Aerospace Medicine Clinic

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You are the physician on call at a ground-based, in-flight medical response agency. An inbound call regarding a man who is seizing early into a transatlantic flight is transferred to you. You are put into communication with the flight attendants and two physician volunteers taking care of the patient. They state that shortly after takeoff, the patient felt ill and called the attendants to his seat. He confessed to ingesting multiple packets of cocaine prior to losing consciousness and beginning to convulse. As part of their in-flight medical response protocols, the attendants called overhead for medical volunteers while also reaching out to your agency.

1. What is the correct next step in managing this patient who is seizing in-flight with suspected drug ingestion?
   A. Instruct the volunteer physicians to treat the patient as they see fit since they are the providers actively taking care of the patient. Your job is to weigh the benefits and risks of diversion.
   B. Recommend diversion as the patient is unlikely to improve without full medical care and tell the attendants that they should follow their airline-provided protocols for seizure management.
   C. Recommend the attendants find the emergency medical kit (EMK) while also providing specific directions to protect the patient's airway, provide supplemental oxygen (O_2), administer benzodiazepines for seizure control, start an intravenous (IV) catheter, administer fluids, and check the blood glucose level; and recommend diversion with mandatory follow-up after these interventions to ensure seizure resolution.
   D. Recommend the attendants move the patient to the galley, lay the patient on his back with his legs elevated, check a blood glucose level, and wait for improvement, as most in-flight medical events are syncopal in nature and can be mistaken as seizure activity.

ANSWER/DISCUSSION

1. C. Although most in-flight medical events (IMEs) are syncopal (32.7%), the recent history of cocaine packet ingestion makes seizures likely.[1] General seizure management follows a structured approach including airway protection, maintenance of respiration and circulation, and treatment of seizures while the etiology is sought.[2] Causes can be varied and include electrolyte and metabolic disturbances, cerebral ischemia/hypoxia, medications, illicit substances (e.g., cocaine), substance (e.g., alcohol, narcotic) withdrawal, toxins, infections, and cancer.[3] Commercial flights may lower the seizure threshold due to sleep deprivation, interrupted sleep patterns and circadian-rhythm-related sleep disturbances, or insufficient medication supplies for known epileptics.[4] Nonsyncopal neurological conditions such as strokes and seizures represent 5.5% of IMEs.[1] The Federal Aviation Administration (FAA) mandates the minimum medical supplies onboard a commercial flight, and medications include antihistamines, aspirin, atropine, bronchodilators, dextrose, epinephrine, lidocaine, nitroglycerine, nonnarcotic pain medications, and saline solution.[5] Although the Aerospace Medical Association recommends more comprehensive medical supplies,[6] additional medical supplies are not standardized among the carriers. Fortunately, airlines often provide their supplies list to ground-based response agencies for rapid reference. For this patient, the flight carrier's medical kit had diazepam available.

The role of the ground-based physician is to assist with patient management and aid the flight crew in diversion considerations if indicated. The initial stabilization of this patient included ensuring the in-flight team protected the patient's airway, provided supplemental O_2, administered 10 mg of intramuscular (IM) diazepam, started a peripheral IV catheter, began normal saline administration, monitored the patient's vitals for signs and symptoms of hyperthermia and cardiac ischemia, and provided a scheduled update in 30 min. Scheduling a call-back is an important step to ensure timely updates during critical in-flight events. In this case, diversion was also recommended due to the concern for ongoing cocaine absorption.

Then 25 min later, you receive an update that the patient initially responded to 10 mg IM diazepam; however, he continues

DOI: https://doi.org/10.3357/AMHP.6480.2024

to have intermittent seizures despite an additional 10 mg IM diazepam. The volunteer physicians report the patient's current heart rate is 80 bpm with a blood pressure (BP) of 81/65. They are attempting to place an IV catheter and the pilots are initiating a diversion. You are concerned about poor perfusion and potentially cocaine-induced cardiac ischemia or infarction leading to hypotension. You recommend continuing O_2, administering a saline bolus once IV access is established and rectal diazepam if unable to give more diazepam parenterally, checking the patient's glucose level, and performing an electrocardiogram (ECG), as this flight had a Tempus ECG machine available.

2. What is the most common cause for in-flight medical diversion?
   A. Gastrointestinal (GI) disorders.
   B. Syncopal disorders.
   C. Respiratory disorders.
   D. Cardiovascular disorders.

