

Master track Medical Imaging and Intervention

Additional guidelines for vein mapping with the use of RI, comorbidities and pulsality to access the vessel wall and potential stenosis to achieve better AVF maturation

Group 1; Joosje de Bakker, Evelien van Genugten, Lisanne Roelofs, Angelique van Vlaenderen

Abstract:

Currently there are 6500 patient in the Netherlands who are in need of hemodialysis. The most common approach to gain vascular access is by creating an AVF (arteria-venous fistula), but not all arteries and veins are suitable for the high flows that accompany the dialysis procedure. Therefore certain Ultra Sound measurements are done beforehand to determine the quality of the vessels. However, there isn't a golden standard for these measurements; every hospital uses different cut-off values for the diameter of the vessels and the flow. Also, despite these measurements many AVFs still fail to mature. We found that the quality of the vessel wall and the risk on stenosis are also important predictive values for the failure of an AVF. We therefore researched certain factors that could predict central stenosis such as: pulsality, RI and comorbidities like age, diabetes and hypertension. If these parameters are present, MRAngio is advised to further examine the veins of a patient to find a potential stenosis. In addition, we introduced fixed cut-off values and further standardization of the measurement process which every hospital should use. Finally, research concluded that monitoring of the blood flow after the placement of an AVF proofed reduced failure rates. We therefore recommend doing this as well.

Evaluating venous elasticity as a diagnostic parameter to determine optimal vascular access surgery in haemodialysis patients.

Group 2; Rick Bergmans, René Geraats, Stephan Romeijn, Madelon Voets

Introduction

Patients suffering from end stage renal disease are dependent on haemodialysis for which adequate vascular access is necessary. Surgically created arteriovenous fistulas (AVFs) are the first choice, but often these shunts fail to mature or fail over time, so reinterventions are needed. Ultrasound venous mapping is commonly used to achieve quantitative vascular parameters prior to surgery. However, it is difficult to predict the outcomes of shunt surgery based on currently used diagnostic and demographic parameters. The goal of this study is to evaluate venous elasticity as a diagnostic parameter to determine the optimal anatomical location for vascular access surgery.

Methods

Literature research and the comparison of three venous mapping protocols of different Dutch tertiary hospitals have been used to describe the current diagnostic best practice. Using ultrasound, differences in vein diameters at different locations at the upper limb in two healthy persons (with and without tourniquet) have been quantified as a measure of vein elasticity. Reproducibility is addressed by calculating intra- and inter-observer variability. Further literature research is used to describe a promising new technology to non invasively measure venous elasticity in the upper limb: strain gauge plethysmography.

Results

Literature research resulted in a flowchart to determine most suitable vascular access. The difference between vein diameters with and without tourniquet has a mean p-value of 0.146. The inter observer coefficient of the diameter measurements is 0.490 without tourniquet and 0.857 with tourniquet. The p-value for the difference between inter-correlation coefficients with and without tourniquet is 0.274. The intra observer coefficient of the diameter measurements is 0.638 without tourniquet and 0.794 with tourniquet. The p-value for the difference between intra-correlation coefficients with and without tourniquet is 0.267. Strain gauge plethysmography provides global values for venous elasticity of the whole forearm.

Conclusion

A flowchart can help in determining patient specific optimal vascular access type and location, however it remains difficult because many parameters play a role in a complex way in predicting shunt outcome. Ultrasound venous mapping seems quite reproducible, but no significant difference has been found between venous diameters with and without tourniquet and between ICC's with and without tourniquet. Further research with a bigger study population is needed to get more reliable results and can be combined with strain gauge plethysmography measurements to investigate if this combination has a predictive value for shunt maturation in end stage renal disease patients.

Key words

shunt (location), haemodialysis, ultrasound, diagnostic parameter, elasticity, end stage renal disease

The influence of inter-observer variability on vascular mapping

Group 4, Mechteld Brasz, Jurre Klaassen, Huib Ruitenbeek

Abstract

Introduction: Duplex US examinations are widely used to predict the success of an AVF creation. This study aims to analyse the inter-observer variability in the vein diameter measured by inexperienced measurers.

