

# WebM&M

Morbidity and Mortality Rounds on the Web

## Spotlight

### When the Lytes Go Out: A Case of Inpatient Cardiac Arrest



Agency for Healthcare Research and Quality  
Advancing Excellence in Health Care

**PSNet**  
PATIENT SAFETY NETWORK

## Source and Credits

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- This presentation is based on the September 2020 AHRQ WebM&M Spotlight Case
  - See the full article at <https://psnet.ahrq.gov/webmm>
  - CME credit is available
- Commentary by: Benjamin Stripe, MD, FACC, FSCAI and Dahlia Zuidema, PharmD, BC-ADM, CDCES
  - AHRQ WebM&M Editors in Chief: Patrick Romano, MD, MPH and Debra Bakerjian, PhD, APRN, RN
  - Spotlight Editors: Ulfat Shaikh, MD and Sandhya Venugopal, MD
  - Managing Editor: Meghan Weyrich, MPH

# Objectives

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*At the conclusion of this educational activity, participants should be able to:*

- Discuss the risk of ventricular arrhythmia related to prolonged QTc intervals that can be affected by electrolyte derangements
- Describe some of the advantages in protocol-based management of complex and rapidly evolving care in disease states such as diabetic ketoacidosis
- Identify potential sources of error related to frequent patient handoffs and unclear roles for different care teams in the hospital
- Discuss the role of the electronic health record and auto-firing alerts to aid in the early identification of factors that can lead to complications or poor outcomes

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# WHEN THE LYTES GO OUT: A CASE OF INPATIENT CARDIAC ARREST

A case describing serious and preventable complications – cardiac arrest due to torsades de points and ventricular fibrillation – related to the management of a patient's chronic medical conditions

## Case Details

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- 44-year-old man with hypertension and diabetes complicated by diabetic retinopathy
- Patient had an open, purulent, draining wound on right third metatarsal head that could be probed to the bone
- Initial labs were consistent with ketoacidosis (leukocytosis, low potassium, anion gap metabolic acidosis, and hyperglycemia)
- Patient was admitted to the General Medicine service with a consult from Orthopedics
- Managed with antibiotics, subcutaneous insulin, and IV fluids

## Case Details

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- Patient had frequent nausea, poor oral intake, and was twice kept NPO after midnight in advance of operative debridements the following day
- Ongoing hypokalemia (as low as 2.5 mmol/L) and was repleted with low doses of oral supplements
- Magnesium level was checked on Day 4 and was low; electrocardiogram the same day showed prolonged QT interval

## Case Details

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- On Day 7, potassium and magnesium remained low
- The patient had a cardiac arrest due to torsades de points and ventricular fibrillation
- Patient was transported to the cardiac ICU with return of spontaneous circulation
- Patient was discharged from the hospital one week later with implanted cardioverter-defibrillator

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# WHEN THE LYTES GO OUT: A CASE OF INPATIENT CARDIAC ARREST

## THE COMMENTARY

By Benjamin Stripe, MD and Dahlia  
Zuidema, PharmD

# Background (1)

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- Torsades de points is a form of polymorphic ventricular tachycardia
- Thought to be induced by early after-depolarizations in the setting of delayed repolarization with a prolonged QT interval
- Prolonged QT interval can be due to genetic abnormalities, it can also occur in relation to medications or electrolyte abnormalities, such as hypokalemia, hypomagnesemia, and hypocalcemia

## Background (2)

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- Hypomagnesemia can be common in diabetics
  - Due to poor dietary intake, altered insulin metabolism, metabolic acidosis, osmotic diuresis, hypophosphatemia and hypokalemia
  - Can be associated with poor glycemic control
  - Underlying risk factor for foot ulcers and increase risk of cardiac arrhythmias

## Background (3)

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- Treatment of torsades de pointe should follow the advanced cardiac life support algorithm, with an emphasis on early defibrillation
  - Correction of hypomagnesemia can stabilize torsades de pointe even before the QT interval can be shortened
  - Medications that may be causing or contributing to QT interval prolongation should be stopped
  - Electrolytes should be corrected and optimized

## Background (4)

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- Managing diabetic ketoacidosis using a standardized approach during the first 24-48 hours has been shown to improve patient safety
  - Focus on correction of fluid loss with IV fluids, correction of hyperglycemia with IV insulin, correction of electrolyte disturbances (particularly potassium loss), correction of acid-base balance, and treatment of underlying cause
  - Successful transition from IV to subcutaneous insulin requires overlap with basal insulin for 2-4 hours to prevent rebound hyperglycemia

