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Predicting Morbidity and Mortality in Asthma

ABSTRACT & COMMENTARY

Source: Magadle R, et al. The risk of hospitalization and near-fatal and fatal asthma in relation to the perception of dyspnea. *Chest* 2002;121:329-333.

THE PURPOSE OF THIS STUDY WAS TO MEASURE THE PERCEPTION OF dyspnea (POD) in patients with asthma and to relate POD with life-threatening attacks within a 24-month period of follow-up. The authors hypothesized that low POD would identify patients at risk for fatal or near-fatal asthma attacks. Study subjects consisted of 113 patients with stable asthma referred to an outpatient asthma clinic by their primary physician. To measure POD, subjects breathed against a progressive load at one-minute intervals to achieve mouth pressures of 0, 5, 10, 20, and 30 cm H_2O. The subjects rated the sensation of difficulty (SD) in breathing using a linear scale from 0 (none) to 10 (maximal). Normal POD was defined as a mean ± SD of 100 age and sex-matched normal subjects. Pre-bronchodilator morning peak expiratory flow rate (PEFR), daily regular treatment, and beta 2-agonist consumption were recorded in a diary for the first four weeks.

Compared to normal patients, 17 patients (15%) had a high POD, 67 patients (59%) had POD within the normal range, and 29 patients (26%) had a low POD. In the patients with low POD, there was a tendency for older age, higher female/male ratio, and a longer duration of disease. The mean daily beta 2-agonist consumption in the low-POD group was significantly lower ($p < 0.01$) than in the patients with high POD, although the mean PEFR was lower in the low-POD group. During the two years of follow-up, when compared to the normal-POD and high-POD groups, respectively, the patients in the low-POD group had statistically significantly more emergency department (ED) visits ($p < 0.001$ and $p < 0.01$), hospitalizations ($p < 0.001$ and $p < 0.001$), near-fatal asthma attacks ($p < 0.001$ and $p < 0.001$), and deaths ($p < 0.001$ and $p < 0.001$).

COMMENTARY BY STEPHANIE B. ABBUHL, MD, FACEP

The prevalence of asthma has increased dramatically during the past 30 years, now affecting almost 8% of the U.S. population. There

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are more than 550,000 deaths from asthma each year.[1,2] Although predicting which patients will have fatal or near-fatal asthma attacks is likely to continue to involve multiple factors, this study suggests that reduced POD may be one of several factors that predispose patients to a life-threatening attack.

While this study is not without methodologic flaws, the conclusion appears sound and complements previous work done in 1994.[3] In the 1994 study, patients with near-fatal asthma were compared to patients who had asthma of similar severity but no history of near-fatal attacks, and were found to have a decreased perception of dyspnea when breathing through tubes with increasing resistance. In a prospective design, the Magadle study has shown that reduced POD patients go on to have significantly more life-threatening episodes than normal- or high-POD patients.

The authors use their data to conclude that measurement of POD should be performed at least once in all asthma patients, to identify those at high risk for a fatal attack. Although one wonders if that would be feasible, the message for emergency physicians is more straightforward. Reliance on a patient's perception of the severity of his or her shortness of breath is fraught with difficulty and we need to continue to make treatment and admission decisions based on the National Institutes of Health guidelines, which include: peak flows; history of prior steroid use, ED visits, hospitalizations, and intubations; medication use over the course of the flare; medical or psychiatric comorbidity; access to medical care; home conditions, and other factors.[4] ❖

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Cooling after Cardiac Arrest: Conclusively Favorable, or Equivocally Studied?

ABSTRACT & COMMENTARY

Abstract 1

Source: The Hypothermia after Cardiac Arrest Study Group. Mild Therapeutic Hypothermia to Improve the Neurologic Outcome after Cardiac Arrest. *N Engl J Med* 2002;346: 549-556.

