



Original Article

Evaluation Of Blood Flow in Superficial Arteries of Face by Doppler Ultrasound in Young Adults

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ABSTRACT

Acknowledgement: Knowledge of vascular hemodynamics of a particular region is essential to draw a fine line between normal and a pathological state. Face is highly vascular and little is known about normal blood flow characteristics of its superficial arteries. Thus there is a need to assess the normal blood flow characteristics of the face and to establish a normative database. This may later be helpful in planning of aesthetic procedures, face reconstruction following trauma or during surgery and in follow up examination of many skin diseases. To evaluate the blood flow of superficial arteries of face by Doppler ultrasound in young adults. **Methods:** A cross sectional descriptive study was conducted at University of Lahore Teaching Hospital and University Ultrasound Clinic Green Town, Lahore. Data was collected according to inclusion criteria. Sample size of 311 patients were included in this research comprising 112 (36%) females and 199(63.9%) were males. Data entry and analysis was done by using SPSS version-23. **Results:** Analysis of data showed that out of 311 patients 112 (36%) females and 199(63.9%) were males, According to the result analysis of the total number of 311 patients, facial artery had a mean diameter of 1.4 mm (0.14cm) and diameter of temporal artery at tragus was calculated 1.5mm (0.15cm) with SD 0.2. Facial and temporal artery average PSV among individuals was 26.8 ± 5.3 and 35.2 ± 11.9 respectively. Average RI value of facial artery was 0.81± 0.05 mm and for temporal was 1.0 ± 0.8 mm . **Conclusion:** The facial and temporal artery can be assessed on Doppler ultrasound for velocity and resistance parameters. No significant difference was seen in the parameters between males and females.

INTRODUCTION

Vascular supply is an important key for maintenance of healthy tissue conditions but also with regard to healing process following trauma or therapeutic interventions. Compromised vascularity is not only a leading cause of alterations in healthy tissues conditions but may also cause many blood borne diseases [1]. The human face is probably the most exposed and vascular region of the body. There are many diseases of the skin that may lead to change in the hemodynamics of the skin [2]. For instance acne is a common skin disease and often leads to scarring. Tissue and Collagen damage from the acne inflammation ends up causing permanent skin texture and vascular changes [3]. Acne is a widely affecting skin disease ranked

8th most common among other skin diseases Its worldwide prevalence (equal for ages) estimates about 9.38% [4]. Global disease study conducted in 2010 stated that prevalence of acne varies widely, with an estimate of 35% for 100% of adolescents having acne at some point of their life [5]. Atopic dermatitis (AD) is also quite common. It is the common chronic inflammatory skin disease with increased blood flow. It has a wide range of clinical presentations and symptoms. Estimate shows that prevalence of atopic dermatitis among children is 20% and 3% among adults yet it is still on an increase [6]. Changes in blood supply are also influenced by progressive age, diabetes mellitus, impediment, increased fatty acids, cigarette smoking and

so many other contributing factors. With many factors which can change blood supply to the skin, knowledge of the normal blood flow is essential to treat a unhealthy condition [7]. Surgical interventions of face are in high demand and rapidly increasing with time and so their need of arterial mapping. Knowledge of normal vascular architecture and flow parameters is essentials. Deviations from normal parameters can guide the surgical planning and even impair the patient's postoperative recovery. Various invasive and non-invasive procedures are used to estimate blood supply of face.. These procedures comprise venous occlusion plethysmography, Doppler ultrasonography, blood flow Doppler laser, thermostrom, Hertzman photoelectric plethysmography and radioactive isotopes. All of these methods have their own limitations. Among all Doppler ultrasonography is much common, easily available, non- invasive and radiation free mehod for estimating blood flow [8]. Doppler ultrasound enables assessment of hemodynamics, which includes dynamic features of both vascular architecture and blood flow and these features are a direct determinant of viability of a certain region[9]. In order to achieve maximum accuracy it is important to understand the meaning of the parameters of Doppler US and how to adjust them.

METHODS

It was a cross-sectional descriptive study conducted in 9 month as MS research at University of Lahore Teaching Hospital and University Ultrasound Clinic, Green town Lahore, Pakistan. A total of 310 healthy volunteers were included. The study was aimed to evaluate the blood flow in superficial arteries of face in young adults. Approval was taken from the institutional review board (IRB) and the Ethical Committee of the University of Lahore. Volunteers have been explained the procedure and also aim of the research therefore a written informed consent was signed.. Volunteers were asked for demographic details like age and gender, and measures like arterial diameter, PSV and EDV, RI, PI were recorded The results were summarized in the form of graphs and tables. Facial arteries were examined on grey scale and Doppler ultrasound with 7-10 MHz frequency transducer at the intersection border of mandible with the anterior border of masseter muscle, and superficial temporal arteries were interrogated at the level of the tragus. Data entry and analysis was done by using Med calc software. Descriptive analysis was done on all variables. Categorical variables were presented in the form of frequency and percentage. Data regarding artery diameter, PSV, EDV, RI and PI was reported in mean ± S.D. Kruskal-Wallis test and chi-square test was used to compare the results between male and female individuals.

