EMERGENCY MEDICINE ALERT

An essential monthly update of developments in emergency medicine

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INSIDE

DKA Management: Is the Blood Gas Necessary?

ABSTRACT & COMMENTARY

Source: Ma OJ, et al. Arterial blood gas results rarely influence emergency physician management of patients with suspected diabetic ketoacidosis. *Acad Emerg Med* 2003;10:836-841.

THE PRIMARY OBJECTIVE OF THIS PROSPECTIVE OBSERVATIONAL study was to test the hypothesis that arterial blood gas (ABG) results for patients with diabetic ketoacidosis (DKA) do not influence emergency physicians' decisions regarding final diagnosis, treatment, and final disposition of patients. An additional aim was to assess the correlation between venous pH and arterial pH values in the emergency department (ED).

Patient inclusion criteria were capillary blood glucose equal to or greater than 200mg/dL; ketonuria; and clinical signs and symptoms of DKA. The protocol dictated that electrolytes, ABGs, and venous pH samples be drawn either simultaneously or within 30 minutes of each other and before intravenous (IV) fluid or insulin administration. Attending emergency physicians indicated planned management and disposition on a standardized form before and after reviewing ABG and venous pH results.

The results of the ABGs changed the emergency physicians' final diagnosis in two of the 200 cases (1.0%; 95% CI = 0.3-3.6%), altered treatment in seven of 200 cases (3.5%; 95% CI = 1.7-7.1%), and changed the final patient disposition in two of 200 cases (1.0%; 95% CI = 0.3-3.6%). Venous pH correlated well with arterial pH results (r = 0.951) and bias plotting yielded a value of -0.015 (± 0.006 pH units). The authors concluded that ABG results rarely influenced emergency physicians' decisions on diagnosis, treatment, or disposition in suspected DKA patients.

COMMENTARY BY STEPHANIE B. ABBUHL, MD, FACEP

In truth, one could conclude that neither the ABG nor the venous gas altered the major decision-making in these patients. This hould come as no surprise, given that an appropriate interpretation of the anion gap usually is an excellent indicator of the degree of

metabolic acidosis and can guide the major decisions in initial management. In addition, there has been mounting evidence that bicarbonate use may be detrimental in DKA regardless of the pH, and therefore, one would not suspect that pH results would have an impact on this potential aspect of treatment. (No one in this study received bicarbonate.) In five of the six cases in which the pH dictated a change in decision-making, the change was in the route of insulin administration (IV to subcuticular, or vice versa). In only two cases was there a change in decision-making based on either the PO_2 or the PCO_2.

An important caveat in reviewing this study is that only 48 of the 200 suspected DKA patients (24%) act ally fulfilled the diagnosis of DKA as defined by the American Diabetes Association (i.e., having a pH of less than 7.30, serum bicarbonate of less than 15 mmol/L, serum glucose greater than 250 mg/dL, ketonuria, and an anion gap of greater than 10 mmol/L^2). It appears that most of the patients in this study had mild or early DKA, and this would not necessarily be the group in which either ABG or venous gas data would be expected to offer additional significant information. The study only was powered to detect a 10% difference in management decisions, and so the possibility exists that a larger study might find a greater difference.

Despite these potential limitations, we now have additional evidence to support the management of many DKA patients without ABGs, and often without venous gases. When the emergency physician feels that pH data may change decision-making, a venous gas is the appropriate test unless there are reasons to suspect that precise oxygenation measurement is needed (rarely) or that ventilation may be compromised, usually by coexisting cardiopulmonary illnesses; in those cases, an ABG could be helpful in a small number of patients. ❖

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Pediatric Cyclic Antidepressant Ingestions: When Is It Safe to Stay Home?

ABSTRACT & COMMENTARY

Source: Spiller HA, et al. Use of dosage as a triage guideline for unintentional cyclic antidepressant (UCA) ingestions in children. *Am J Emerg Med* 2003;21:422-424.

Cyclic antidepressant (CA) poisoning has significant potential for life-threatening complications, most notably malignant dysrhythmia, obtundation, and seizure. In adults, overdose frequently is intentional and the amount ingested may be unclear. Children often present with unintentional, single-drug ingestions, where pill counts or witnessed events may allow for a firm estimate of the amount ingested. Spiller and colleagues sought to evaluate outcomes relative to amount of CA ingested, using toxicology center data in a case series format.

