Evacuation of Non-ST Elevation Myocardial Infarction in West Africa

19 Hours of Lessons Learned in Prolonged Casualty Care and En Route Care

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ABSTRACT

Trauma casualty care has historically been the cornerstone of special operations military medical training. A recent case of myocardial infarction at a remote base of operations in Africa highlights the importance of foundational medical knowledge and training. A 54-year-old government contractor supporting operations in the AFRICOM area of responsibility (AOR) presented to the Role 1 medic with substernal chest pain with onset during exercise. Abnormal rhythm strips concerning for ischemia were obtained from his monitors. A MEDEVAC to a Role 2 facility was arranged and executed. At the Role 2 a non-ST-elevation myocardial infarction (NSTEMI) was diagnosed. The patient was emergently evacuated on a lengthy flight to a civilian Role 4 treatment facility for definitive care. He was found to have a 99% occlusion of the left anterior descending (LAD) coronary artery, as well as a 75% occlusion of the posterior coronary artery and a chronic 100% occlusion of the circumflex artery. The LAD and posterior arteries were stented, and the patient made a favorable recovery. This case highlights the importance of preparedness for medical emergencies and care of medically critical patients in remote and austere locations.

Background

Non-ST-elevation myocardial infarction (NSTEMI) is a subset of acute coronary syndrome (ACS) characterized by atherosclerotic plaque rupture or erosion without persistent ST segment elevation but with elevation of cardiac enzymes, such as troponin. In addition to NSTEMI, ACS also includes ST-elevation myocardial infarction (STEMI) and unstable angina (UA). The annual incidence of ACS in the US population stands at more than 780,000, but the incidence in the deployed setting is not as well documented.[1] One study from a Role 3 facility in Afghanistan diagnosed approximately 19 cases of ACS over a two-year period, making it the sixth most frequent admission diagnosis at the facility.[2]

While initial treatment of NSTEMI focuses on relieving the ischemia through platelet inhibition and anticoagulation, management of respiratory status and hemodynamics is paramount. In the austere environment, medications may be available, but in limited quantity. Furthermore, definitive treatment of patients with NSTEMI requires specialized evaluation in a tertiary facility that can provide advanced diagnostic and therapeutic services, such as angiography, interventional cardiology, and cardiothoracic surgery. NSTEMI patients in austere locations can require lengthy transport times to obtain tertiary care, creating a unique type of Prolonged Casualty Care (PCC) scenario for the medical providers. Managing resources during PCC of a cardiac patient requires knowledge of cardiac and respiratory physiology, as well as a thorough understanding of resource management specific to the evacuation platform and timeline.

We present the case of a 54-year-old man who suffered an acute NSTEMI in a remote location in Africa. His case, from presentation to the Role 1 to definitive management at a Role 4 in Europe, demonstrates the need for vigilance for the unexpected medical emergency in the austere environment and underscores the significance of preparedness to care for these patients for an extended period of time on the ground and in the air.

Case Report

A 54-year-old man with no past medical history presented to a Role 1 medical facility in a remote area in the AFRICOM AOR complaining of chest pain and shortness of breath. The pain was substernal and described as a pressure-like sensation. Initial vital signs included a heart rate of 84 beats per minute, blood pressure of 148/70 mmHg, respiratory rate of 18, temperature of 98.8°F, and SpO_2 of 92% on room air. The patient received 324mg aspirin and sublingual nitroglycerin tablets, which moderately improved his pain. There was no capability to obtain a full 12 lead electrocardiogram (ECG), however the Role 1 provider was able to transmit individual rhythm strips to the Role 2 physician. The rhythm strips demonstrated 2–3mm ST segment depressions in lead II (Figure 1) and similar depressions in lead III, concerning for inferior ischemia. Because of this concern, further doses of nitroglycerin were withheld due to the potential for preload dependent cardiac pathophysiology. Anticoagulation was not available at the Role 1.