## Background (5)

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- Magnesium is not only useful for suppressing torsades de pointes, it is also important in the regulation of potassium in the distal nephron
  - When magnesium is low, the renal outer medullary potassium (ROMK) channels allow potassium into the urine; when the magnesium levels are adequate, potassium excretion is reduced
  - Checking and repleting magnesium can improve the rate of potassium repletion

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# Approach to Improving Safety

# Approach to Improving Safety (1)

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- Protocol-based management
  - Management of diabetic ketoacidosis requires close attention and rapid titration of therapy (e.g., fluid resuscitation, management of hyperglycemia, electrolyte repletion)
  - Nurse-led protocols can aid in making quick changes and prevent multiple communication sessions with the physician team

## Approach to Improving Safety (2)

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- Educating and supervising medical trainees
  - Trainees may underestimate the challenge of knowing different formulations and ordering potassium and magnesium is not always clear
  - Inpatient pharmacists can educate physicians about the advantages and disadvantages of alternative formulations and advise on replacement strategies for electrolyte abnormalities

# Approach to Improving Safety (3)

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- Effective team communication
  - In this Case, more than one team was involved in the care of the patient (Orthopedics managing the foot wound and Internal Medicine managing the medical issues).
  - Important abnormalities can go untreated if clear lines of team communication are lacking
  - Handoffs are often unclear as to whether electrolytes need to be checked and repleted through the night. Interventions aimed at improving sign out and handoffs have not definitively shown to improve electrolyte repletion and avoidable death

# Approach to Improving Safety (4)

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- Electronic health record alerts
  - In one study of risk factors for QT prolongation, EHR alerts were shown to increase assessment for QT prolongation in patients at risk. However, the overall increase in any action taken after the alert was modest and only 21% of alerts led to physician action

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# Systems Change Needed/ Quality Improvement Approach

# Systems Change Needed (1)

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- When there is shared responsibility, need to clearly define what team has the primary responsibility for a patient
  - In this case, it was unclear whether an Internal Medicine or Orthopedics team held primary responsibility
  - Need to identify barriers to carrying out the Internal Medicine team's intent
  - Orthopedic surgery residents may not typically manage patients with medically complex issues; in this case, the patient may have been better served on an internal medicine team with an orthopedics consult to streamline the treatment of the medical problems

## Systems Change Needed (2)

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- Protocol-based electrolyte depletion can reduce the time from when an abnormal lab test value is reported to the administration of a repletion dose of potassium
  - In this case, the patient was repeatedly NPO for surgery – the protocol can provide important flexibility to switch between IV and oral repletion routes
  - Dietary consultation could have provided an assessment of the patient's nutritional status and fluid and electrolyte balance.

## Systems Change Needed (3)

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- Pursue good glycemic control to improve wound healing
  - Insulin is the agent of choice
  - A multidisciplinary approach with a physician, dietary consultation, pharmacist and bedside nurse for diabetes education can achieve blood glucose goals much faster while the patient is being treated for a foot infection and to prevent damage to limb

## Systems Change Needed (4)

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- Effective, frequent communication
  - Multidisciplinary rounds will often facilitate communication, but more frequent brief communications between the bedside nurse, pharmacy team, and the primary physician team are crucial
  - Bedside nurses should feel empowered to reach out to the physicians with suggestions to expedite electrolyte repletion

## Systems Change Needed (5)

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- Consider the experience and competence of the primary resident
  - Helping to prevent mistakes is the job of the senior residents and the attending physician on service
  - Timely bedside teaching via direct intervention by a more experienced physician can prevent adverse outcomes and help reinforce important learning points for a new physician

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# TAKE HOME POINTS

## Take-Home Points (1)

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- Patients with a history of poor glycemic control can be at higher risk for electrolyte disturbances exacerbated by DKA, infection and the patient's NPO status that is often ordered in preparation for procedures; clinicians must recognition the importance of glycemic control in relationship to potential electrolyte disturbances.
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- Protocolized repletion of electrolytes can help to prevent prolonged hypokalemia by empowering the bedside nurse, leading to shorter time from when an abnormal laboratory value is reported to administration of a dose for repletion.

## Take-Home Points (2)

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- Physician shift-to-shift handoff has been shown to be a potential source missed communication or miscommunication thus leading to error, but interventions have not yet been demonstrated to improve patient outcomes such as electrolyte repletion.
- Recognition of medications that can cause QTc prolongation (like anti-emetics and antibiotics) is essential

## Take-Home Points (3)

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- EHR alerts may stimulate action by physicians in response to early signals of potential problems, but they have limited ability to induce action and may lead to “alert fatigue.”
- Inclusion of an interprofessional team (medicine, nursing, pharmacy, dietary) to coordinate management and ensuring inter-team communication (between medical/surgical services as well as with ancillary services) is an important mechanism to identify issues and prevent poor outcomes from conditions that are usually easily to reverse.

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