RESULTS

Analysis of data showed that out of 311 patients 112 (36%) females and 199(63.9%) were males, According to the result analysis of the total number of 311 patients, facial artery had a mean diameter of 1.4 mm (0.14cm) and diameter of temporal artery at tragus was calculated 1.5mm (0.15cm) with SD 0.2. Facial and temporal artery average PSV among individuals was 26.8 ± 5.3 and 35.2 ± 11.9 respectively. Average RI value of facial artery was 0.81± 0.05 mm and for temporal was 1.0 ± 0.8 mm

Facial artery	Value	Confidence interval	Male	female	P-value
Peak systolic velocity (cm/s)	26.8±5.3	26.2-27.4	27	27	0.33
End diastolic velocity (cm/s)	5.1±1.6	4.9-5.2	5.6	5.5	0.98
Resistive index	0.9±0.4	0.8-0.9	0.7	0.7	0.4
Pulsatility index	2.1±0.6	2.1-2.2	2.0	1.8	0.60
Diameter	1.4 ± 0.2	1.44 -1.51	1.5	1.6	0.08

Table 1: Descriptive statistics of vascular status of facial artery

Temporal artery	Value	Confidence interval	Male	female	P-value
Peak systolic velocity	35.2±11.9	33.8-36.5	33	30	0.05
End diastolic velocity	4.7±2.6	4.4-5.0	4.1	4.1	0.5
Resistive index	1.0±0.8	1.0-1.1	1.0	1.0	0.5
Pulsatility index	2.5±0.5	2.4-2.5	2.6	2.7	0.89
Diameter	1.5±0.2	1.49-1.54	1.5	1.6	0.63

Table 2: Descriptive statistics of vascular status of temporal artery

DISCUSSION

This study was designed to evaluate the hemodynamic characteristics of superficial arteries of human face by color Doppler ultrasound in order to provide normative data base for future comparison with pathological states. In this study, attempt was made to determine normal ranges of different parameters of superficial arteries by using high frequency color Doppler ultrasound. Data was collected from 311 healthy volunteers, out of which 199 were males (63.9%) and 112 were females (36%). In our study the detection rate of facial artery and temporal artery in male and female individuals was 100%. In a previous study the detection rates of the main trunk of facial artery and it's all branches was 100% [10]. Another study found detection rate of main facial artery trunk was 77.6% [11]. Similarly, masseter branch of the facial artery was detected in 88% of the cases [12]. Temporal artery showed 100% detection rate in almost every case. Most of available data regarding superficial arteries of face is based on its examination in cadaveric studies. Difference in the detection rate of vessels could be due to the reason that cadaver procedures which includes latex injection may cause vessel dehydration and morphologic changes. In our study, the facial artery had a mean diameter of 1.4 mm (0.14cm). No

significance difference was found in the diameter of facial artery in males and females ($p=0.08$). A study found the mean diameter of right and left facial artery to be 1.6mm (0.16 cm) and 1.5mm (0.15 cm) respectively [7]. In another study it was 1.0 ± 0.4 mm (range: 0.4–2.2 mm) with no difference between face sides [13]. Other found facial artery mean diameter to be 1.8mm [11]. These studies provided a close agreement with the value as analyzed by our study. However, a study showed a mean diameter of 2.14mm (0.21cm) with the SD of 0.43 [14]. The diameter of the facial vessels in an anatomic study was determined and ranged from 1.7 to 3.6 mm (mean, 2.6 mm) [1]. We assume the difference found among these studies could be due to methods used and specific area analyzed. In our study diameter of temporal artery at tragus calculated was 1.5mm (0.15cm) with SD 0.2. Temporal artery diameter was consistent and showed no difference among males and females ($p=0.63$). A study published in literature stated the superficial temporal artery mean diameter 1.5 mm (95% confidence interval) [13]. In other study it was 1.6 mm (0.16 cm) SD 0.35 mm at the front of the tragus [15]. Another study found diameter of superficial temporal artery, 1.7 ± 0.43 mm [16]. Temporal artery diameter value showed a strong comparison with the values found earlier in literature. In our study facial and temporal artery average peak systolic velocity (PSV) among individuals was 26.8 ± 5.3 cm/sec with a range from 16.4 to 46.3 cm/sec and 35.2 ± 11.9 cm/sec with a range from 16.7 to 69.7cm/sec respectively. There was no significance difference of indices found among male and female individuals. In another study maximum peak systolic velocity (PSV) of 24.6 cm/s and minimum to be 5.1 cm/s [11]. Peak systolic values of facial artery and temporal artery provided a close agreement with the previous studies. In our study we found facial artery resistive index (RI) to be 0.9 ± 0.4 mm with a range from 0.7 to 2.8 and temporal artery resistive index (RI) recorded was 1.0 ± 0.8 mm with a range from 0.6 to 3.9 same for both genders. No significant difference was observed ($p= 0.497$). Tucunduva in his study observed the average value of resistive index (RI) of facial artery was 0.81 ± 0.05 mm. and of temporal artery 0.79 ± 0.11 mm [14]. In another study facial artery resistive index (RI) was 0.79 ± 0.05 mm. Other found resistive index (RI) of facial artery to be 0.08mm [11]. No statistically difference was present between male and female individuals in this index. Resistive index value provided a close agreement with the findings published in early literature. In this study the mean and Standard deviation of facial artery pulsatility index (PI) among individuals was 2.1 ± 0.6 . and temporal artery pulsatility index (PI) was 2.5 ± 0.5 . No statistical difference was observed between male and female in this regard. Arijji Y et al., found facial artery pulsatility index (PI) to be 2.51. 32

Both finding were in close agreement [11]. In a study published in literature facial artery peak systolic velocity (PSV) recorded was 21.38 ± 13.70 cm/sec and temporal artery peak systolic velocity (PSV) recorded was 42.09 ± 23.02 cm/sec [17]. Some literature has discussed these perspectives in great detail as book chapters [18–20] but no data regarding pulsatility index (PI) of temporal artery and end diastolic velocity of both vessels were found in literature and need further investigation.

CONCLUSION

The facial and temporal artery can be assessed on Doppler ultrasound for velocity and resistance parameters. No significant difference was seen in the parameters between males and female.

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