Evacuation to the nearest Role 2 facility was arranged, and a medical evacuation (MEDEVAC) platform was dispatched to recover the patient. Upon turnover to the MEDEVAC team, the patient's vital signs included a heart rate of 94, blood

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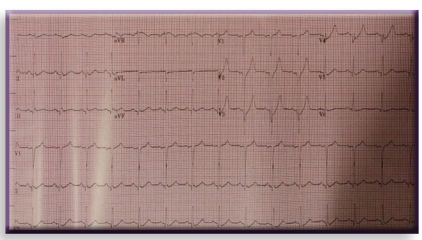
FIGURE 1 *Lead II.*

pressure of 152/90, respiratory rate of 16, and an SpO_2 of 97% on a non-rebreather at 15 liters per minute. A 12 lead EKG was performed, which demonstrated depressions in lead II. After 8mg of morphine, the patient reported mild residual chest pain of 3/10. In order to maintain adequate preload, the patient had received approximately 1.5L of crystalloid by the time of handover to the MEDEVAC team. His vital signs and chest pain remained stable during transport, and no changes were noted on telemetry. Ultimately, due to distance, it would take 7 hours from symptom onset to reach the Role 2.

At the Role 2, a physical exam revealed a patient in mild distress with absence of jugular venous distention, murmur, or lower extremity edema. A brief history confirmed that the patient had no prior medical history, no surgeries, and took no medications. A 12-lead EKG was performed and demonstrated ST depressions in the precordial leads indicating posterior ischemia (Figure 2). A chest x-ray was significant for cardiomegaly. A cardiac point of care ultrasound revealed cardiomegaly, septal wall hypokinesis, and a decreased ejection fraction. A single non-high sensitivity troponin I was significantly elevated to 14.41ng/mL. Time at the Role 2 facility was limited due to aircraft and operational constraints; therefore, a posterior ECG was not obtained. Cardiology at a Role 4 facility was consulted via telehealth. After reviewing the ECG, the diagnosis of non-ST segment elevation myocardial infarction (NSTEMI) was made. A heparin bolus and drip were given, and the decision was made to MEDEVAC the patient to a higher level of care immediately.

FIGURE 2 *Role 2 12-lead ECG.*



Less than one hour from arrival to the Role 4 facility, the patient was loaded onto a MEDEVAC-capable accompanied by an emergency physician and a nurse anesthetist. The patient was transferred onto the aircraft in supine position, which resulted in the development of moderate dyspnea and an increased oxygen requirement. This acute change was suspected to be related to the development of moderate pulmonary edema. The patient was repositioned to a 90° seated position. Diuretics were considered, but held due to the concern for an inferior, or right ventricular, infarction. CPAP and BiPAP were not available on the MEDEVAC platform. The upright positioning improved the patient's dyspnea, and he remained stable throughout the remainder of the flight. Total en route care, which including one refueling stop, was approximately 9 hours.

At the destination airfield, the patient was transferred to an ambulance and transported to the hospital. The patient was taken for emergent cardiac catheterization within 30 minutes of arrival. Diagnostic angiography revealed severe three vessel disease and a reduced ejection fraction of 31%. The left anterior descending artery demonstrated a 99% stenosis and was treated with two stents. The circumflex artery demonstrated 75% stenosis, and the right coronary artery had moderate to severe chronic stenosis. These lesions were not treated during the initial procedure.

The patient recovered for 24 hours in the intensive care unit and was transferred to the cardiology floor of the hospital. He was started on dual antiplatelet therapy and a statin. His inpatient course was notable for a brief acute kidney injury, which was successfully treated with fluids. On hospital day seven, the patient was taken back-to-back to the catheterization lab for stenting of the circumflex. Repeat diagnostic angiography after stent placement demonstrated an ejection fraction of 50%. The patient was discharged on hospital day eight and returned to the United States for continued outpatient management.

Discussion

While stabilization and management of traumatic injuries are the cornerstone of deployed special operations medicine, this case serves as an important reminder that critical patients can present anywhere at any time. Over 19 hours elapsed between presentation and definitive management in the catheterization lab, with more than 11 of those hours in the air. The successful management of this patient required thorough medical training, coordination with several contract, active component, and civilian entities, and optimal resource utilization for delivery of effective PCC by the medical team.

