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Original Research Article

Superior Mesenteric Artery Responses for Variant Meals by Color Doppler

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Abstract: Duplex ultrasound (DU) is ultrasound techniques that provide a simple, portable, reproducible, and non-invasive assessment of blood flow. Doppler sonography is also the most affordable method to measure noninvasively the main characteristics of mesenteric artery blood flow. This technique demonstrate the measurement of luminal diameter and blood velocity, allows estimation of blood flow and peripheral resistance and the detection of arterial occlusive disease. Owing to its size and anatomic position, the superior mesenteric artery (SMA) is also accessible to DU. Applied to the superior mesenteric artery; this method confirms that blood flow in this vessel increases in response to a meal. The objectives of this study was to evaluate the contribution of the different meals types for the blood flow in the superior mesenteric artery after eating and determine the relative potencies of the major nutrient stimuli in healthy human subjects. This a Prospective, study using U/S technique of superior mesenteric artery assessment for different meals intake enhanced by color Doppler. The target population of this study was healthy volunteers presented to our department. Selection of participation was done through simple random sampling. Data collection sheet was designed to include all variables. The results of the study showed that the basal superior mesenteric artery blood flow volume (SMABFV) measurements were approximately near to similar in values for different four meals type. The mean basal SMABFV is 285 ml/min for grilled goat meat, 305 ml/min for beans meal, 299 ml/min for the cheese with yoghurt meal, and 278 ml/min for the jam with boiled egg meal, .The study recommended the usage of new ultrasound equipment version with Doppler capability to obtain accurate diagnosis. And results of different variables of SMA, further studies were recommended for assessment of SMA in illness patients with liver cirrhosis and other diseases.
Keywords: SMA, RI, Doppler ultrasound, healthy volunteers

INTRODUCTION

Medical imaging is the technique, process and art of creating visual representations of the interior of a body for clinical analysis and medical intervention. Medical imaging seeks to reveal internal structures hidden by the skin and bones, as well as to diagnose and treat disease [1].

Diagnostic sonography (ultrasonography) is an ultrasound-based diagnostic imaging technique used for visualizing internal body structures including tendons, muscles, joints, vessels and internal organs for possible pathology or lesions. In physics, 'ultrasound' refers to sound waves with a frequency too high for humans to hear. Ultrasound images (sonograms) are made by sending a pulse of ultrasound into tissue using an ultrasound transducer (probe). The sound reflects and echoes off parts of the tissue; this echo is recorded and displayed as an image to the operator. Many different types of images can be formed using ultrasound. The most well-known type is a B-mode image, which displays a two-dimensional cross-section of the tissue being imaged. Other types of image can display blood flow, motion of tissue over time, the location of blood, the presence of specific molecules, the stiffness of tissue, or the anatomy of a three-dimensional region. Compared to other prominent methods of medical imaging, ultrasonography has several advantages. It provides images in real-time (rather than after an acquisition or processing delay), it is portable and can be brought to a sick patient's bedside, it is substantially lower in cost, and it does not use harmful ionizing radiation.

Sonography can be enhanced with Doppler measurements, which employ the Doppler Effect to assess whether structures (usually blood) are moving towards or away from the probe, and its relative velocity. By calculating the frequency shift of a particular sample volume, for example flow in an artery or a jet of blood flow over a heart valve, its speed and direction can be determined and visualized. This is particularly useful in cardiovascular studies (sonography of the vascular system and heart) and essential in many areas such as determining reverse blood flow in the liver vasculature in portal hypertension. The Doppler information is displayed graphically using spectral Doppler, or as an image using color Doppler (directional Doppler) or power Doppler (none directional Doppler). This Doppler shift falls in the audible range and is often presented audibly using stereo speakers: this produces a very distinctive, although synthetic, pulsating sound [2, 3].

Doppler ultrasound has become increasingly important in investigating abdominal vascular disease. Both the coeliac and superior mesenteric vessels have been studied in detail in response to physiological stimuli such as feeding and exercise. Dubbins have reported its use in diagnosing renal artery stenosis, and a few anecdotal reports have discussed the potential role of ultrasound in investigating both superior mesenteric artery and coeliac artery stenosis [1].

