

To Study Vertebral Artery Blood Flow Velocity During Cervical C1-C2 Manual Traction -Mulligan

Shhalini Grover and G.L.Khanna

Abstract

Aim: To investigate the blood flow of vertebral artery at c1-c2 region during manual traction -Mulligan. **Method:** The focus of the present study is measuring haemodynamic parameters including peak systolic velocity (PSv) and end diastolic velocity (EDv) of vertebral arteries at the sub occipital region of cervical spine in neutral positioning and whether there is change in the hemodynamic parameters during c1-c2 manual traction (mulligan) using Doppler ultrasonography in normal individual mean age 24.68 ± 2.03 year. **Results:** The result showed significance difference ($p=0.000$) in blood flow velocity for PSv and EDv between neutral position and during manual traction for left and right vertebral arteries. **Conclusion:** This technique had no mechanical effect on vertebral artery rather it has an impact on hemodynamic status of artery and are of great value in increasing the knowledge of the possible treatment protocol related to the blood flow changes with the movements of cervical spine.

Shhalini Grover

Associate Professor,
Department of Physiotherapy, Faculty of Applied Science
Manav Rachna International University, Faridabad, India
E-mail: shalinigrover.fas@mriu.edu.in

G.L.Khanna

Professor & Dean Faculty of Applied Science
Manav Rachna International University, Faridabad, India
E-mail: dean.fas@mriu.edu.in

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Introduction

Cervical spine mobilizations and manipulations are commonly used by physiotherapists and other health professionals to treat mechanical neck pain. After manipulation of cervical spine, minor short term side effects are very usual. (Refshauge 1994) Subjects may feel only local discomfort at the cervical spine where mobilization or manipulations are addressed. Other common symptoms like headache, tiredness, and radiating discomfort dizziness or nausea can also be seen in patients (Ernst 2001 and Cagnie 2004). Refshauge 1994 hypothesized that there can be ischemia in the area supplied by vertebral artery. The vertebral artery is unique among the neck vessels by virtue of its position with the cervical spine and relationship to the adjacent muscle, ligaments & disc etc. It is the major blood supply to musculoskeletal structures of the cervical spine and the cervical spinal cord. (Moore & Dalley 1999). The vertebral artery is, divided into four parts; the first part originates from the subclavian artery in the root of the neck to the sixth cervical vertebra, second part courses through the foramina transversaria of the sixth cervical vertebra to the first cervical vertebra; third part is from the foramen transversarium of the first cervical vertebra (atlas) to the dura mater at the foramen magnum also called as suboccipital part and the fourth part lies within the cranium to the pontomedullary border (Abd El-Bary and Dujovny 1995; Anderson & Bannister 1989) Between the first and second cervical vertebrae, the vertebral artery runs a variably tortuous course. It is at this level that much of the rotation of the cervical spine takes place (Kapandji, 1987; Soames, 1994),

