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Collaborative Approach to the Creation of an Arteriovenous Fistula on a US Navy Hospital Ship

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Abstract

Early creation of arteriovenous fistulas (AVFs) decreases morbidity and mortality in patients with end-stage renal disease and is the standard of care in the United States. However, this procedure is frequently not accessible in low- and middle-income countries (LMICs). We present the first reported case of successful AVF creation as part of a humanitarian assistance mission. The patient was a 51-year-old male with diabetes, hypertension, and end-stage renal disease on hemodialysis via a temporary dialysis catheter. Preoperative assessment and patient selection were coordinated with the host nation (HN) nephrologist and dialysis team. The visiting surgical team provided education on AVF anatomy, complications, and cannulation techniques to the HN dialysis team. A left brachiocephalic AVF was created under regional anesthesia performed by the visiting surgeon and anesthesiologists. There were no postoperative complications, and the AVF was matured and accessed successfully by the HN dialysis team 7 weeks after creation. Performing AVFs as part of humanitarian assistance missions has the potential to significantly reduce morbidity and mortality in LMICs.

Keywords

hemodialysis access, arteriovenous fistula, humanitarian assistance, low- and middle-income countries, Pacific Partnership

Introduction

Recent global health initiatives have been focused on the need for universal access to surgical and anesthesia care, provided safely through a collaborative approach between surgeons, anesthesiologists, and host nation (HN) partners.[1] The United States Naval Ship (USNS) Mercy (T-AH-19) has been participating in humanitarian assistance missions (HAMs) for over a decade.[2] Pacific Partnership is the largest annual multilateral humanitarian assistance and disaster relief preparedness mission conducted in the Indo-Pacific region.[3]

There is an increasing risk for the development and sequelae of vascular disease; however, these nations frequently lack vascular capabilities.[4] The Kidney Disease Quality Outcomes Initiative, implemented in 1997, advocates for early arteriovenous fistula (AVF) creation in an attempt to decrease morbidity and mortality in patients with end-stage renal disease and is the standard of care in the United States.[5] Unfortunately, these same standards are not currently attainable in low- and middle-income countries (LMICs).[6] Reasons for this include low surgeon-to-patient ratios, decreased surgical subspecialties, and significant resources committed to trauma. We present the first reported case of a successful AVF creation during a HAM and argue for an increased presence of vascular surgery in HAMs.

Case Report

The patient is a 51-year-old Fijian male with type 2 diabetes mellitus, poorly controlled hypertension, and stage 5 chronic kidney disease (CKD). He is a right-hand dominant and was hemodialysis (HD) dependent via a right internal jugular vein temporary dialysis catheter for 6 months. He underwent HD twice weekly.

A preoperative screening evaluation was completed prior to the arrival of the USNS Mercy by the HN nephrologist and visiting vascular surgeon. Vein mapping was performed by the vascular surgeon utilizing a portable ultrasound machine. The patient's left upper arm cephalic vein diameter ranged from 2.8 to 3.1 mm.

The patient underwent HD 1 day prior to the ship's arrival and 2 days prior to the planned surgery. The patient's recent laboratory results and HD record were brought on board the

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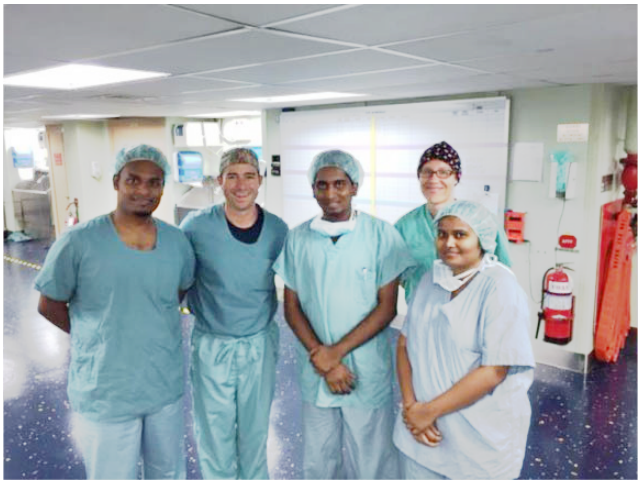

Figure 1. Host nation nephrologist and hemodialysis nurses in collaboration with the visiting surgeons on board the USNS Mercy.

USNS Mercy prior to surgery. Multidisciplinary evening rounds were conducted with the vascular surgeon, anesthesiologist, surgical and anesthesiology residents, and the ward nursing staff. Potential contraindications to proceeding with surgery, such as uncontrolled hypertension, overt signs of volume overload, or profound thrombocytopenia or anemia, were assessed for. Other than hypertension, which was controlled with as need antihypertensive medications, there were no identified contraindications and he was cleared for surgery.

The anesthesia team performed a left supraclavicular nerve block under ultrasound guidance. A standard end-to-side left brachiocephalic AVF was created without difficulty, and palpable distal pulses and an AVF thrill were appreciated at the completion of the case. There were no intraoperative or immediate postoperative complications. The patient was discharged to home from the USNS Mercy on postoperative day 1 with 30 days of 81 mg acetylsalicylic acid.