At ultrasound scanning combined with the pulsed Doppler technique we can non-invasively monitor alterations in blood flow velocity [2, 3]. Duplex ultrasound (DU) provides a simple, portable, reproducible, and non-invasive assessment of blood flow. Measurement of luminal diameter and blood velocity allows estimation of blood flow and peripheral resistance, and the detection of arterial occlusive disease. This method has gained widespread acceptance as a reliable tool in many vascular beds such as the carotid, aorto-iliac, peripheral limb, and renal functions. Owing to its size and anatomic position, the superior mesenteric artery (SMA) is also accessible to DU [5] Applied to the superior mesenteric artery (SMA), the method confirms that blood flow in this vessel increases in response to a meal. The vasoactive components seem to be influenced by the digestive products of the diet, so that the effect of a meal on splanchnic blood flow may depend on the intraluminal digestion [2, 3]. The intake of food results in an increase in superior mesenteric artery blood flow (SMABF) in man after liquid meals. The relative contribution of different food components to the postprandial mesenteric blood flow has, however, not been thoroughly investigated up to now in humans. There are extensive data from animal experiments. From these, it is clear that the hydrolytic products of food digestion are primarily responsible for the food induced hyperaemia [4].

OBJECTIVES OF THE STUDY

To investigate the contribution of different types of meals in increasing blood flow in the superior mesenteric artery after eating and determine the relative potencies of the major nutrient stimuli in healthy human subjects.

MATERIAL AND METHODS

Ultrasound Equipment

This study was performed using ultrasound scanner available

Testing Procedure (Protocol)

The volunteers were told to prepare themselves carefully for the scan by abstaining from food for the last 6 hours prior to investigation with continuous taking their drugs, imposing dietary restrictions, walking for 30 min before the examination, water contrast. Usually the examination was carried out with the participants in supine position. A coupling agent gel was used to ensure good acoustic contact between the transducer and the skin. After informing the patients about the procedure, the area of interest in the abdomen was completely evaluated in at least two scanning planes. Surveys were used to set correct imaging techniques, to rule out pathologies, and to recognize any normal variants [6].

Sample Size

Forty samples of healthy participants, their ages between 20 to 50 years were selected according to the positive evidence completely health, among the outflow of them in to ultrasound departments at collage of applied medical sciences, Taif University, KSA.

Ethical consideration, viability and reliability

Special consideration was given to the right to confidentiality and anonymity of all survey participants. Anonymity was achieved by using numbers for each survey participant that will provide link between the information collected and the participants. In addition confidentiality was censured by making the collected data accessible only to the researchers [7].

Statistical Analysis Used

The data was analyzed using SPSS version 16. The associations between the different variables of the results and the (SMA) measurement are tested.

RESULTS AND DISCUSSION

Basal superior mesenteric artery blood flow volume (SMABFV) measurements were approximately near to similar in values for different four meals type. The mean basal SMABFV is 285 ml/min for 1st meal, 305 ml/min for 2nd meal, 299 ml/min for 3rd meal, and 278 ml/min for 4th meal, increase in response to the oral intake of four meals is shown in [Figure 1]. An immediate and marked increase in mesenteric blood flow was observed, and the maximum was reached within 30-60 minutes of taking four meals, this differ with Nami Someya, *et al.* they found that the baseline values did not differ between experimental and control trials except for BF in the forearm [8]. Thirty minutes after 2nd and 4th meal intake, SMABFV fall towards basal values and was not significantly different from baseline at 90 minutes postpranially. (359 ml/min for meal 2, and 433 ml/min for meal 4). In contrast sixty minutes after 1st and 3rd meal intake, SMABFV decreased gradually, but was still significantly (p<005) above basal values(656ml/min for meal 1, 779ml/min for meal 4) at the 90 minutes, they found that, the mean SMA diameter was significantly lower in patients than in healthy control (p > 0.001), in the two groups, the mean blood velocity was not significantly difference between the two groups, whereas mean SMA blood follow was significantly lower in patients[9].