LABORATORY STUDIES SUGGEST THAT HYPOTHERMIA induced shortly after the restoration of spontaneous circulation may improve neurologic outcome. Conclusive human studies are lacking. This study originates in Austria from attempts to determine whether mild, systemic hypothermia increases the rate of neurologic recovery after resuscitation from cardiac arrest due to ventricular fibrillation. The study was a multi-center trial with blinded assessment of the outcome of patients who had been resuscitated after cardiac arrest due to ventricular fibrillation. These patients were randomly assigned to undergo therapeutic hypothermia (target temperature, 32°-34°C, measured in the bladder) over a period of 24 hours or to receive standard treatment without hypothermia.

The authors state that both groups received similar

intensive care treatment based on standard critical care protocols. Despite random assignation, 19% of patients in the control group had diabetes vs. 8% in the hypothermia group; and 43% of the control group had coronary artery disease, compared to 32% of the hypothermia group. The hypothermia group also received intravenous fentanyl, midazolam, and pancuronium during the hypothermia phase, but no mention is made of a similar drip for the control group. The primary end point was a favorable neurologic outcome within six months of cardiac arrest; secondary end points were mortality within six months and the rate of complications within seven days. Six-month neurological recovery was better in the hypothermia group. Seventy-five of the 136 patients in the hypothermia group (55%) had a favorable neurologic outcome, compared with 54 of 137 (39%) in the normothermia group (risk ratio [RR], 1.40; 95% confidence interval [CI], 1.08-1.81). Mortality at six months was 41% in the hypothermia group (56 of 137 patients died), as compared with 55% in the normothermia group (76 of 138 patients; RR, 0.74; 95% CI, 0.58-0.95). The complication rate did not differ significantly between the two groups. In patients who successfully have been resuscitated after cardiac arrest due to ventricular fibrillation, therapeutic mild hypothermia increased the rate of a favorable neurologic outcome and reduced mortality.

Abstract 2

Source: Bernard SA, et al. Treatment of comatose survivors of out-of-hospital cardiac arrest with induced hypothermia. *N Engl J Med* 2002;346:557-563.

This Australian study used a randomized, controlled trial to compare the effects of moderate hypothermia and normothermia in patients who remained unconscious after resuscitation from out-of-hospital cardiac arrest. Randomly assigned study subjects were treated with hypothermia (with the core body temperature reduced to 33°C within two hours after the return of spontaneous circulation and maintained at that temperature for 12 hours), or normothermia. The primary outcome measure was survival to hospital discharge with sufficiently good neurologic function to be discharged to home or to a rehabilitation facility.

The demographic characteristics of the 77 patients in the study were similar in the both groups. Twenty-one of the 43 patients treated with hypothermia (49%) survived and were discharged home or to a rehabilitation facility. In comparison, nine of the 34 treated with normothermia (26%) achieved the same end point. This difference was statistically significant, although not robustly so ($p = 0.046$). Interestingly, the normothermia group died more often (23 of 34, or 68%) when compared to the hypothermia group (22 of 43, or 51%). The authors performed an adjustment for base-line differences in age and time from collapse to the return of spontaneous circulation and determined that the odds ratio for a good outcome with hypothermia as compared with normothermia was 5.25 (95% CI, 1.47-18.76; $P = 0.011$). Hypothermia was associated with a lower cardiac index, higher systemic vascular resistance, and hyperglycemia. There was no difference in the frequency of adverse events. The authors conclude that treatment with moderate hypothermia appears to improve outcomes in patients with coma after resuscitation from out-of-hospital cardiac arrest.

COMMENTARY BY RICHARD J. HAMILTON, MD, FAAEM, ABMT

Previous studies have found induced hypothermia to have no protective effect in acute brain injury, leading to prolonged hospital stays and complications.[1] These two new studies examine this novel therapy for a protective neurologic effect in cardiac arrest. The Austrian study follows the authors' earlier publication of a successful feasibility study.[2] The results of both of these studies seem to indicate that hypothermia protects the cerebral circulation, and this very well may be the case. However, the first study is too flawed to provide conclusive support to that theory. First of all, many more of the patients in the control group had diabetes and coronary artery disease—apparently despite the randomization. The morbidity and mortality associated with these conditions could account for the outcome difference. Second, if hypothermia preserves central nervous system function, I would expect an improvement in neurologic outcome early in the patient's course—within a week, rather than within six months.