ANSWER/DISCUSSION

2. D. Only 4–7% of IMEs result in aircraft diversion. While cardiac events make up only 7% of all in-flight events, they represent 26.4% of medical diversions.[1,7] The differential for chest pain is broad and can be caused by neuropsychological, cardiopulmonary, GI, and musculoskeletal pathologies. Aspirin, nitroglycerin, and O_2 are included in the FAA-mandated EMKs for treatment of suspected acute coronary syndrome. Most aircrafts do not have ECG capabilities; however, the FAA requires any commercial flight with at least 1 flight attendant and a capacity for 30 or more passengers to have an automated external defibrillator.[5] If a patient progresses to cardiac arrest, the EMK contains epinephrine in both 1:1000 (1 ml) and 1:10,000 (2 ml) concentrations as well as lidocaine at 20 mg · ml^{-1} (5 ml).

Then 11 min later, you are updated that IV access was established and the patient received a saline bolus with improvement in BP. Current vitals are: BP = 146/82, pulse = 157 bpm, and O_2 saturation = 97% via simple mask. The ECG had a noisy baseline but demonstrated sinus tachycardia and T-wave inversions inferiorly (**Fig. 1**).

Your patient, intermittently conscious, begins to complain of chest pain. Current vitals include a BP of 185/110 and heart rate of 118 bpm. You are concerned about cardiac ischemia secondary to cocaine intoxication. Benzodiazepines (the standard for cocaine-induced chest pain) are already being given to control seizures.