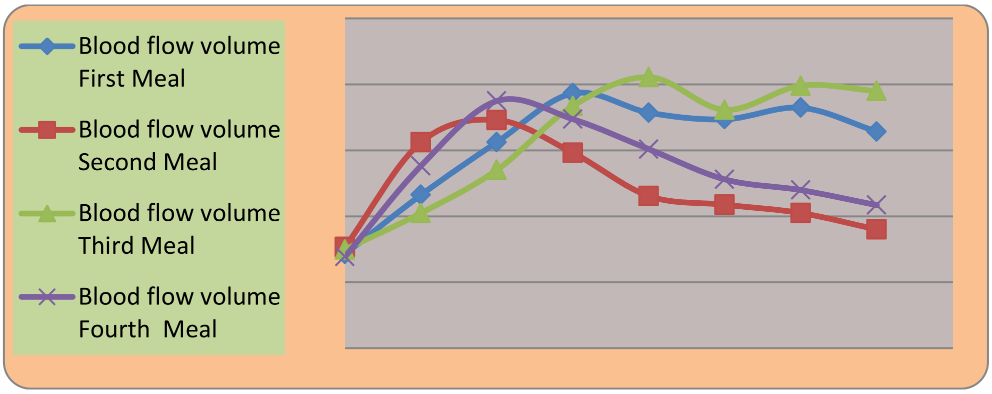

Fig 1: Superior Mesenteric Artery Blood Flow Volume (SMABFV) Pre and Postprandial.

The peak systolic velocity PSV of the SMA changed with time to reveal a main effect of four meals types and the alteration of the PSV of the SMA was in the same direction in 1st and3rd meals in which the maximum PSV reached at 30 minutes and then decrease gradually toward baseline value. In contrast in 2nd, and 4th meals the maximum PSV reached at 45, 60 minutes consequently in 2nd , and 4th meals , then slightly decrease but still significant at the end of these meals at 90 minutes postprandially which is shown in [Figure 2]. This was differ with M. J. Perko, [10], they found that all types of food (mixed, carbohydrate, fat and protein) produce increases in blood velocity and diameter of the artery and as a consequence, elevate SMA blood flow. By contrast, water or isotonic NaCl do not influence DU para meters. Alterations in flow parameters are most pronounced about 60 min after intake of a mixed meal. The diastolic systemic blood pressure selectively decreases reflecting peripheral vaso- relaxation which, together with increases in heart rate, elevates cardiac output. In the SMA peak systolic velocity doubles but the diastolic velocity increases 10-fold, reflecting the high sensitivity of this parameter to changes in peripheral resistance. The diameter of the SMA also increases, resulting in an increase in mesenteric blood flow from 500±85 to 2300±260 ml min−1 (±SE).

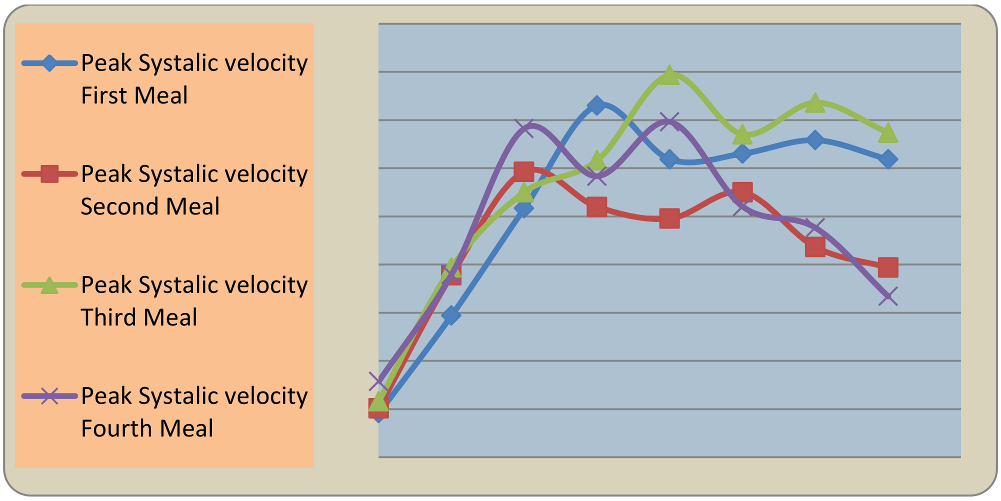

Fig 2: The Peak Systolic Velocity PSV of the SMA Pre and Postprandial Four Meals Types