Children 6 years of age or younger who had ingested an identified amount of CA and for whom there was telephone follow-up that established a known outcome were included; children with polydrug ingestions were excluded. Ingested CA agents included amitriptyline (53%), imipramine (27%), nortriptyline (10%), doxepin (7%), amoxapine (1%), and clomipramine (1%). Mean subject age was 2.4 years (range 7 months to 6 years) among the 246 subjects included in the study. Outcomes generally were benign, as 75% remained asymptomatic

(185/246) and another 23% (57/246) were judged to have only minor effects. One hundred thirty-six children (55%) were evaluated in an emergency department (ED), while 110 were monitored in the home. Seventy-one percent (96/136) of those seen in the ED had ingested less than 5 mg/kg of CA; the majority of those were asymptomatic (74/96, 77%), whereas the other 22 had minor symptoms at most. However, nearly two-thirds of the asymptomatic ED group and roughly the same proportion of the minor symptom ED group had been given activated charcoal. Looking at those children managed at home, 22% (24/110) were reported to be drowsy at worst, while the remaining children (78%, 86/110) were asymptomatic.

Using a 5 mg/kg threshold that has some literature support,[1] the authors found that 75% (43/57) of patients with minor symptoms reported an ingestion less than 5 mg/kg. Only four patients had ingestions exceeding the 5 mg/kg criterion, with half having a moderate effect and the other half having a major effect outcome. There were no fatalities. The authors concluded that home monitoring might be appropriate in children age 6 years or younger with known unintentional CA ingestions totaling 5 mg/kg or less.

COMMENTARY BY RICHARD A. HARRIGAN, MD, FAAEM

It would be helpful to have a reliable numerical dividing line with CA ingestions; it could serve as a triage tool for poison centers, much like the 150 mg/kg threshold in acute pediatric acetaminophen ingestions (healthy, non-fasting children). At first pass, I was wary of lumping all these CA agents together under one 5 mg/kg umbrella; unlike acetaminophen, these are different drugs that share chemical structural similarity. However, the agents in this study appear to be of equivalent potencies after reviewing the dosage ranges published in the Physicians' Desk Reference. While this paper seems to tell us that those patients who ingest less than 5 mg/kg do well, its observational nature by design allowed some patients to receive activated charcoal while others did not. Furthermore, only four patients had moderate or major effects (outcomes that are evidently defined by the Toxic Exposure Surveillance System,[2] yet are not defined in the body of the paper), and paradoxically it would be comforting to see more children with serious toxicity—and their mg/kg ingestion calculations—before accepting this threshold. This study really seems to demonstrate that children with CA ingestions who are asymptomatic or exhibit minor symptoms at most generally do well when monitored without aggressive treatment. ❖

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DANAMI-2 Trial: More Comparison of Fibrinolysis vs. Primary PTCA

ABSTRACT & COMMENTARY

Source: Anderson HR, et al. A comparison of coronary angioplasty with fibrinolytic therapy in acute myocardial infarction. The "DANAMI-2" Trial. *N Engl J Med* 2003;349:733-742.

Well-done studies have established that percutaneous transluminal coronary angioplasty (PTCA) is superior to fibrinolytic administration for the reduction of early death (7% vs 9%), non fatal re-infarction (3% vs 7%), or stroke (1% vs 2%), provided that the center where it is performed has expertise with the procedure, and door-to-balloon time can be kept to 90 minutes or less.[1] Overall, when performed by experienced operators at high-volume centers, PTCA is expected to save 20 lives and result in 60 fewer subsequent events for every 1000 patients treated when compared to fibrinolysis. Despite this fact, the majority of patients with acute myocardial infarction (AMI) in the United States receive fibrinolytic therapy, as most hospitals do not have around-the-clock angioplasty capabilities. Fibrinolysis becomes the default treatment regimen at these centers, as there is assumed to be significant risk involved in patient transfer for primary PTCA, given the inherent delays this can represent as well as the assumed risk of transportation during active myocardial infarction.

The DANAMI-2 study is an attempt to definitively answer this question. Anderson and his Danish colleagues randomly assigned 1572 patients presenting with AMI at one of 24 referral hospitals to treatment with either primary PTCA at one of five regional centers or accelerated intravenous alteplase at the referral hospital. They report that these 24 referral hospitals and five regional centers serve approximately 62% of the Danish population. The primary end-point for the study was a composite of death, reinfarction, or disabling stroke at 30 days.

