Severity of AV access aneurysms. Panel A shows the images from 6 patients with not advanced AV aneurysms. Panel B shows images from 6 patients with advanced AV aneurysm.

PO1031

Evaluation of a Wearable Device for Continuous, Noninvasive Monitoring of Hematocrit Levels in Hemodialysis Patients

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Background: Maintenance of euoleemia is a major challenge for hemodialysis patients, who account for a combined 6.5M annual hospital days. Clinical outcomes could be improved, and healthcare costs lowered, by enabling better management of fluid status and anemia, which is common among ESRD patients. This study presents a novel wearable device, SmartPatch, that uses multi-wavelength photoplethysmography (PPG) and other sensors to measure blood hematocrit (Hct), a key metric for monitoring fluid status and anemia. The SmartPatch is a component of a novel Remote Monitoring System (RMS) that facilitates secure data transmission and analysis and generates actionable alerts. Data demonstrating the feasibility of the RMS were previously presented at Kidney Week 2019 (Kuraguntla et al.). The aim of this study was to evaluate the system’s ability to accurately and precisely measure Hct in a real-world dialysis setting.

Methods: 14 ESRD patients with arteriovenous fistulae currently undergoing dialysis were recruited to participate in this study. Each of these patients had a SmartPatch device placed on the skin over their fistula at each of three dialysis sessions two weeks apart. Reference Hct measurements were taken immediately before and after the session, times to coincide with SmartPatch data recordings. A total of 83 sets of multi-channel PPG data were recorded and analyzed to determine the accuracy and precision of Hct measurement.

Results: The RMS measured Hct with root-mean-square error (RMSE) of 2.13 Hct compared to reference values obtained from a Sysmex XN-1000 blood analyzer. The standard deviations for each read on the same patient—with the same device—were computed and averaged, weighted by group size, as a measure of precision. The RMS measured Hct with a mean standard deviation of 1.15 Hct. These error and standard deviation values compare favorably to available point-of-care devices like the HemoCue Hb 201+, which has been reported to measure Hct with a mean of 4.32±4.81 Hct and standard deviation of 1.56±3.88 Hct.

Conclusions: The results of this study illustrate the ability of the wearable SmartPatch to non-invasively measure blood Hct in ESRD patients with AV fistulae, to a degree of accuracy and precision that may outperform available point-of-care methods. This study also demonstrated the efficacy of the end-to-end Remote Monitoring System.

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PO1032

Impact of a Change in Vascular Access Flow Volume After Percutaneous Transluminal Angioplasty on Cardiac Function

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Background: Vascular access (VA) is necessary for patients on hemodialysis, and percutaneous transluminal angioplasty (PTA) is a useful treatment for maintaining VA function. PTA immediately increases the VA flow volume, which can affect cardiac function. We investigated the relationship between changes in VA flow volume and cardiac function in patients who underwent PTA.

Methods: This was a single-center retrospective observational study, including patients who underwent PTA between June 2016 and August 2016. VA flow volume and cardiac function were measured by sonography before and 1 hour after PTA.

Results: This study included 50 PTA procedures in 50 cases. PTA significantly increased the median VA flow volume from 445 (range, 150−1229) to 725 (350−1268) mL/min. Although the ejection fraction and diameter of the inferior vena cava were unchanged, the cardiac output (CO) and cardiac index increased significantly in most cases. Surprisingly, the CO was obviously decreased in 18% of cases despite the increased VA flow volume. In this atypical group, a high CO before PTA was found to be a significant factor for the decrease in CO by PTA.

Conclusions: In most cases, both VA flow volume and CO were increased by PTA, whereas in some cases, the CO was decreased despite increase in VA flow volume. This atypical phenomenon may be due to the insufficient adaptive response in the peripheral artery and heart and could predict risks for future cardiac events. Therefore, it is important that such patients are carefully followed up.

PO1033

Predicting Arteriovenous Graft Failure with Sound Signatures in Patients on Hemodialysis

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Background: The fast-growing prevalence of end stage renal disease leads to an increasing population requiring dialysis worldwide. Specifically, patients on hemodialysis face the problem of maintaining their vascular accesses. Unfortunately, occurrence of stenosis and clots is not uncommon, especially in arteriovenous grafts (AVG). Graft longevity can be improved by effectively detecting and preventing these circumstances. The aim of this study is to develop a portable recording device that detects stenosis by extracting information from blood flow sounds.

Methods: Blood flow sounds were collected at four different locations on the arm, including venous and arterial ends of arteriovenous access. Measurements were conducted weekly, with four one-minute recordings per patient. A logistic regression model is used to analyze sound data. Recordings obtained prior to percutaneous transluminal angioplasty (PTA) procedures were labeled abnormal and those after PTA were labeled normal. Extracted features from each labeled recording include energy, spectrum, mel-frequency cepstrum, and chroma, as shown in Figure 1.

Results: In total, we have 109 labels, 25 of which are abnormal cases. Note that each case contains 4 separate recordings. For evaluation purposes, we randomly chose 75% of the labels as training cases and used the rest as testing cases. Each random trial compares single-location detection models to one integrated model, which combines data from all four locations. The trial was repeated 100 times. Our results in Table 1 indicate that arterial sounds are more informative than venous sounds in detecting stenosis. Note that the integrated model also significantly outperforms the other single-location models.

Conclusions: Our proposed model shows excellent performance in screening for AVG failure. This algorithm has potential to provide reliable and reproducible detection of vascular access abnormalities, optimizing AVG outcome and management for clinicians and patients.

Funding: Clinical Revenue Support

PO1034

A Novel Method for Ligation of Accessory Veins: A Case Series of Eight Patients

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Introduction: Accessory veins are a common cause for decreased blood flow through the body of arteriovenous fistulae (AVF). A common practice is to have these ligated surgically through a cut-down procedure. Alternatively, these can be blocked by coiling, embolization, or by percutaneous ligation. We present a case series where accessory veins were ligated percutaneously under direct ultrasound (US) visualization.

Case Description: A total of 8 patients underwent percutaneous accessory vein ligation from Dec 2020 through May 2021. None had any immediate complications. Cessation of blood flow through the accessory vein was confirmed by color doppler ultrasonography and by angiography. Technique description: After identifying the accessory vein on angiography and its impact on the flow through the AVF, the vein is then identified using the US. The location to ligate the vein is then chosen as close as possible to the vein “take-off”. Using a 4-0 absorbable suture and under direct US visualization, the needle is inserted from one side of the vein and passed to the side to come out from the other side. Then, the needle is flipped and inserted back subcutaneously, passing above the vein to come out eventually next to the initial insertion site. The suture is then tied firmly. Depending on the size and location of the vein, another suture can be done in a similar fashion a few millimeters away. Color doppler is then used to detect any flow through the vein. Confirmation of the cessation of flow can also be achieved by repeat angiography.

Discussion: Percutaneous ligation of the accessory veins is a technique that saves the patients from undergoing an open surgical intervention. Utilizing the US for direct visualization of the needle during the procedure enhances its safety and efficiency.