The Australian study does a better job of controlling demographic variables, although there were more women in the treatment group. The study found a difference in a rather soft end point—discharge to home or rehabilitation center. In fact, the normothermia group died more often than the hypothermia group. This may have less to do with neurologic outcome and more to do with a positive cardiologic benefit. In other words, could the elevated systemic vascular resistance and lower cardiac index have had a salutary effect on cardiac survival? Only further study will tell.

It's my opinion that hypothermia may have some benefit, but it may not necessarily be due to the lowered temperature. The authors are to be commended on a tremendous effort to bring this study to fruition through the institutional review process and coordinating the efforts of so many practitioners. Both groups have identified the limitations in their studies, and their effort may help us understand the effect of hypothermia, who benefits from this intervention, and why. ❖

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Evaluation of Apparent Life-Threatening Events

ABSTRACT & COMMENTARY

Source: Davies F, Gupta R. Apparent life threatening events in infants presenting to an emergency department. *Emerg Med J* 2002;19:11-16.

APPARENT LIFE-THREATENING EVENTS (ALTE) frighten us all. These episodes are defined as alarming events involving apnea, color change, alteration in muscle tone, choking, or gagging. Infants frequently are seen in the emergency department (ED) after "spells" of turning blue, breath-holding, or going limp. Parents understandably are concerned, especially after publicity about sudden infant death syndome (SIDS). Since most infants are completely normal by the time of arrival in the ED, what must the attending physician ascertain in evaluating the episode? What tests are appropriate? What are the chances of recurrence or worsening? How can the parents be comforted?

To better understand the optimal evaluation and long-term outcomes of ALTEs, Davies and Gupta studied 65 infants younger than 1 year of age seen over a 12-month period in 1997. All were admitted after evaluation of ALTEs in a London ED that sees 67,000 children annually. Cases of febrile convulsions were excluded. Each infant underwent detailed evaluation by parental questionnaire, physical examination, and extensive in-hospital testing: complete blood count (CBC); chemistry panel; urinalysis with culture; urine drug screen; levels of lactate, ammonia, amino acids, and reducing substances; nasal swab for pertussis and respiratory syncytial virus (RSV); chest film; electrocardiogram (ECG); and radioisotope milk scan for gastroesophageal reflux disease (GERD). All infants were followed after hospital discharge for six months to three years. Median age was 7 weeks; 67% were younger than 10 weeks of age. Cases were distributed evenly throughout the study year.

The most frequent symptoms by questionnaire and clinical evaluation were cyanosis (71%), apnea (70%), breathing difficulty (62%), pallor (51%), stiffness (46%), floppiness (43%), choking (35%), red face (29%), limb jerking (22%), and vomiting (18%). Duration greater than 60 seconds occurred in 43%. Minor stimulation was successful in 60% and vigorous stimulation in 11%. Two infants were treated with mouth-to-mouth resuscitation, two required bag-mask ventilation, and one was intubated. None had cardiac compressions. Fifty-four percent had normal clinical evaluation in the ED. White blood cell count was greater than 12,000 in 33%; elevated lactate (> 3 mmol/L) was found in 15%. Only three had oxygen saturation less than 95%—one case each of bronchiolitis, pertussis, and bronchitis with patent ductus arteriosus (PDA). After exhaustive evaluation in the hospital, final diagnoses included GERD (25%); unknown (23%); lower respiratory tract infection (LRTI) (9%); seizure (9%); pertussis (9%); urinary tract infection (8%); factitious/Munchausen's-by-proxy (3%); and one case each of RSV, hypocalcemia, brain tumor, opiate intoxication from cough syrup, laryngomalacia, paroxysmal atrial tachycardia (heart rate 240 beats/min), PDA, and gastroenteritis.