Methods: A US examination is performed on 4 subjects by 3 researchers. Vein diameters of the vena cephalica were measured on 8 different locations on both arms. Afterwards the Intraclass Correlation Coefficient is measured to decide whether there was some inter-observer variability or not.

Results: Calculated ICC values per arm range from 0,468 to 0,967 where a higher number indicates a smaller difference between measurements.

Discussion: The research population in this study is very small. A bigger population will result in different and more reliable results. In the future new techniques should be designed to reduce the interobserver variability. Tools to make vascular mapping easier could be helpful.

Conclusion: Great differences in measurements were observed and therefore it is important to look for possible additional techniques to narrow the difference between measurements of different observers.

Effect of increasing the hand temperature using heat elements on the diameter of the cephalic vein and the diameter and flow in the radial artery for assessment of vascular access via arteriovenous fistula for hemodialysis.

Group 5; Tessa Brouwer, Nienke de Laat, Bas Schippers, Nienke Wassenaar

Abstract

Introduction: Patients with renal failure who require hemodialysis need a shunt for vascular access. Vascular access through an arteriovenous fistula (AVF) created by anastomosing the radial artery with the cephalic vein is most beneficial and commonly used. The possibility of the location and choice of shunt is dependent on different parameters and are determined with Duplex Ultrasound (DUS). One of the parameters to assess if AVF is a suitable option is the cephalic vein diameter. Previous research showed that placing the arm in a warm water bath increases the vein diameter. Due to the time consuming process and difficult implementation of this method a new provocation method is needed. This research examines if increasing the hand temperature using heat elements will also lead to increasing the cephalic vein diameter. Furthermore, 28-53% of the fistula will never mature after the operation. A new alternative technique is needed to improve the development of vascular access.

Method: The examination of increase of the cephalic vein diameter was called the Heat experiment. The hand was warmed using heat elements with a constant temperature of 52.4 degrees measured with a Voltcraft 300K thermometer. The diameter of the cephalic vein and radial artery are measured together with the flow of the radial artery. These parameters determine the location and possibility of the fistula based on the flowchart. The diameter measurement locations are: (1) Vene Lower Arm Distal (VLAD), (2) Vene Lower Arm Middle (VLAM), (3) Vene Lower Arm Proximal (VLAP), (4) Vene Upper Arm Distal (VUAD), (5) Vene Upper Arm Proximal (VUAP) and (6) Artery Lower Arm Distal (ALAD). The seventh measurement (7) was the flow on the ALAD position. These measurements were done with an Ultrasound S1000 from Siemens. This was done before and three minutes after warming the hand of three participants.

Statistical analysis: Differences in vein diameter before and after heating were statistically analyzed using a Wilcoxon signed rank test in IBM SPSS statistics 24.

Results: The mean diameter change in mm and significant level respectively for the six diameter measurements were: (1) +0.33, 0.414 (2) +0.27, 0.593 (3) -0.30, 0.593 (4) -0.50, 0.109 (5) -0.43, 0.593 (6) 0, no significance and average on all locations +0.11 with a significance of 0.586. The seventh measurement (7) flow +0.05 ml/s sign. 0.593.

Alternative techniques: To increase the chance of a shunt to mature after operation and improve the primary and secondary patency rates of AVF, far infra-red (FIR) therapy can be used in obesity patients, in patients with an upper arm shunt and patients with aortic arch calcification.

Conclusion: There was no significant change in the diameter of the cephalic vein after heating the hand using heat elements. Neither did the heat experiment significantly affect the diameter and flow of the radial artery.