where the vertebral artery is more prone to compress and stretch without being damaged but excess of compression or stretch can also cause damage of the artery. (Haynes and Milne, 2001; Thiel 1991). However, it is now generally agreed that the natural tortuosity of the artery between the first two vertebrae allows the vessel to stretch without damage during normal rotation of the cervical spine. Also according to Rivett (2004), vertebral arteries are important entity during manual therapy because of its vulnerability of getting stressed in its torturous course in the cervical spine. The suboccipital part of the vertebral artery is susceptible for injury more than the proximal parts of the artery. (Braun et al, 1983 & Frumkin, 1990). At this suboccipital region of the cervical spine, the artery takes a loop of approximately 90 degree and passes postero-medially from the foramen transversarium to posterior to the lateral mass of the atlas vertebra and passes along the superior surface of the posterior arch of the vertebra before entering the spinal canal. It is almost fixed in position by connective tissue at this region (Mann 2001 & Mitchell 2003). It is possible that the artery can be stretched across the rim of the foramen transversarium on the contralateral side to cervical rotation (Haynes and Milne, 2001) and can be compressed against the rim of the lateral mass on the same side of cervical rotation (Bolton, Stick, and Lord, 1989). There is reduction of blood flow in the vertebral artery in both the case whether it is ipsilateral or contralateral side of cervical movements (Mitchell 2003). Moreover the surrounding connective tissue which otherwise supports the artery may exacerbate this distortion by restraining the artery movement against cervical spine rotation. Thus, the vertebral artery is expected to be mortified in this region. Although the physiological parameters of blood flow in the vertebrobasilar system are well understood, there are few studies in the current literature which emphasis on the sub-occipital part of the artery. Mitchell (2004) The clinical importance and relevance of vertebral artery (VA) blood flow differences associated with cervical spine movements with either rotation, extension or combination of movements (extension and rotation) of cervical spine used by physiotherapists during the treatment of neck disorder are now a days is main focus of research. Many studies have been conducted on vertebral artery blood flow changes in relation to cervical spine rotation, few studies report decrease of blood flow in vertebral artery in contralateral to the cervical rotation Li et al (2008) some report shows no changes in blood flow irrespective to the rotation of cervical spine and one of the study shows an increased flow velocity in the vertebral artery during ipsilateral rotation Lich et al (1999). Arnold 2004 reported that there is decrease of blood flow whether in contralateral or ipsilateral rotation of cervical spine or in pre-manipulative hold (sustained extension with rotated cervical spine), all these position put greatest mechanical stress on artery and causes significant decrease in peak systolic and end diastolic velocity of blood flow of vertebral artery. Mitchell (2008) found the blood flow measurement is an important factor and very much dependent upon the part of vertebral artery to be insonated. Many studies have chosen suboccipital area to be researched for vertebral artery blood flow measures because this region is considered to be risky for injury during cervical spine rotation and also lead to blood flow compromise to the hind brain thus causing vertebrobasilar insufficiency or ischaemia. For the diagnosis of the hemo-dynamic status in vertebrobasillary artery system, techniques like magnetic resonance angiography, digital subtraction angiography, invasive electromagnetic flow meter (EMF), and color Doppler Ultrasound (CDU) are used. Currently Colour Doppler ultrasonography is the first choice in the examination of the extracranial part of vertebral artery (Ozdemir, et al 2005). Research has suggested that the Duplex Doppler ultrasound is a safe, non-invasive, cost-effective, painless, widely available, and easily administered diagnostic test. It provides an accurate measure of blood flow in real time thereby allowing for the flow of blood to be measured at various points within an artery (Johnson et al 2007). Vertebral artery is relatively non-tapered and has no appreciable branches in the cervical segment, blood flow measurements of vertebral artery are

accepted as reliable. Flow volume is an important parameter for evaluation of vertebral artery morphological characteristics and posterior circulation perfusion (Kizilkilic et al 2004). Although blood flow volume is the main parameter affecting brain perfusion, relative changes in velocity may be used to reflect changes in volume. Because the internal diameter (and mean cross-sectional area) does not change during normal laminar blood flow but blood flow velocity (cm/s, i.e., speed of blood flow) and blood flow volume (cm³/s i.e. taking the speed of flow with respect to the cross-sectional area) will vary proportionally. Thus, a measure of changes in blood flow velocity, associated with movements of the cervical spine, can be considered a good indicator of related changes in blood flow volume. (Mitchell 2003). Mean flow velocity and the “modified Pourcelot Index” (ratio between end-diastolic and maximum blood flow velocity) are considered as signs of increased peripheral resistance. Narrowing of the vessel radius distal of the point of insonation reduces diastolic flow before the systolic flow and thereby reduces markedly the modified PI. The normal range for the modified Pourcelot Index (PI) in the VA is 0.12-0.41, as reported by Biedert et al 1986. A modified PI of less than 0.1 and a difference in blood flow velocity of more than 50% between the left and right sides were used as diagnostic criteria for intracranial stenosis or hypoplasia of the VA (Karnik et al 1987). Various research studies have been conducted for measuring the changes in blood flow velocity associated with cervical spine rotation in normal and symptomatic subjects at all segments of vertebral artery. This present study is focused on measuring haemodynamic parameters including peak systolic velocity (PSv) and end diastolic velocity (EDv) of vertebral arteries at the suboccipital region of cervical spine in neutral positioning and whether there is change in the haemodynamic parameters during c1-c2 manual traction (mulligan) using doppler Ultrasonography. It may be considered that manual techniques performed closer to the overall neutral position of the cervical spine will have less effect on the arteries. The c1-c2 manual traction is simple mobilization with movements explained by Mulligan 2003 which bring about resolution of vertigo or other signs that are produced with neck movement. The aim of this study is to investigate whether this c1-c2 mulligan traction can bring about the change in the vertebral artery flow in normal asymptomatic subjects measured with ultrasonography. There is no such study investigated blood flow during specific manual therapeutic technique using ultrasonography. So the question arise was to investigate the effect c1-c2 manual traction on blood flow in vertebral arteries in healthy young participants and to find out whether there was any differences in vertebral artery blood flow while giving cervical manual traction (mulligan) at c1-c2 region. This study is focused on normal young adults aged 20 to 30 years.