Of all cases, 88% experienced only one ALTE, while eight (12%) had recurrent episodes. Infants older than 2 months of age were more likely to suffer recurrence (risk ratio [RR] = 2.87; p = 0.009) than were infants with abnormal findings on initial clinical examination (RR = 3.8). Of infants younger than 2 months of age, normal clinical evaluation in the ED, and lactate level less than 2 mmol/L, none had recurrent ALTE or a definitive diagnosis. No infants died during the three-year follow-up period.

COMMENTARY BY MICHAEL FELZ, MD

The authors conclude that ALTEs in infants are usually single episodes and unassociated with serious underlying disorders. They recommend mandatory inpatient observation, to allow expanded evaluation for definitive etiologies and for parental reassurance. They cite nine earlier studies, one of which is their own, to compare the range of ALTE diagnoses from the worldwide literature involving 4966 infants from 1982 to present. These studies reveal frequencies of GERD (18-62%), unknown (15-51%), LRTI (4-7%), and seizure (2.5-9%) remarkably similar to those observed in the current study, and confirm the rarity of other disorders (e.g., airway, arrhythmia, congenital heart disease, drug effect, central nervous system mass, and electrolyte disorder) and death (0-2%).

I find these data most helpful. ALTEs provoke anxiety in families of victims, prehospital personnel, and in ED personnel. Yet the triad of age younger than 2 months, normal initial clinical assessment in the ED, and low lactate level proved most reassuring. It was noteworthy that GERD accounts for more than 25% of cases in most studies, outranking infectious etiologies and seizures. The rarity of death, including SIDS, is further emphasized.

The authors provide an evidence-based algorithm for

evaluation of the first ALTE in infants. I would suggest that ED physicians, as well as nonspecialists caring for infants, be reminded that most ALTEs are innocent, solitary episodes due to unknown causes or treatable conditions such as GERD and LRTI. Seizures, sepsis, RSV, and pertussis are rare, but must not be forgotten. Periodic breathing, with 12-15 seconds of apnea, is normal in healthy infants up to three months of age and is not to be confused with an ALTE. Finally, some parents would benefit from cardiopulmonary resuscitation (CPR) training for personal reassurance and for the possibility of recurrent ALTEs. ❖

Victims of Torso GSW Deserve Trauma Team Care

ABSTRACT & COMMENTARY

Source: Sava J. All patients with truncal gunshot wounds deserve trauma team activation. *J Trauma* 2002;52:276-279.

THE PURPOSE OF THE STUDY WAS TO VALIDATE recently revised American College of Surgeons standards for trauma team activation.[1] These new criteria add penetrating torso trauma (regardless of field vital signs) to traditionally cited physiologic variables. Eight and one-half years of registry data from two busy inner city Level I trauma centers (Los Angeles County and University of Southern California Medical Centers) with more than 7000 annual admissions were reviewed—4128 patients with gunshot wounds (GSW) to the chest, back, flank, abdomen, and pelvis formed the cohort for study. Traditional trauma team activation criteria (TTAC) included: unresponsiveness to painful stimuli, systolic blood pressure less than 90 mmHg, heart rate greater than 120 bpm, and physician judgment. Patients were identified as either meeting or not meeting these criteria on admission. Severe injury was defined as death, intensive care unit (ICU) admission, non-orthopedic operation within 24 hours of admission, or injury severity score (ISS) greater than 15.

Sixty-one percent of patients with traditional TTAC met the definition of severe injury, as did 46% of patients without them. The mortality among patients with TTAC was 17%, compared with 1% in patients not meeting TTAC. Thirteen percent of patients with TTAC were admitted to the ICU and 41% required surgery, compared with 9% and 29%, respectively, in the group without TTAC. Notably, 21% of the non-TTAC patients had an ISS of 15 or greater.

COMMENTARY BY MICHAEL A. GIBBS, MD, FACEP

Emergency physicians are under constant pressure to deliver better care to more patients for less. The acute management of severely injured patients puts a tremendous drain on our very limited resources in terms of personnel, time, space, and equipment. Although we may be tempted to streamline care delivery to conserve, this should never come at the expense of good patient care.