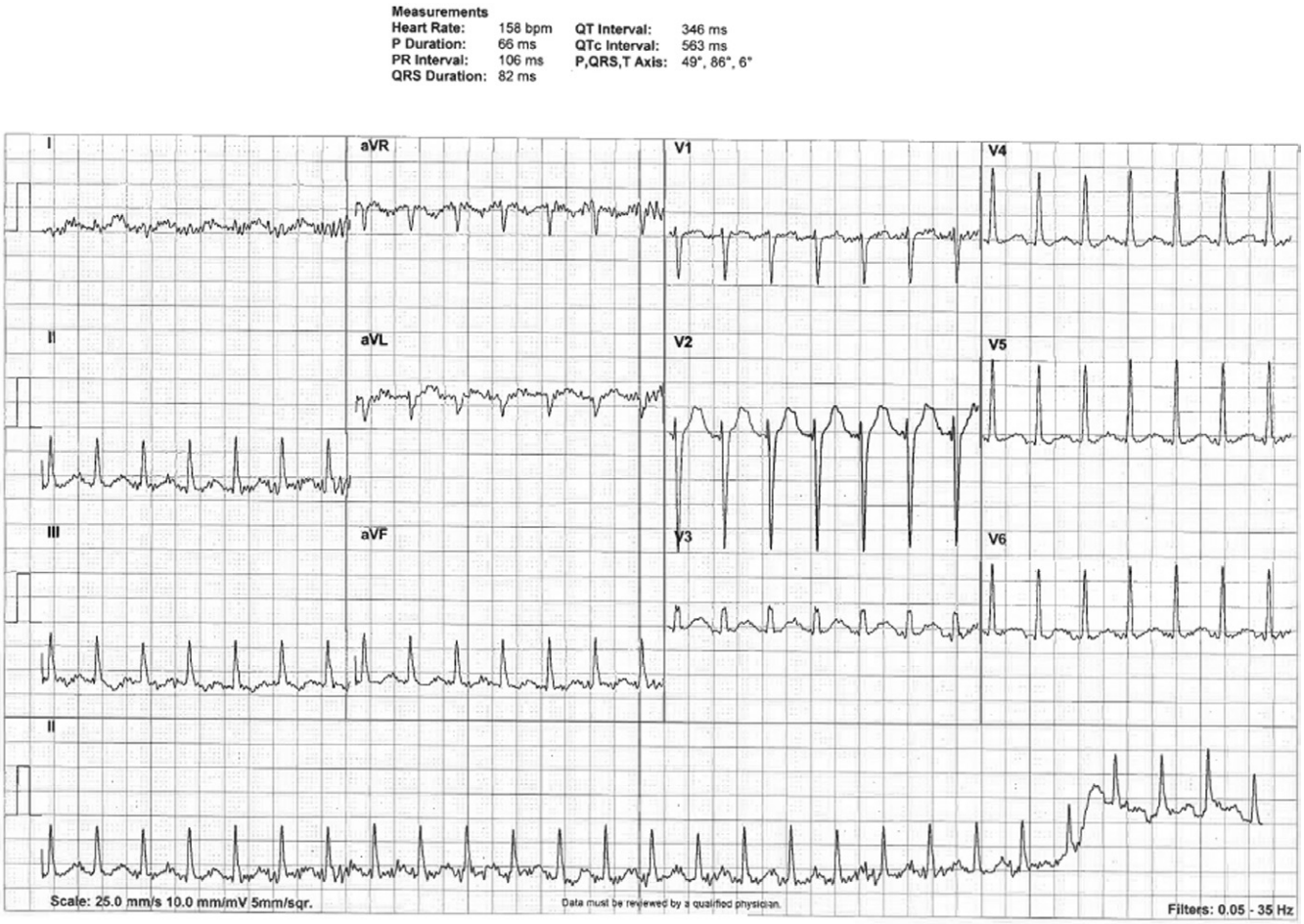

Fig. 1. Electrocardiogram obtained from the Tempus ECG device in flight, demonstrating sinus tachycardia, prolonged QTc, and inferior T-wave inversions.

3. Given availability and no allergies, which of the following treatments would be contraindicated in this scenario?
   A. Aspirin tablet for antiplatelet effect.
   B. Nitroglycerin to improve coronary blood flow and help reduce BP.
   C. Metoprolol for heart rate and BP control.
   D. Morphine sulfate for pain.

ANSWER/DISCUSSION

3. C. Cocaine is a potent sympathomimetic agent that potentiates the action of catecholamines on alpha- and beta-adrenergic receptors. Intoxication can lead to significant increases in heart rate, cardiac contractility, and systemic vasoconstriction resulting in hypertension, myocardial ischemia, myocarditis, and cardiomyopathy.[8] Chest pain secondary to tachycardia, myocardial ischemia, and infarction are common presenting symptoms of cocaine intoxication, and cardiac arrest can be the result. Administration of metoprolol, a selective beta-adrenergic receptor antagonist, could result in unopposed alpha-adrenergic stimulation, precipitating a hypertensive crisis and exacerbating cardiac ischemia.

The potential inferior ischemia only confirms your decision to divert. An additional 44 min pass prior to the next update. The patient continues to have intermittent seizures and was given an additional 10 mg of IM diazepam by the volunteer physicians. The glucose returned as 2 mmol · L^{-1} (36 mg · dL^{-1}) and the patient's current vitals are a BP of 142/97 and a pulse of 98 bpm. You advise the responding team to continue to maintain the patient's airway and provide O_2 supplementation, but also order administration of glucose gel inside the patient's lip. You are informed the plane is about to land and that local emergency medical personnel and police are already on scene at the receiving airport.

4. What is true regarding medical diversion?
   A. Diversion is decided solely by the medical providers treating the patient.
   B. Diversion occurs in 73% of IMEs.
   C. Diversion requires the aircraft to land at the closest medical facility.
   D. Diversion to the closest hospital early in flight may not be possible due to the fuel weight of the aircraft.

ANSWER/DISCUSSION

4. D. Diversion occurs in 4.4–7.3% of all in-flight medical responses and is most commonly caused by patients with cardiac arrest, obstetric emergencies, cardiac symptoms, and suspected stroke.[1,9] Commercial aircraft lack comprehensive medical facilities and personnel, making diversions necessary in critical cases. However, making this decision involves numerous considerations, including fuel availability, landing weight, proximity of appropriate medical facilities, patient preferences, and the potential cost of diversion, which can range significantly.[1] The pilot in command, in consultation with ground-support experts and physicians, ultimately makes the diversion decision, aiming to balance the passenger's condition, logistical factors, and operational considerations. Cardiac arrest cases during flight present particularly complex diversion decisions due to factors such as time to land, which is often greater than 30 min even if a capable medical facility is nearby when the decision is made to divert, and the impact on the well-being of other passengers.

Upon landing, the patient is taken by emergency medical services to the closest capable medical facility. Follow-up revealed that the patient received an additional 20 mg of IV diazepam in the emergency department to break the intermittent seizures. Subsequent radiographs revealed opacities consistent with ingested drug packets throughout the GI tract and surgical consultation was requested.