Material and Methods

The 57 healthy young adults with mean age 24.68 ± 2.03 participated in this study. All the subjects were explained about the aim and objectives of the research. Out of these, seven reported a history of intermittent cervical pain but were not currently experiencing any symptoms of pain, headache or dizziness/ vertigo, five having stiffness/tightness in neck movements while performing the test ,three didn't report for measurement and reading of two subjects could not be taken because of technical issue. So rest 40 were subjected to do the procedure. Any history of serious cervical spine trauma, such as previous fractures, any congenital disorder recognized which could be associated with hypomobility or instability of the upper cervical spine, diagnosed vertebrobasilar artery insufficiency (VBI) were excluded..(Lucy et al 2013.) The included participants had no neck pain or limitation to neck movement. In this study, Color-coded duplex Doppler Ultrasound imaging is used to measure blood flow velocity i.e. peak systolic velocity (PSv) and end diastolic velocity (EDv) of vertebral arteries (left & right) in centimeters per second (cm/s). These measurements quantify maximum (PSv) and minimum flow velocity (EDv). All measurements were taken in a echo laboratory using the duplex Doppler US machine (Philips HDI 5000; Philips Medical

Systems) having a 7.5 MHz linear array transducer .The measurements of vertebral artery (VA) blood flow velocity were performed at the highest insonable part of the vertebral artery near lateral part of c1-c2 cervical region . The subject was positioned in a supine lying with neck placed in neutral position without pillow. The hand-held probe of 7.5 MHz was placed on lateral aspect of right side of neck and moved up till the mastoid process anterior to the sternocleidomastoid muscle.The probe was angled approximately 60 degree and maneuvered to insonate the underlying vertebral artery, so that an audible and the sharpest visual representations of blood flow in the artery could be obtained. This procedure was repeated to insonate the left side vertebral artery. Measurements of blood flow about peak systolic velocity and end diastolic velocity of the left and the right vertebral arteries were recorded. Following this, each subject was given manual traction at c1-c2 (Mulligan mobilization) Mulligan (1993).The measurement for the blood flow (peak systolic and end diastolic velocity) of right and left vertebral arteries were taken again while maintaining the traction force and readjusting the probe as above. This was necessary because it was not possible to measure blood flow continuously during traction. In this way, the best sonograph was recorded for the right and left vertebral artery.

Results

Descriptive statistics were expressed included mean, standard deviation, standard error and 95% confidence intervals between baseline and during mobilization position left and right for PSv and EDv . The dependent variables were tested using kolmogorov –Smirnov, s test . As the data were bind to follow the normal distribution, we used the parametric test for analysis. A multiple linear regression model was used to compare the pre and post PSv and EDv .These pair-wise difference were analysed for statistical significance with using paired t-tests. All statistical tests were completed using SPSS 21 version. The significance level was set at 0.000 and following a significant effect, paired t test was carried. The result showed significance difference in blood flow velocity for PSv and EDv between neutral position and during manual traction for left and right vertebral arteries.

Table 1. Mean ± SD of Pre & Post (during traction) haemodynamic parameters of right and left vertebral artery

Parameters	N	Pre-Mean	Post mean	t value	P value
PSv (Rt)cm/sec	40	56.51±8.45	64.85±10.87	4.97	0.000
PSv (Lt) cm/sec	40	63.335±10.34	67.83±11.66	5.72	0.000
EDv (Rt) cm/sec	40	24.333±5.37	30.46±7.77	7.26	0.000
EDv (Lt) cm/sec	40	25.99±4.59	29.70±6.14	6.67	0.000