This study reminds us of two simple facts: 1) patients shot in the torso often are critically ill; and 2) many of these patients are at substantial risk for death, ICU admission, early surgery, and high ISS, despite "normal" prehospital vital signs. The authors recommend including a history of torso GSW as an independent criterion for trauma team activation, regardless of field vitals signs. I strongly agree. An "abbreviated" trauma response may be perfectly reasonable in many injured patients, but not in this situation. Let us put our precious resources where they belong. ❖

Reference

1. ACS Committee on Trauma. Revisions to: Resources for optimal care of the injured patient: 1999. Chicago: American College of Surgeons; 2000.

Special Feature

Knee Extensor Mechanism Disruptions

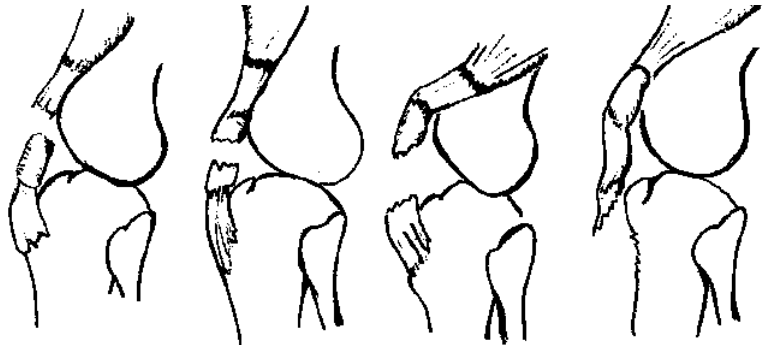
By William J. Brady, MD

THE EXTENSOR MECHANISM DISRUPTIONS INCLUDE rupture of the quadriceps tendon, patellar fracture, patellar tendon rupture, and tendon avulsion at the tibial tubercle;[1-4] the most commonly encountered form of disruption involves rupture of the patellar tendon. *(See Figure 1.)* Extensor mechanism disruption generally occurs as the result of the quadriceps muscle suddenly contracting forcefully against a slightly flexed knee; in fact, biomechanical study has shown that when the knee is slightly flexed the forces across the patellar tendon are maximal. Direct trauma to either the patella or the proximal tibia also may result in extensor mechanism disruption, usually involving a patellar fracture or avulsion of the patellar tendon. Misdiagnosis by the primary care provider has been reported to be as high as 40%. Accurate early diagnosis is essential to ensure the best outcome with early surgical repair and intensive physical therapy.

Quadriceps tendon rupture is more common in

Figure 1

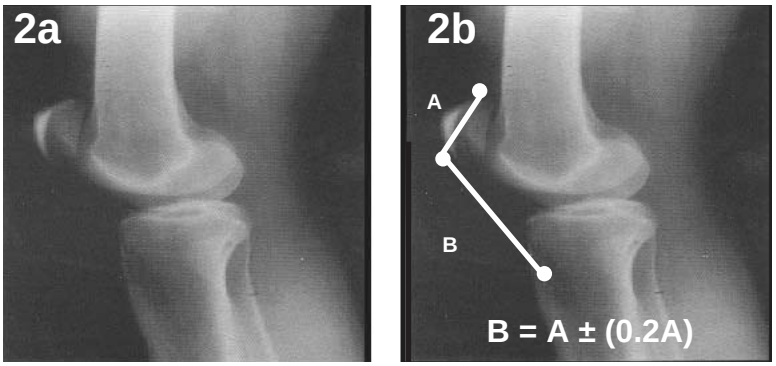
Types of knee extensor mechanism disruption



The four types of knee extensor mechanism disruption (from left to right): Rupture of the quadriceps tendon, fracture of the patella, rupture of the patellar tendon, and avulsion of the tibial tuberosity.