Intra and interobserver reliability of ultrasound imaging for preoperative venous mapping

Group 6; Nadine Coorens, Alexander Lau, Mark Selles, Beau van Woudenberg

Abstract:

Background: In order to predict the outcomes of an arteriovenous fistula (AVF), preoperative venous mapping is performed. A single morphological parameter for prediction is still lacking, but the venous diameter sizes are considered of great influence in AVF outcomes. Ultrasound (US) is widely used, but the interobserver variation varies significantly. This paper researches the inter and intra observer variation with US and discusses possible techniques to improve measurement reproducibility in the preoperative assessment.

Method: The experiment was performed with two novice examiners and two healthy subjects. One operator performed the measurements twice and the other once on both subjects. The experiment was performed twice: once with both subjects clenching their fists and once without. All measurements were done with the Siemens Ultrasound S1000. Images of the cephalic vein at the wrist, proximal forearm, elbow and distal upper arm were made. The radial artery and its flow velocity were also imaged. From these images, the depths and diameters were determined. The intra and interobserver reliability were analyzed in SPSS with the intraclass correlation coefficient (ICC).

Results: The intraobserver reliability shows that with a clenched fist, the measurements in the elbow and upper arm are more consistent. The consistency at the lower arm and wrist is poor, regardless of fist clenching. The consistency for blood flow velocity is high. The interobserver reliability is poor and unmitigable by fist clenching.

Discussion/conclusions: The variation between the examiners was found to be significant, but fist clenching was found to increase the intraobserver reliability for venous mapping of the upper arm. Further research is necessary to study other parameters or modalities like venography that can increase the interobserver reliability, thereby optimizing the probability of a successful AVF outcome.

Keywords: arteriovenous fistula; cephalic vein; radial artery; hemodialysis; interobserver variation; intraobserver variation; US; venography; venous mapping

Possibilities of imaging modalities in monitoring early treatment response of neoadjuvant chemotherapy in breast cancer.

Group 7; Rob van Dijk, Chien Nguyen, Michelle Simons, Lisanne Zwart

Abstract:

For women, breast cancer is the most frequent type of cancer in the Netherlands. The main aim of neoadjuvant chemotherapy (NAC) is to achieve a pathological complete response prior to further treatment. At the moment there is no standard imaging method for monitoring the early treatment response to NAC. Conventional imaging techniques rely on macroscopic changes of tumor size, whereas NAC initially causes changes in tumor vascularization and metabolism. These changes can only be assessed by functional imaging techniques. This research paper compares 4 functional imaging modalities. Molecular breast imaging, PET/CT, Diffusion weighted MRI and mammography are compared.

FDG-PET and DWI show very promising sensitivities and specificities as first-line modalities to assess the early-treatment response of NAC therapies. The four techniques cannot be compared fully yet. Because different parameters were used to describe the pathologic complete response and different cut off values were used in different researches. Modalities as MBI and mammography are not that far in research phase, but show promising first results.

Diffuse reflectance spectroscopy in reducing breast cancer re-excision rates

Group 8; Jos Nijhof, Jasper van der Graaf, Stefan Smorenburg, Mathijs Dijsselhof

Abstract:

Last year in the Netherlands, 1690 men and women were diagnosed with breast cancer. The risk of developing breast cancer for a woman during her life is 12-13%. Of all patients undergoing partial or whole mastectomy curative treatment, re-excision percentages are between the 20-60% globally. Surgeons have severe difficulty in locating and removing all tumor tissue during the surgeries. Due to this, the risk of recurrence increases, with an increased discomfort to the patients and costs to the hospital as important side-effects.

Optical spectroscopy might be a solution to this. The diffuse reflectance spectroscopy (DRS) tool is a tool which uses light to differentiate between tumor- and normal tissue. The DRS tool is able to acquire spectra of various tissues using known absorption and scattering parameters of tissue components.