PSv- peak systolic velocity; EDv- end diastolic velocity

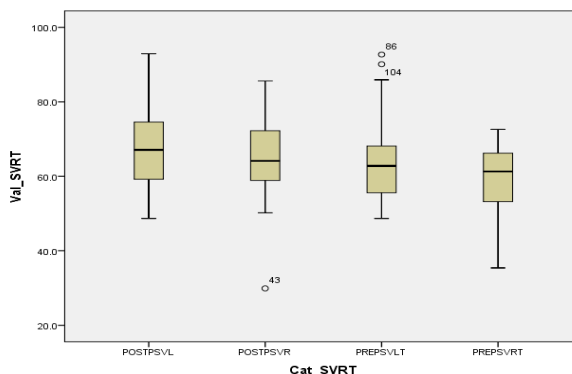
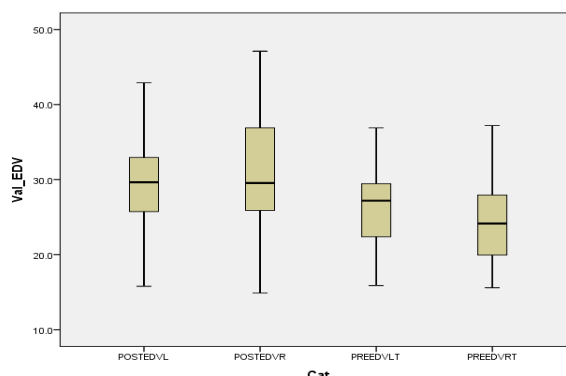


Figure 1. Peak systolic velocity(rt & lt, cm/sec) of vertebral artery pre and post (after manual traction)



Figur 2. End diastolic velocity(rt & lt, cm/sec) of vertebral artery pre (neutral) and post(after manual traction)

Discussion

The present study was focused on measuring hemodynamic parameters including peak systolic velocity (PSv) and end diastolic velocity (EDv) of vertebral arteries at the sub-occipital region of cervical spine in neutral positioning and whether there is a change in the haemodynamic parameters during c1-c2 manual traction (mulligan) using doppler ultrasonography. The findings from this study suggest that the c1-c2 manual traction significantly changes the vertebral artery blood flow velocity in terms of peak systolic velocity (PSv) and end diastolic velocity (EDv). To date, there have been no previous studies investigating blood flow in the vertebral arteries during manual traction using doppler ultrasonography method. Previous studies examining blood flow changes during neck rotation in the vertebral arteries and showed reduction in flow velocity with contralateral rotation Mitchell (2008). An ultrasound study demonstrated marked reduction of vertebral artery flow on neck rotation in some individuals, yet no signs of insufficiency being evoked saying that there is no compromise in cerebral blood supply as the blood supply to the brain is maintained Rivett et al (1999). The study investigated that changes (<10%) in blood flow volume normally occur in the anxious state of an individual or while doing a mental task which is not unfavorable to brain functions Kreiger et al (2012). The results of the present experimental

study have proved that during intervention of manual traction at c1-c2 level there are statistically significant changes in blood flow velocity. Post intervention, the peak systolic velocity (PSv) of right side vertebral artery increased by 14.7% and End diastolic velocity (EDv) by 25.19 % and peak systolic velocity (PSv) of left side increased by 7.1 % and End diastolic velocity (EDv) by 14.2 %. Most of the studies have seen the changes in the blood flow with cervical rotation and found the reduction of vertebral artery flow (Haynes, hart and McGeachie 2000; Hynes and Milne 2001). Functional factors such as sustained end range rotation of cervical spine decrease the blood flow in the suboccipital region by distorting the vertebral artery Mitchell J (2005). The present study has investigated the effect of manual traction on blood flow without cervical spine rotation thus to minimize the over stretching and compression of vertebral artery and hence danger to traumatize the vertebral artery was avoided. Peter (1999) demonstrated the effect of cervical manipulation on vertebral artery blood flow in an experimental study done on animals and concluded that there was approximately 20% increase of blood flow after 20-40 seconds after manipulation of cervical spine. The results of present study shows an increase of blood flow while giving cervical traction for the reason that it has some effect on the length of vertebral artery. The results of the present study were in consistent with the study done by Mangat and Mcdowall (1973) which shows that there is an increase of blood flow of vertebral artery after surgical fusion and post operatively neck traction.

Conclusion

The manual traction at c1-c2 (Mulligan mobilization) technique was used on asymptomatic sample subjects but in our opinion the symptomatic subjects are the representative of the patient's population on which this technique might be used. None of the subject reported symptoms like vertigo, dizziness, nausea or nystagmus associated with any change in blood flow of vertebral artery. Analysis of the paired comparisons showed that this technique had no mechanical effect on vertebral artery rather it has an impact on hemodynamic status of artery. As such, this study is of great value in increasing the knowledge of the possible treatment protocol related to the blood flow changes with the movements of cervical spine.

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Conflict of Interest: None declared