Figure 2

Patella alta in a patient with patellar tendon disruption



2a. Patella alta. **2b**. Patella alta occurs as described in the following equation: B = A ± (0.2A) where B = the distance from the inferior pole of the patella to the superior portion of the tibial tuberosity and A = the distance from the inferior pole of the patella to the superior pole of the patella.

patients with systemic disease, such as chronic renal failure, gout, hyperparathyroidism, diabetes mellitus, and obesity; also, patients with degenerative arthritic changes in the knee are susceptible. Patellar tendon injuries in these patient groups are less common; in general, these patients tend to be younger and less likely to have degenerative disease or systemic illness. Bilateral patellar tendon rupture has been reported and is associated with systemic lupus erythematosus and rheumatoid arthritis.[2] Extensor mechanism disruption has been reported as an unusual complication of Paget's disease; the patellar tendon usually is avulsed from the tibial tubercle in the region of pagetic bone. In other instances, rupture of the tendon often occurs through a pathologic area of the tendon; in fact, several studies have implicated steroid injections and microscopic damage to the tendon's vascular supply as a cause of failure.[5] Ongoing or recent treatment with fluoroquinolone antibiotics also has been associated with tendinopathy and tendon rupture, including the quadriceps tendon.[6]

Clinical Presentation and Diagnostic Approach

The clinical presentation of an extensor mechanism disruption generally includes the complaint of acute onset of knee pain with loss of function. The history includes either stumbling or jumping followed by sudden buckling of the knee and extreme pain. The patient usually describes a history with the common theme of forceful axial loading on a partially flexed knee; the inability to extend the knee results in the loss of function. Further, a careful medical history is essential to alert the examiner to associated systemic illnesses. Physical examination may reveal a palpable defect in the quadriceps or patellar tendon. The position of the patella should be assessed. Quadriceps tendon ruptures will present with inferior displacement of the patella (patella baja), proximal ecchymosis, and swelling. Proximal patellar displacement (patella alta), inferior pole tenderness, and swelling indicate patellar tendon rupture. Evaluation of range of motion will reveal markedly depressed active extension at the knee, inability to maintain passive extension against gravity, or complete loss of knee extension. Patients with partial ruptures may have active extension, but it will be markedly weakened.[3,4] Hematoma or hemarthrosis may mask the clinical signs discussed above. In most cases, the diagnosis is made with the inability to extend the knee in the setting of the appropriate mechanism.

Radiographic findings in patients with quadriceps tendon rupture include inferior patellar displacement (patella baja), superior pole boney avulsion fragment, and degenerative spurring of the patella seen on the tangential view (tooth sign). Complete disruption of the patellar tendon will be indicated by superior displacement of the patella and inferior boney avulsion fragment. *(See Figure 2.)* Comparison views may be necessary to diagnose subtle patellar displacement. In cases involving bony injury, either patellar fracture or avulsed bone fragment will be seen on the radiograph. In many cases, the radiograph may be entirely normal; such a finding should not dissuade the clinician from the correct diagnosis.

Additional radiographic imaging may be required, usually after referral to the orthopedic surgeon. The quadriceps and patellar tendons are easily visualized using magnetic resonance imaging. Partial tears and tendinosis may be difficult to diagnosis, but complete tears are easily visualized. Patellar fractures, bone bruises, and avulsion of the tibial

tubercle are revealed as changes in marrow signal intensity. MR imaging also is extremely useful in identifying associated meniscal tears and chondromalacia patella. Ultrasound and computed tomography (CT) also have been used to evaluate continuity of the extensor mechanism.[5]

Treatment

Accurate diagnosis of partial or complete patellar tendon ruptures, avulsion fractures of the patella or tibial tubercle, and complete quadriceps tendon tears is essential because best results are obtained with early surgical repair. The primary treatment issue for the emergency physician is accurate diagnosis and timely orthopedic referral. Orthopedic consultation should occur either at the time of injury or within 24 hours of presentation. Knee immobilization with crutch walking should be advised until orthopedic follow-up is accomplished. Ultimate repair involves surgery in most cases.[7] The delay in treatment of a quadriceps tendon tear for 4-6 weeks may result in the tendon being difficult to mobilize. Patients with patellar tendon ruptures that have gone undetected for more than two or more weeks may develop significant proximal retraction of the patella with quadriceps contracture and adhesion.