The initial diagnostic and treatment modalities for NSTEMI are present at most Role 1 facilities. However, forward deployed medical provider must remain prepared for the possibility of a complicated cardiac patient and plan for the according treatment. Per the 2014 American Heart Association and American College of Cardiologists (AHA/ACC) guidelines for NSTEMI, treatment begins with the administration of aspirin, a $P2Y_{12}$ inhibitor (clopidogrel or ticagrelor), and anticoagulation (unfractionated heparin, low molecular weight heparin, fondaparinux, or bivalirudin).[1] The AHA/ACC guidelines for STEMI recommends against the routine use of $P2Y_{12}$ inhibitors in patients before catheterization who may require coronary artery bypass graft (CABG) in the following 5 to 7 days.[2] Nitroglycerin should be given if chest pain is present, but used with caution in the setting of suspected right ventricular ischemia. In our case, ST depressions in leads II and III were concerning for right ventricular compromise, and nitroglycerin was used judiciously. Importantly, clopidogrel was withheld in the event the patient might require CABG. Beta blockers and statins may be beneficial within the first 24–48 hours, but not necessarily at the first point of contact. Notably, this case was prior to the release of the updated 2020 AHA guidelines; therefore, the 2014 AHA guidelines were used as a reference.

The MEDEVAC from Role 1 to Role 2 was a positive example of a contract MEDEVAC platform with a contract medic, as well as an integrated active-duty component critical care nurse. The presence of an experienced nurse familiar with the complicated physiology of myocardial infarction and the potential for significant heart failure proved invaluable for the patient's fluid resuscitation and symptom management.

During the MEDEVAC from Role 2 to Role 4, the patient began to deteriorate with increased shortness of breath and decreased SpO_2. While this may have been precipitated by worsening infarction, it was suspected that the cause was iatrogenic due to fluid administration and a heparin bolus. Diuresis was considered, but concern remained for right ventricular compromise making this patient's physiology especially dependent on preload. Also, this occurred in the early stages of a 10-hour flight with limited resources. Had the patient responded too strongly to diuresis and required fluids, supplies may have been depleted. The patient was sat straight up with self-administered suction for his secretions, and his respiratory status improved significantly after several minutes.

Only two D cylinder oxygen tanks were brought for this long trip, as it was planned to use the aircraft's oxygen supply if needed. A MEDEVAC aircraft may or may not be equipped with therapeutic oxygen. Its presence is a key planning factor for treatment teams and planners, and a backup solution needs to in place in the event of system failure. Unfortunately, the oxygen on the aircraft did not supply sufficient flow rates to be effective. The oxygen tanks were continuously adjusted between 0.5 and 2 liters per minute to maintain an SpO_2 greater than 88%. The D cylinders held approximately 340 liters of oxygen. At a rate of 2 liters per minute, a cylinder will last 2 hours and 50 minutes. With the lower rates, the cylinders lasted the entire trip.

This critical cardiac patient stands as a reminder that while it is not ideal, PCC is something that every team in an austere environment must be prepared for at any given time. In AORs as large as Africa, medical teams often cover great distances, and the amount of time providing patient care while awaiting MEDEVAC and during flight can be significant. The Joint Trauma System addresses PCC (previously termed Prolonged Field Care (PFC)) in no less than 10 Clinical Practice Guidelines (CPGs).[3] Nursing care is addressed in CPG 70 with recommendations presented in a minimum, better, best format.[4] Similarly, the PCC Working Group provided recommendations for the core capabilities of PCC in a similar format.[5] These recommendations are largely dependent on environment, team personnel, equipment, and supplies. In terms of personnel, nurses are extremely well trained to provide PCC, and our patient benefited greatly from the expertise of the intensive care and emergency medicine trained nurses involved in his care. While it is not feasible to assign nurses to every operational platform, this case illustrates the necessity of training to PCC best practices at every level of care.

Conclusion

This case highlights important considerations that must be made in training and preparing medical teams and personnel in the remote deployed environment. We propose an increase in training for medical emergencies to supplement the already robust trauma training such teams receive. Additionally, an emphasis on the principles of, and preparation for, PCC during pre-deployment training is advised. All providers in the chain of care must be familiar with not only the medical interventions required, but also with the resources are available at their location, as well as those that may be needed during transport.

Disclosures

The authors are military service members or federal/contracted employees of the United States government. This work was prepared as part of their official duties. Title 17 U.S.C. 105 provides that "copyright protection under this title is not available for any work of the United States Government." Title 17 U.S.C. 101 defines a U.S. Government work as work prepared by a military service member or employee of the U.S. Government as part of that person's official duties.

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Conflicts of Interest

None.

Disclaimer

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