The Resistive Index RI in the SMA tended to decrease in the four meal in consequently with time, the maximum decrease in mean RI reached at 30 minutes after (2nd , 4th meals), then start to increase gradually toward the value that nearly the baseline. In contrast the maximum decrease in mean RI for 1st, and 3rd meal was reached at 60 minutes after meals, then tend to decrease but still significant (P = 0.60) after the end of the meal at 90 minutes postprandially is shown in [Figure 3].This was matches with P. Taourel, *et al.* [9] they found that The RI of the SMA decreased significantly ($p < 0.05$) after the meal in both healthy subjects (13%) and cirrhotic patients (8%). The postprandial decrease was significantly less pronounced ($p < 0.05$) in patients with cirrhosis than in healthy subjects.

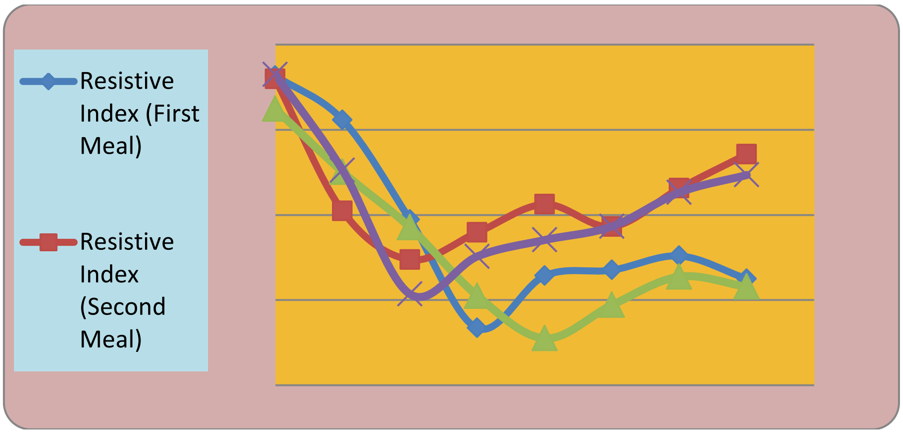

Fig 3: Resistive Index (RI) in Superior mesenteric artery pre and postprandial four meals types.