Most surgical repair techniques are followed by immobilization in a long leg cast in extension for four to six weeks with partial weight bearing using crutches. Intensive physical therapy is prescribed beginning with active flexion and passive extension exercises. Strengthening exercises are advanced as knee flexion returns. Patients return to sporting activities in four to six months, when knee flexion is at least 120° with strength deficits less than 10%.[7] ❖

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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

36. In two years of follow-up, when compared to asthma patients with normal or high perception of dyspnea, asthma patients with low perception of dyspnea were found to have statistically:
a. more ED visits.
b. more hospitalizations.
c. more near-fatal asthma attacks.
d. more deaths.
e. All of the above

37. Hypothermia after cardiac arrest:
a. may improve mortality in victims of gunshot wound to the head.
b. seems to help only in diabetic patients.
c. may be beneficial with respect to neurologic outcome.
d. is most beneficial if induced after 12 hours of normothermia following cardiac arrest.

38. The most frequently identified etiology of ALTE in infants is:
a. sepsis.
b. respiratory infection.
c. GERD.
d. congenital heart disease.

39. Trauma team activation should be employed for victims of torso gunshot wound:
a. regardless of other trauma severity indices.
b. only if hypotension is found on presentation.
c. only if the wound is above the umbilicus.
d. only if an exit wound is not visualized on trauma survey.

40. Patellar tendon rupture is characterized by all of the following *except:*
a. It most often requires surgery.
b. It is a rare form of extensor mechanism disruption.
c. Orthopedic evaluation is necessary at presentation or within 24 hours of presentation.
d. It is a common form of extensor disruption.

41. Quadriceps and patellar tendon rupture have been associated with all of the following *except:*
a. end-stage liver disease.
b. quinolone antibiotic therapy.
c. chronic renal failure.
d. systemic lupus erythematosus.

42. When treating patellar tendon ruptures, avulsion fractures of the patella, or quadriceps tendon tears, best results are obtained when surgical repair is *delayed* at least two weeks.
a. True
b. False

A "Sited" Tachycardia

By Ken Grauer, MD

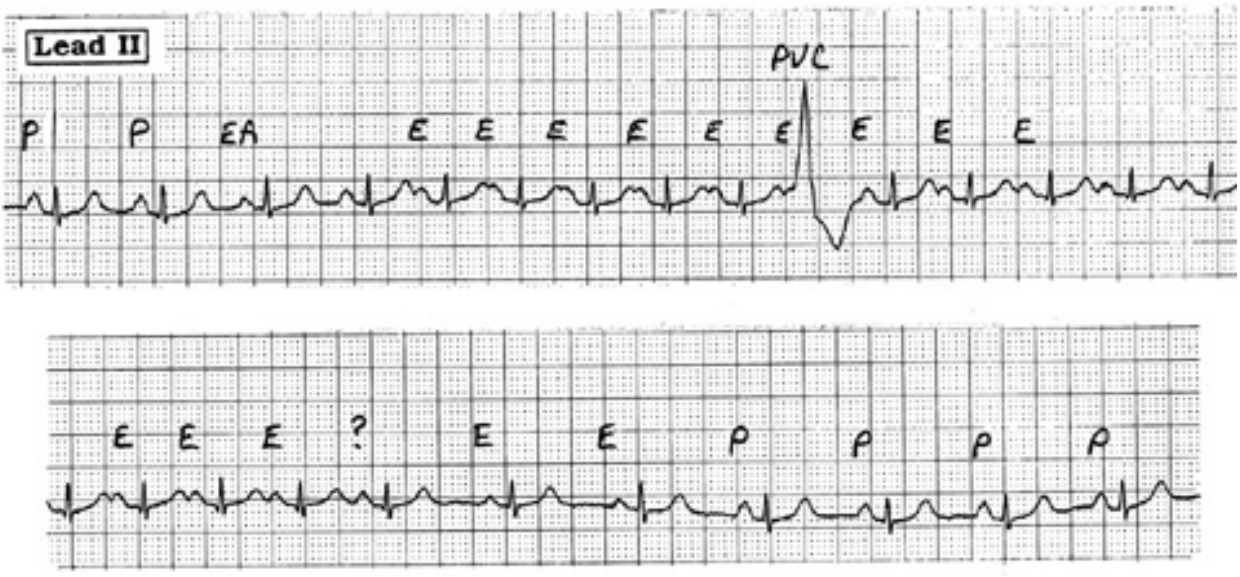

Figure. Telemetry rhythm strips showing the onset and resolution of this patient's tachycardia.