5. Which of the following would be definitive management for the ingested packets?
   A. No further treatment is needed as the seizures have stopped. Expectant management can be used for the rest of the packets.
   B. The patient should undergo an esophagogastroduodenoscopy (EGD) to retrieve any packets in the stomach, and expectant management should be used for any packets that have made it past the pylorus.
   C. As the patient experienced intoxication, he should undergo an exploratory laparotomy to remove any identifiable packets, as it is unknown where in the GI tract the leaking packet(s) could be. If indicated, intraoperative EGD and colonoscopy can also be performed.
   D. Cocaine intoxication is too dangerous for anesthesia, and conservative management in the intensive care unit should be pursued unless the patient develops a bowel obstruction.

ANSWER/DISCUSSION

5. C. Asymptomatic patients who have ingested drug packets should undergo conservative management with laxatives and promotility agents until the packets have passed. Polyethylene glycol is often used, as it is safe from an electrolyte and fluid balance perspective.[10] Patients who have ingested drug packets should undergo surgery if they experience GI obstruction, have signs or symptoms of intoxication suggestive of a leaking packet, or fail to progress with conservative management.[11] X-rays have poor sensitivity but high specificity (97%) in detecting ingested packets.[10] Radiographic signs include air trapped between layers of drug packets appearing as the "double condom sign" or air associated with knots tied in balloons, condoms, and other wrapping materials appearing as "rosettes."[11] If there is diagnostic uncertainty or if there is a need for preoperative localization, CT imaging can be utilized if it does not delay management. An exploratory laparotomy allows for removal of the packets via a gastrotomy, enterotomy, or

colotomy as indicated. Intraoperative EGD and colonoscopy can aid in ensuring complete GI clearance. Monitoring for postoperative infections is warranted, as there may be up to a 32.9–40% risk of wound infections.[12]

The patient underwent an exploratory laparotomy with removal of over 60 drug packets. Despite a prolonged hospitalization, he made a full recovery.

Stabenau KA, Petersen E, Alves P, Lindgren J. *Aerospace medicine clinic: cocaine toxicity on a commercial airline*. Aerosp Med Hum Perform. 2024; 95(10):807–810.

ACKNOWLEDGMENTS

The opinions expressed in this article are those of the author alone and do not necessarily reflect the opinions or policy of MedAire, the University of Arizona, or Banner University Medical Center.

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STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION
(Required by 39 U.S.C. 3685)

1. Title of Publication: Aerospace Medicine and Human Performance. 2. Publication No. 008-760. 3. Date of Filing: October 1, 2024. 4. Frequency of Issue: Monthly. 5. No. of Issues Published Annually: 12. 6. Annual Subscription Price: $353. 7. Complete Mailing Address of Known Office of Publication: Aerospace Medical Association, 320 S. Henry St., Alexandria, VA 22314-3579. 8. Complete Mailing Address of Headquarters or General Business Office: Aerospace Medical Association, 320 S. Henry St., Alexandria, VA 22314-3579. 9. Full Names and Complete Mailing Address of Publisher, Editor, and Managing Editor: Pubisher -- Aerospace Medical Association, 320 S. Henry St., Alexandria, VA 22314-3579. Editor -- David Newman, MBA, Ph.D., 16 .Greg Norman Dr., Point Cook, Victoria, 3030 Australia. Managing Editor -- Rachel Trigg, B.A., Aerospace Medical Association, 320 S. Henry St., Alexandria, VA 22314-3579. 10. Owner: Aerospace Medical Association, 320 S. Henry St., Alexandria, VA 22314-3579. 11. Known Bondholders, Mortgages, and other Security Holders Owning or Holding 1 Percent or More of Total Amount of Bonds, Mortgages, and Other Securities: None. 12. For Completion by Nonprofit Organizations Authorized to Mail at Special Rates: The purpose, function, and nonprofit status of this organization and the exempt status for Federal income tax purposes has not changed during the preceding 12 months.
13. Publication Name: *Aerospace Medicine and Human Performance*.
14. Issue Date for Circulation Data: September 2024.

15. Extent and Nature of Circulation:	Avg. No. of Copies Each Issue During Preceding 12 Months	No. Copies of Single Issue Published Nearest Filing Date
a. Total no. copies	165	173
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