±21.85	82.64±23.51	2.18±2.35	p=0.362 t=0.918

Table 3: Within-group comparison of MAP

Groups	Before		After		T1-T3 comparison	T2-T4 comparison
	Mean ± standard deviation		Mean ± standard deviation			
	Five minute before (T1)	One minutes before (T2)	One minute after (T3)	Five minute after (T4)		
Experimental	96.61±14.65	83.33±22.72	81.12±22.10	79.15±21.85	p=0.005	p<0.005
Control	85.28±15.83	82.05±23.46	82.23±22.32	82.64±23.51	Non-significant	Non-significant

and anxiety, Field et al. (2011) found that massage alleviated hand pain and state anxiety and reduced BP [32]. Moyle et al. (2013) also reported that foot massage improved mood, alleviated anxiety, and reduced diastolic and systolic BP among long-term staffs working with elderly people who suffered from dementia [33]. While we provided massage to the study participants, they seemed happy and calm and felt being close to us. Massage can improve nurse-patient relationship. Foot massage technique is simple and hence can be easily educated to and implemented by nurses. This technique can also be employed for patients who are on complete bed rest. It is a simple and inexpensive technique which can be implemented in a short amount of time.

5. Conclusions

It can be concluded from the study findings that while given regularly and accurately, foot massage can regulate MAP in intensive care patients. As foot massage is a simple, short-term, and easy-to-use technique, it can be used

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by nurses, physicians, physical therapists, and even patients' family members for improving outcomes and recovery among patients hospitalized in ICUs.

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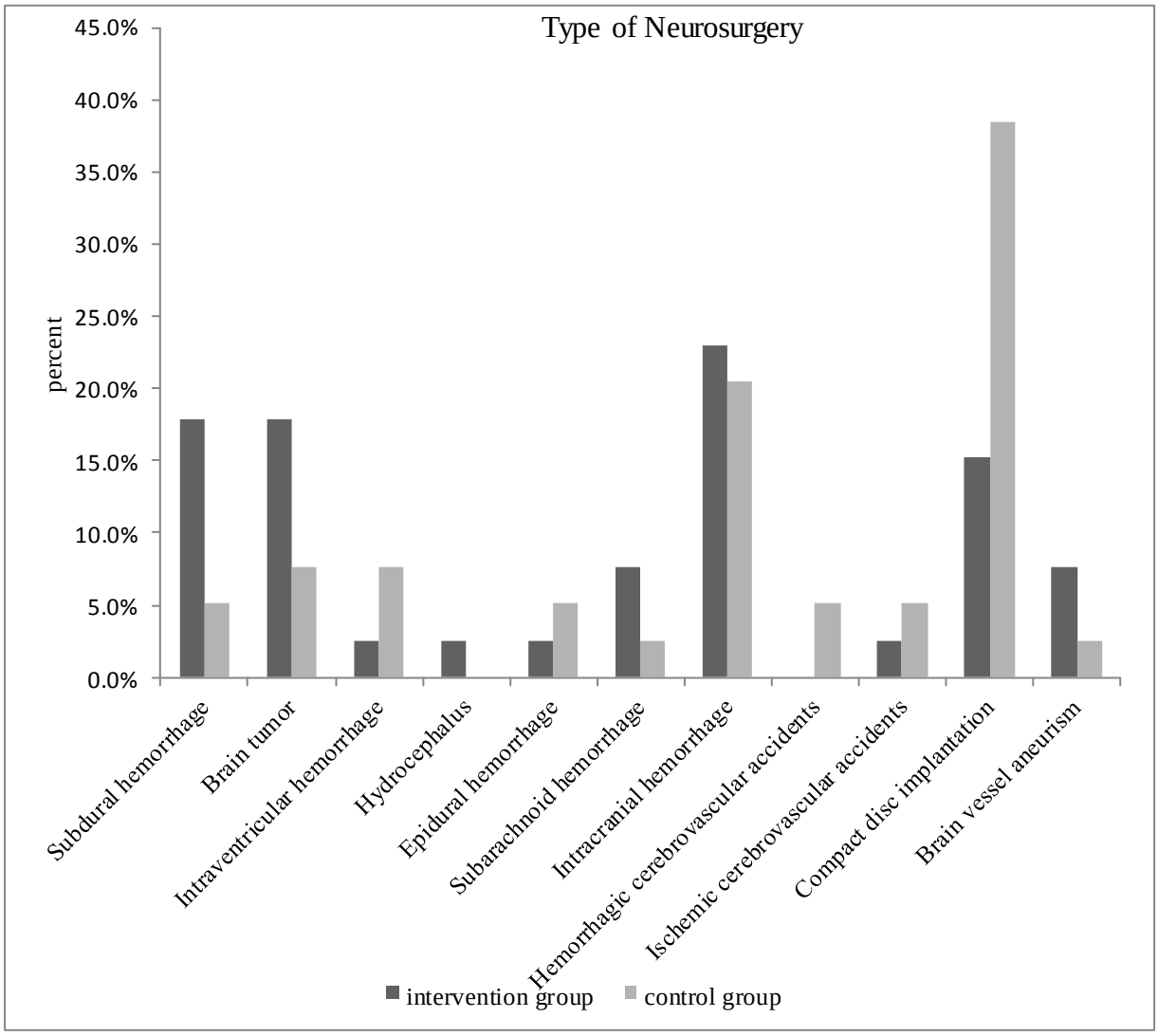

Diagram 2: The type of surgeries undergone by the study participants

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