The reported results from the study are impressive. The primary endpoint was reached in 8.5% of the patients transferred for PTCA, vs. 14.2% in the fibrinolysis group (p = 0.0002). Virtually all of the difference in the two groups was driven by the reduction in the rate of reinfarction (6.7% for PTCA, 12.3% for fibrinolytic). There was no significant difference in the overall rate of death or stroke between the two groups. Notably, 96% of patients were transferred within two hours of randomization. Median interval from randomization to start of transport was 50 minutes, and median transport time was 32 minutes. Overall, the median interval from symptom onset to treatment for the fibrinolysis group was 169 minutes (interquartile range 110-270), and 224 minutes for the PTCA group (interquartile range 171-317). Also important to note was the fact that there were no deaths en route. Described events during transport include 14 patients who developed atrial fibrillation, 13 patients who developed advanced atrioventricular block, and eight patients who developed ventricular fibrillation. One patient developed refractory ventricular fibrillation en route, and died one hour after arrival at the regional center.

COMMENTARY BY ANDREW D. PERRON, MD, FACEP

This is an important study that has the potential to impact the everyday practice of our specialty. The authors, as well as an accompanying editorial,[2] advocate a clear change in the "door-to-balloon in 90 minutes or less or else fibrinolysis" algorithm that has become ingrained in our practice. This well-done, randomized study extends this window of opportunity to improve patient outcome beyond 90 minutes, provided that transfer can be accomplished in fewer than two hours. An absolute reduction of 5.7% in a combined end-point of re-infarction, death, and stroke can be achieved, according to these authors, with the adoption of this strategy.

So what are the barriers to implementing this strategy in the United States right now? As always, the devil is in the details. As the authors of the study point out, the study was "designed to minimize all components of delay in treatment." All patients were brought primarily to the coronary care unit (bypassing the ED), where a decision was made and randomization occurred while the transporting ambulance crew waited with the patient. The receiving hospital's angioplasty suite was contacted directly, and the patient was brought directly to that area on arrival. Ideal, yes, but not necessarily real-world. Delay will be compounded in overcrowded EDs, where door-to-triage time, triage-to-bed, bed-to ECG, and ECG-to-physician time all can slow this process. Similarly, over-taxed emergency medical services may have to choose between sending ambulances out of their coverage areas or calling in on-call teams for such transports.

The accompanying editorial to this article asks: "Primary Angioplasty for Acute Myocardial Infarction—Is It Worth the Wait?" This important study concludes that the answer is a strong "yes." What remains to be seen is whether these results can be reproduced in our medical system, which has not been "designed to minimize all components of delay in treatment." ❖

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Special Feature

Community-Acquired Pneumonia

By David J. Karras, MD, FAAEM, FACEP

COMMUNITY-ACQUIRED PNEUMONIA (CAP) DEVELOPS in more than 5 million individuals annually in the United States, one-fifth of whom are hospitalized. While the overall mortality of CAP is 1-5%, mortality among hospitalized patients reaches 12%, underscoring that CAP is a frequent cause of death. Emergency physicians play a critical role in the evaluation and treatment of CAP. Studies suggest that time-to-antibiotic-treatment is an important predictor of outcome for patients with pneumonia, and that the majority of patients remain on the antibiotic started in the emergency department (ED).[1] As emergency physicians, we need to correctly determine which CAP patients require hospitalization, decide which antibiotic is most appropriate, and ensure that therapy is delivered promptly.

Estimates of the frequency of specific pathogens in CAP vary widely, depending on the population studied and the method of identifying the organism. The most common pathogens implicated in healthy individuals are *Streptococcus pneumoniae, Mycoplasma pneumoniae,* and viral organisms, each recovered in 15-40% of CAP cases. No specific organism is recovered in at least one-third of patients, and multiple pathogens are recovered in about 20% of cases.[2] Somewhat less common causes of

CAP in healthy individuals include *Chlamydia pneumoniae* and *Legionella pneumophila,* each responsible for roughly 10-20% of cases. Additional organisms responsible for CAP in smokers are *Haemophilus influenzae* and *Moraxella catarrhalis*. *Staphylococcus aureus* and gram-negative entero-pathogens are uncommon in healthy individuals but are considerations in patients with underlying medical problems.