The HN nephrologist and HD nurses were present in the operating room to observe the surgery (Figure 1). In addition, they participated in a formal didactic teaching session provided by the visiting surgeons, focusing on AVF anatomy, complications, and cannulation techniques. Follow-up information was obtained through close communication with the HN dialysis team. The AVF was matured and cannulated by the HN dialysis nurses at 7 weeks postoperatively. At 6 months postoperatively, there have been no reported complications, and the AVF continues to be accessed successfully.

Discussion

This case is the first reported case of successful AVF creation during a HAM, which was performed on board a US hospital ship during Pacific Partnership 2015 (PP15). Although the USNS Mercy is well equipped with fully functional operating rooms and diverse surgical staffing, resources are limited. One example of such limited resources is the blood bank, which has a small supply of packed red blood cells, but no fresh frozen plasma or platelets are kept on board. A second example would be that there are electrocardiogram machines but limited echocardiogram capabilities and a limited supply of cardiac medications. This limits the number and type of operations performed. Table 1 lists the most common operations performed during PP15. The technical complexity of many cases is increased due to a lack of or variability in specific equipment. The HNs visited during each Pacific Partnership mission, historically, have varying levels of medical knowledge, infrastructure, and medical supplies. Not all LMICs are equipped to care for complex postoperative patients. The USNS Mercy as a surgical and medical platform is regularly considered an austere environment.

Table 1. Most Common Surgeries Performed on the USNS Mercy During Pacific Partnership 2015.

Procedure	Number Performed
Cataract	98
Hernia repair	89
Excision of benign skin mass	40
Cleft lip/palate	36
Circumcision	21
Hydrocelectomy	21
Thyroid (subtotal/lobectomy)	17 (5/12)
Pterygium excision	16

This case report demonstrates a collaborative approach between the HN medical providers and the visiting surgical teams. This process begins with patient screening and selection, wherein, the HN providers identified patients in need of surgical care who were medically and socially fit to undergo surgery. The visiting surgeon further selected patients after a review of comorbidities, physical examination, and sonographic and laboratory studies. Our patient was deemed a good candidate for AVF creation based on controlled comorbidities and adequate vein diameter. This reflects careful and collaborative patient selection. Multidisciplinary rounds to include nursing staff, anesthesiologists, surgeons, and the patient provide a forum for review of all potential patient- and procedure-related complications. Rounds included a review of recent HD records, laboratory data to include electrolyte derangements, anemia, thrombocytopenia or evidence of infection, physical examination focused on pulmonary edema or significant shortness of breath, and management of comorbidities such as hypertension. Before proceeding, all necessary or potentially necessary equipment and medications were ensured to be available and functioning. A plan of care was discussed with the ward nurse for management in the preoperative and postoperative phase. Although such rounds may seem standard or even unnecessary at a major institution, these were vital to prevent complications in an austere environment. Finally, education of the HN providers was critical and encompassed all phases of care. Preoperative education ensured that adequate resources were available, such as correctly sized HD needles. Intraoperative teaching illustrated patient anatomy and improved understanding of the

surgical procedure. Most importantly, as the HN providers were to assume long-term care for the patient, a thorough understanding of the possible postoperative challenges encouraged early recognition and timely management of complications improving the durability of surgical procedures, such as AVF functional patency.

The World Health Organization has focused on shortages in the delivery of basic surgical care to LMICs for over a decade. In response to this deficit, multiple international programs were established, including the Emergency and Essential Surgical Care Project in 2004 and the Global Initiative for Emergency and Essential Surgery in 2005. Their emphasis on integration into the health systems of LMICs and collaboration among various humanitarian assistance organizations and HNs has led to a potential improvement in availability, quality, and delivery of surgical care.[7]

Despite this worldwide commitment for delivering quality surgical care to LMICs, there remains a dearth of research on the provision of vascular surgery. Chronic medical conditions, such as CKD and peripheral vascular disease, are increasing worldwide and are projected to surpass the morbidity from acute infectious disease.[4] Of the over 200 million patients with peripheral vascular disease worldwide, 70% are estimated to live in LMICs. In most of these countries, there is 1 general surgeon per 100 000 people and no vascular surgeon.[8] Although the true global burden of vascular disease has not been completely delineated, these data highlight an impending burden and demand for vascular surgery worldwide. In contrast to more common surgical procedures, such as hernia repairs or cataract surgery, vascular surgery frequently involves high-risk patients with multiple comorbidities and more complex surgical procedures and intensive postoperative care. This complexity requires collaboration and integration if vascular patients are to be successfully treated in LMICs. This inaugural case, while a straightforward AVF performed without complication, will hopefully serve as a catalyst for increased discussion and greater implementation of vascular procedures in LMICs.

Conclusion

Performing AVFs during a HAM has the potential to significantly reduce morbidity and mortality in LMICs. This inaugural case demonstrates that through careful patient selection, preoperative planning, and collaboration between the surgical team and HN physicians and nurses, AVFs can be created safely and effectively in an austere environment.

Declaration of Conflicting Interests

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