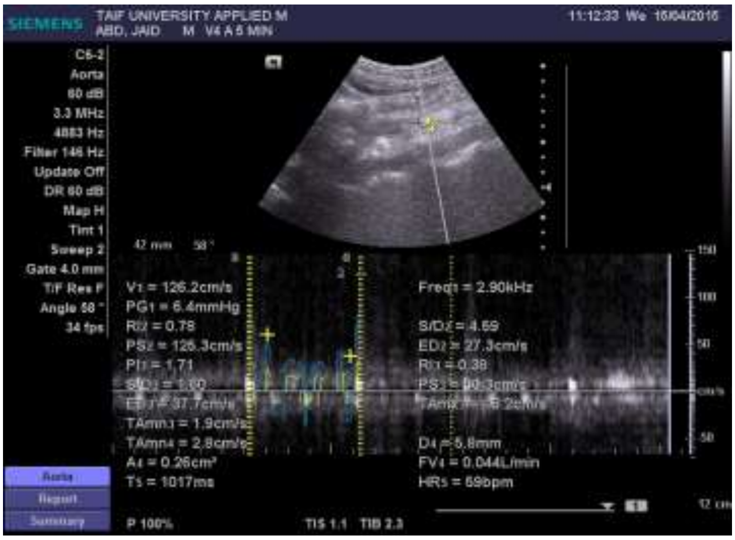

Fig 4: Duplex sonogram of the SMA showing resistive index with other parameter

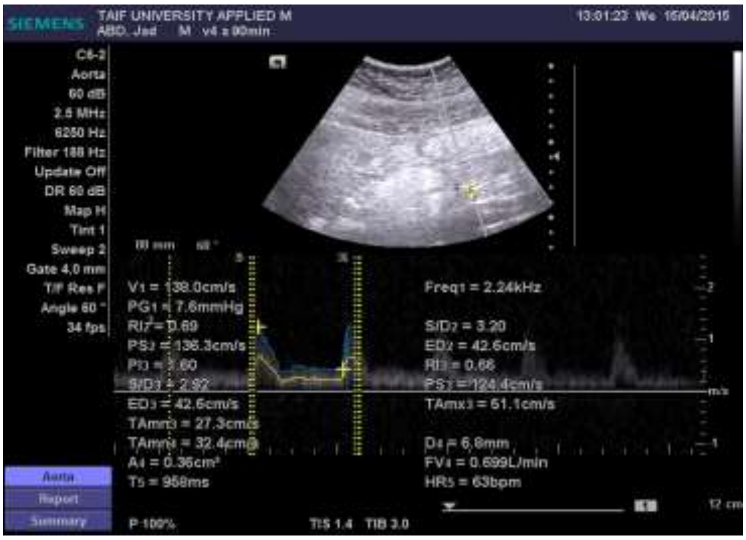

Fig 5: Duplex sonogram of the SMA showing blood flow volume

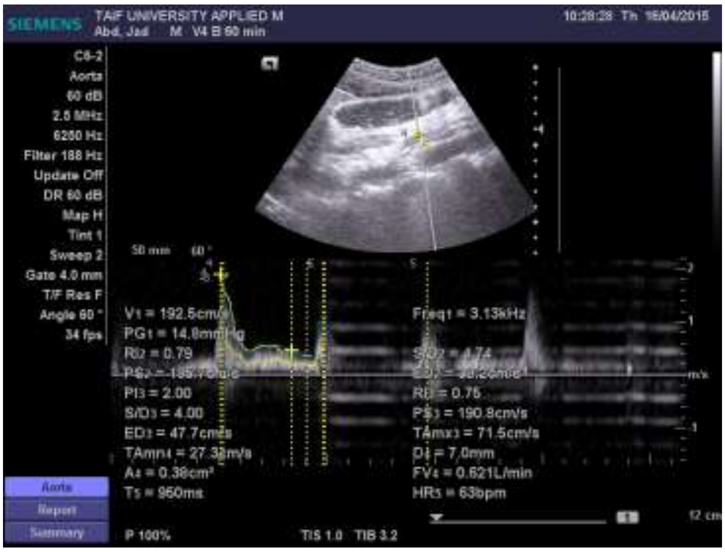

Fig 6: Duplex sonogram of the SMA showing heart rate

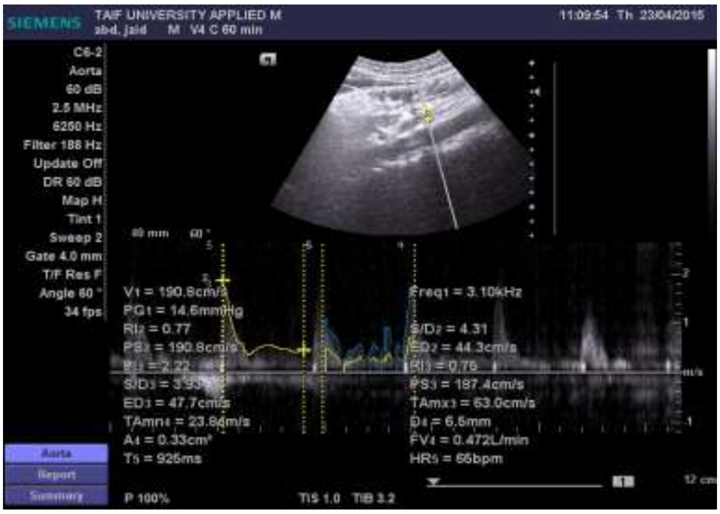

Fig 7: Duplex sonogram of the SMA showing peak systolic velocity with other parameter

Fig 8: Duplex sonogram of the SMA showing end diastolic velocity with other parameter

CONCLUSION:

In conclusion, we believe that Doppler sonography evaluation of the SMA is a promising noninvasive method of detecting inflammatory disease of the small bowel to evaluate its extent and to document the resolution after therapy, provided that the vessel is examined both in resting state (fasting) and during stress (after a meal). However, the decrease in the postprandial RI compared with that in a fasting state is significantly less pronounced in ill patients than in healthy subjects.

RECOMMENDATION

We recommend using good ultrasound equipment with Doppler capability to obtain accurate diagnosis and results and availability of abdominal ultrasound in all ultrasound departments to decrease chance of missed or wrong diagnosis of disease.

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