Determining Disposition

The Pneumonia Patient Outcomes Research Team (PORT) study is a landmark in decision analysis and sets de facto criteria for determining whether inpatient therapy is appropriate for patients with CAP.[3] The authors identified a group at very low risk of CAP-related mortality: adults 50 years of age and younger with no serious underlying illness, a normal mental status, and relatively normal vital signs (pulse < 125 bpm, respiratory rate < 30/min, systolic blood pressure at least 90 mmHg, and temperature 35-40º C). These class I patients had CAP-related mortality less than 0.5% and, concluded the authors, can be treated safely at home.

Patients not meeting class I criteria still may be appropriate for outpatient therapy, but calculating their CAP-related mortality requires use of a fairly complex algorithm and a point scoring system based on co-morbidities, laboratory results, and vital sign abnormalities. The algorithm is contained in the article and the calculations can be performed easily online or with any of several medical software packages.

The Pneumonia PORT study was validated carefully and is employed widely both by health care workers to make admission decisions and by insurers to determine, retrospectively, whether hospitalization was justified. While it's essential that emergency physicians be familiar with the system, it should be recognized that the Pneumonia PORT criteria do not account for exceptional circumstances such as absence of follow-up care, inability to obtain medication, inadequate social support, and other too-common, real-world scenarios. Interestingly, while a low PaO_2 enters into the mortality calculations for patients in higher-risk classes, the authors did not include a low pulse oximetry value as a vital sign abnormality. A patient could therefore meet class I criteria despite a dangerously low oxygen saturation. Given these limitations, the decision whether to admit a patient with CAP still requires that physicians look beyond the algorithm.

Antibiotic Resistance Patterns

Recommendations for antibiotic treatment of CAP in otherwise healthy patients focus largely on the drugs' anti-pneumococcal efficacy. In this country, at least 35% of pneumococcal isolates are penicillin-resistant, about 8% are cephalosporin-resistant, and 10-20% are macrolide-resistant in vitro. Pneumococcal resistance to fluoroquinolones is quite low (about 1% nationally), but there are a few communities in which this rate is greater than 10%.[4] With increasing fluoroquinolone use, the resistance rate inevitably will continue to grow.

While it's tempting to base therapy on antibiotic resistance patterns, it is important to note that there appears to be no link between in vitro pneumococcal resistance and clinical outcomes in CAP.[5] This is in contrast to many diseases, such as with meningococcus, in which there is a strong relationship between drug resistance and treatment failure. While some studies have detected higher mortality in CAP patients with drug-resistant pathogens, these differences have disappeared when the results were controlled for co-morbidities and disease severity. In vitro drug resistance, therefore, does not appear to be an overriding factor in choosing an empiric antibiotic regimen for patients with CAP.

Antibiotic Selection

The Infectious Diseases Society of America (IDSA) and the American Thoracic Society (ATS) regularly issue guidelines for the management of CAP based on presumptive etiology.[6,7] The Sanford Guide to Antimicrobial Therapy is a convenient and widely used reference that addresses empiric CAP treatment, incorporating both the IDSA and ATS guidelines as well as the authors' own expert opinions. Any of these sources is an excellent reference when selecting an antibiotic for patients with CAP.

Patients with CAP first should be stratified according to the presence of significant co-morbidities and the treatment setting—outpatient, general hospital floor, or intensive care unit. Some panels advise obtaining a sputum culture prior to initiating antibiotics, while others forgo this step. For hospitalized patients, most infectious disease specialists would expect that blood cultures be obtained and at least an attempt made at obtaining sputum cultures prior to initiating antibiotics, although not at the risk of delaying therapy.

For otherwise healthy patients with CAP who don't require hospitalization, a macrolide antibiotic or doxycycline is recommended. Gastrointestinal side effects and the prolonged course of therapy may make doxycycline compliance problematic, and macrolides may be more cost-effective in the long run despite their higher initial cost. Fluoroquinolones (other than ciprofloxacin) also are acceptable for treating outpatients. Some experts, however, do not recommend the fluoroquinolones for uncomplicated patients, based on recommendations

from the Centers for Disease Control and Prevention's (CDC) Drug-Resistant *Streptococcus pneumoniae* Therapeutic Working Group.[8] The CDC panel advises restricting fluoroquinolones to limit emergence of drug-resistant pneumococci, and suggests that this class of antibiotics be used only in patients who have failed other regimens, who are allergic to alternatives, or who have documented infections with highly resistant organisms. That being said, the "respiratory fluoroquinolones" are widely used and highly effective for treating CAP in otherwise healthy patients.