Studies have focused on DRS tool measurements of breast tissues including tumors. Ex vivo tissue samples were compared by a pathologist. The tool shows very promising results for detecting infiltrating ductal carcinomas but other types remain a challenge due to different breast tissues, especially encapsulated tumors. Due to the use of light, a shortcoming of DRS is the depth penetration of light. Solutions may lie in fluorophores, which allow for more penetration depth, and folate receptor alpha (FR α), a promising target receptor in image-guided surgery. The use of this tool might decline the rates of re-excision and therefore increase the quality of life of patients and lower hospital costs.

Contrast Enhanced Ultrasound with BR55 coated microbubbles compared to MRI in the diagnosis of breast cancer

Group 9; Lotte van Dongen, Liset Noltes, Ilse Spenkelink, Annelies Winkelhorst

Abstract:

14000 women are diagnosed with breast cancer in the Netherlands each year. Every other year women between the age of 50 and 75 get a mammography in the screening program. If based on this an abnormality is suspected, the woman will get an ultrasound, MRI and biopsy. MRI is considered the most reliable diagnostic tool, although the positive predictive value is only 64%. Furthermore, due to its high costs, doctors are more likely to use a wait-and-see policy. To prevent unnecessary late diagnosis of breast cancer a more reliable and less expensive technique is needed. Contrast Enhanced Ultrasound seems to be a promising option. Several studies show that coating microbubbles with BR55 enhances the visibility of the vasculature of tumors. In the proposed study CEUS will be compared to MRI to investigate whether this is a better technique. The study design is a prospective cross-sectional research in which women who have had a mammography and ultrasound examination get a CEUS and a MRI. The CEUS will be done by a blinded, trained sonographer. When CEUS or MRI is positive the woman will get a biopsy. Based on the biopsy results the positive predictive values are calculated. If the positive predictive value of CEUS is higher, MRI can be replaced by the cheaper, safer and faster CEUS. The aim of this study is to investigate if CEUS with BR55 coated microbubbles has a better positive predictive value for diagnosing breast cancer than MRI, validated with the gold standard, a biopsy.

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F¹⁸-FES PET patient specific dosing of fulvestrant on estrogen receptors in post-menopausal patients with estrogen receptor positive breast cancer.

Group 11; José Enthoven, Maarten Poirot, Bart Thomson

Abstract:

Breast cancer is the most common cancer in women, which is a heterogeneous disease. With a majority of estrogen receptor (ER) positive cells, it can be treated with hormone specific medicine. Hormone therapy can help down regulate the tumor genesis and therefore the expression of ER is an important factor in the prediction of the prognosis and effectiveness of hormone therapy. A used hormone therapy is fulvestrant. To monitor the ER that is degraded and/or occupied by fulvestrant treatment ¹⁸F-FES PET can be used. An incomplete tumor blockade will show ¹⁸F-FES uptake and can be explained by a dose which is too low. Therefore, the goal is to develop an approach to quantify early effects of the therapy and facilitate dose optimization to create the best outcome.

A group of 32 patients with diagnosed I to III ER positive mamma carcinoma is to be included. Baseline ER expression is determined by a FES PET-scan. Patients are divided randomly-double-blind into a research group and controls with both groups a similar mean expression. Fulvestrant is administered to both groups followed by a second FES PET-scan to determine the relation between total biopsy oestrogen receptor expression and fraction of unbound receptors by quantitatively comparing the scan with the baseline. Fulvestrant dosage of the research group will be personally adjusted to aim for maximal receptor coverage. Lastly, the control group will receive a third FES-PET scan to analyse the adjustment and determine final receptor coverage at the new dosage. Primary end point was progression-free survival (PFS). Secondary end points included objective response rate, clinical benefit rate (CBR), overall survival (OS), and quality of life (QOL).

Kuter et al. (2012) have shown a statistically significant increase in progression-free survival and duration of clinical benefit of a 500mg/month dosage over a 250mg/month dosage. Both dosages came with comparable side effects. The expected evidence which this study provides could have similar effects as the study of Kuter et al. (2012) due to the quantitative imaging nature of ER binding in breast cancer. Early dosing schemes can be adjusted and help in patient selection of BC treatment strategies.