More aggressive therapy may be warranted for outpatients with underlying medical problems, and some experts advise adding an oral beta-lactam if macrolides are chosen (or using a fluoroquinolone for monotherapy). Similarly, hospitalized patients with CAP can be treated with a macrolide plus a third-generation cephalosporin or a fluoroquinolone alone—although some advise adding a third-generation cephalosporin to the fluoroquinolone, as well. Ampicillin-sulbactam plus a macrolide or doxycycline also is acceptable for uncomplicated inpatients.[9] While IV therapy is no more effective than oral therapy for a patient with a working gastrointestinal tract, most hospitalized patients will receive IV therapy, either out of tradition or to justify the need for hospitalization.

Finally, for critically ill inpatients, all expert groups advise a two-drug regimen with either a third-generation cephalosporin or ampicillin-sulbactam added to either a fluoroquinolone or macrolide. This provides enhanced activity also against gram-negative enteric pathogens as well as antibiotic-resistance pneumococcus. ❖

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CME Objectives

To help physicians:

- Summarize the most recent significant emergency medicine-related studies;
- Discuss up-to-date information on all aspects of emergency medicine, including new drugs, techniques, equipment, trials, studies, books, teaching aids, and other information pertinent to emergency department care; and
- Evaluate the credibility of published data and recommendations.

Physician CME Questions

30. Children younger than 6 years of age who ingest a known amount of cyclic antidepressant:

a. generally do well if they are asymptomatic or mildly symptomatic, and ingest less than 5 mg/kg.
b. have a 20% mortality rate if they ingest more than 5 mg/kg.
c. safely can be managed at home if they have only one seizure.
d. should receive prophylactic orotracheal intubation if they ingest more than 5 mg/kg.

31. Which of the following statements about the use of ABGs in the management of DKA is *not* true?

a. Venous pH correlates extremely well with arterial pH.

CME Instructions

Physicians participate in this continuing medical education program by reading the article, using the provided references for further research, and studying the questions at the end of the article. Participants should select what they believe to be the correct answers, then refer to the list of correct answers to test their knowledge.

To clarify confusion surrounding any questions answered incorrectly, please consult the source material. After completing this activity, *you must complete the evaluation form that will be provided at the end of the semester and return it in the reply envelope provided to receive a certificate of completion.* When your evaluation is received, a certificate will be mailed to you.

b. The pH was the most common value on the ABG that led to a change in decision-making.
c. When the pH data changed decision-making, the most common change was the administration of bicarbonate.
d. The PO_2 and PCO_2 led to a change in decision making in two of the 200 study patients, or 1%.

32. The DANAMI-2 trial suggests which of the following?
a. Fibrinolysis leads to higher hemorrhagic stroke rates than primary PTCA in males only.
b. Primary PTCA maintains its advantage over fibrinolysis beyond the traditional 90-minute window.
c. Primary PTCA outperforms fibrinolysis only in anterior myocardial infarction.
d. Fibrinolysis and primary PTCA are equivalent in re-infarction rates at 30 days.

33. Fibrinolysis becomes the default treatment regimen for myocardial infarction at most hospitals because:
a. there is an assumed risk involved in the delays inherent in the transfer of patients for primary PTCA.
b. there is an assumed risk of transportation during active myocardial infarction.
c. most hospitals do not have around-the-clock angioplasty capabilities.
d. All of the above

34. Which of the following antibiotics is *not* acceptable as outpatient monotherapy for an otherwise healthy person with pneumonia?
a. A macrolide
b. Levofloxacin
c. Amoxicillin
d. Doxycyline

35. Which of the following is true regarding community-acquired pneumonia?
a. Hospitalized patients should be given a second antibiotic only if a resistant pathogen is verified on laboratory analysis.
b. Antibiotic efficacy correlates strongly with in vitro sensitivity.
c. Fluoroquinolones are effective single agents in critically ill patients.
d. The Centers for Disease Control and Prevention suggests avoiding fluoroquinolones in most healthy patients.

36. Regarding community-acquired pneumonia, *Staphylococcus aureus* and Gram-negative entero-pathogens are uncommon in healthy individuals but are considerations in patients with underlying medical problems.
a. True
b. False

Answer Key

30. a
31. c
32. b
33. d
34. c
35. d
36. a

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g. Total Distribution *(Sum of 15c and 15f)*			431	429
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PS Form **3526**, September 1999 *(Reverse)*

A Harbinger of Tachycardia

By Ken Grauer, MD

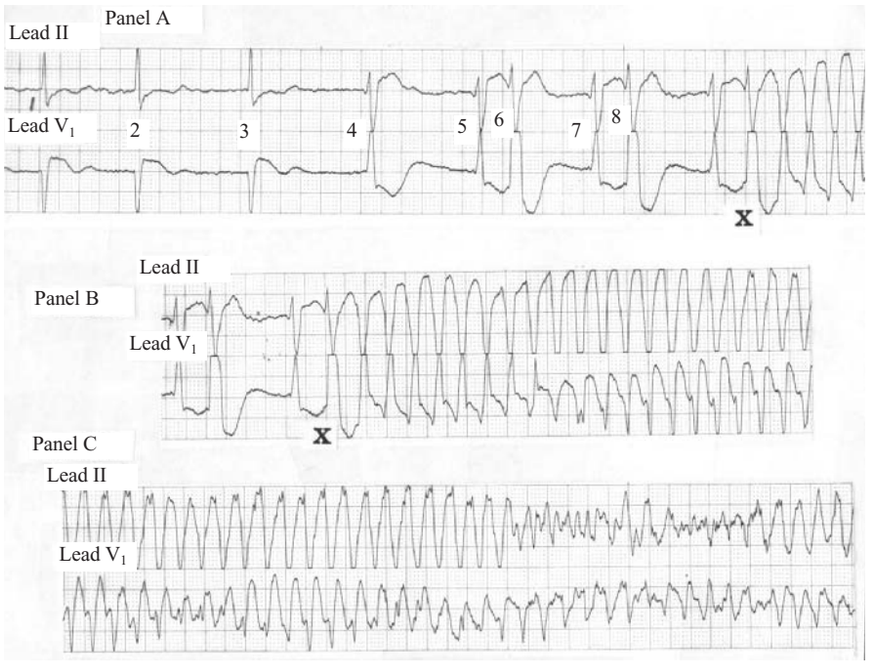

Figure. Series of consecutive rhythm strips obtained from an older woman on multiple medications.

Clinical Scenario: The series of consecutive rhythm strips shown in Panels A, B, and C of the Figure were obtained from an elderly woman on multiple medications including digoxin. She was admitted to the hospital for decreased level of consciousness and recent MI. Are events leading up to the tachycardia that begins with beat X what you would expect? How would you treat this patient?

Interpretation: The rhythm in Panel A begins with atrial fibrillation and a slow ventricular response for the first three beats on the tracing. QRS morphology changes with beat four that looks to be the beginning of a short run of accelerated idioventricular rhythm (AIVR). AIVR is punctuated by several premature ventricular beats from a different focus (beats six and eight) before the onset of the tachycardia that starts with beat X. Thereafter follows an extremely rapid rhythm with changing QRS morphology. This is torsades de pointes. As implied by its name ("twisting of the points"), widened QRS complexes with alternating polarity (initially positive in lead V_1—then negative—then rapidly alternating) persist for the rest of the rhythm strip sequence.

Torsades de pointes often (though not invariably) is associated with a prolonged QT interval on the patient's baseline 12-lead ECG. Nonspecific ST-T wave flattening in lead II of Panel A during the patient's spontaneous rhythm (beats one, two, and three) precludes accurate determination of the QT interval. Uncertainty about where the T wave ends in lead V_1 precludes use of this lead for QT determination, such that without access to a baseline 12-lead ECG tracing, no comment can be made as to whether the QT interval is prolonged. Not commonly appreciated is the precipitating role of preceding bradycardia for initiating episodes of torsades (preceding bradycardia prolongs the subsequent repolarization period and QT interval, and may be contributing to development of torsades in this case).

The key measures for treating torsades include: 1) finding and correcting a precipitating cause whenever possible (e.g., hypokalemia or use of a medication that might further lengthen the QT interval); and 2) administration of magnesium sulfate, often in high dose (1-2 grams IV, which may be repeated several times or given by continuous IV infusion). Magnesium remains the medical treatment of choice for torsades, regardless of whether the patient has pre-existing hypomagnesemia. Overdrive pacing may also be considered if there is no response to repeated magnesium. Finally, while recognizing that torsades is not a common manifestation of digoxin toxicity, this medication should clearly be stopped in a patient with this tachyarrhythmia. ❖

In Future Issues:

The Right Thermometer for Tiny Infants