Clinical Scenario: The tachycardia shown in the Figure was obtained from an older woman who presented with shortness of breath and a recent history of "irregular heart beat" episodes. The top strip shows the onset of one such episode, and the bottom strip shows its resolution. What is the probable mechanism of this patient's arrhythmia? Is the premature ventricular contraction (PVC) seen in the top strip supportive of this diagnosis? How might you treat this patient's rhythm disorder?

Interpretation: The underlying rhythm is sinus, as suggested by the two normal beats that initiate the top tracing. P wave morphology changes with the third beat, which most likely arises from an ectopic atrial site (EA). Acceleration of the rhythm follows, with development of a tachycardia that manifests an upright but different (ectopic) appearing P wave (E) compared to the sinus-conducted beats. The rate of the tachycardia is approximately 135 beats/minute, and the occurrence of the PVC does nothing to terminate the episode. Gradual slowing is seen in the bottom strip, with conversion of P wave morphology back to the sinus-initiated (P) focus.

The features described and illustrated in the above tracings are characteristic of an ectopic atrial tachycardia (gradual onset and offset of the rhythm with ectopic P wave morphology). Unlike the overwhelming majority of supraventricular tachycardia (SVT) rhythms in adults that are AV-nodal "dependent," ectopic atrial tachycardia arises from an *ectopic* atrial site that gradually accelerates and is independent of the AV node for its continuation. As a result, neither PVCs nor vagal maneuvers are likely to terminate the rhythm. Treatment consists of correcting the underlying cause (most likely heart failure, pulmonary disease, electrolyte disturbance, or digitalis toxicity); AV nodal-blocking drugs (for rate control); and occasionally, antiarrhythmic agents (to suppress the ectopic atrial site), though the response to such treatment is highly variable. ❖

In Future Issues: Controversies in Pediatric Asthma Management

BIOTERRORISM WATCH
Preparing for and responding to biological, chemical and nuclear disasters

Traumatized health care providers may need stress counseling in horrific aftermath of bioterror attack

A severe test for a mentally tough profession

In a finding that is likely relevant to many other states, a recent tabletop exercise in Columbus, OH, found that the health care system may be better prepared to deal with bioterrorism victims than the traumatized frontline providers who give them care.

The exercise was conducted by the Ohio Senior Interagency Coordinating Group in Columbus.

After running a scenario involving intentional release of pneumonic plague at a rock concert, emergency preparedness officials discovered there was little in place to address the mental health needs of doctors and nurses in the horrific aftermath. In the exercise, an attack with *Yersinia pestis* resulted in 332 fatalities, 720 hospitalizations, and 4,300 people who were examined and released.

"How do you handle all of the nurses and doctors who have seen many, many deaths, who have tried to decrease panic by remaining calm, and who have survived this huge confusion and turmoil?" asks **Kay Ball**, RN, MSA, CNOR, FAAN, a participant in the exercise and perioperative consultant and educator at K & D Medical in Lewis Center, OH. "What about their mental health? That is something that we found that we are weak in. We really have to develop that better."

The hypothetical event began Friday, March 15, when a popular regional band performed at Shawnee State University in Portsmouth, OH. Approximately 2,000 students and community members went to see the band, which is known for its use of smoke and visual enhancements, according to the scenario. **(See tabletop timeline, p. 3.)**

"[The terrorists] aerosolized the agent in a fogging system and that is how it was spread throughout the building." says **Darren Price**, exercise training officer with the state of Ohio Emergency Management Agency in Columbus.

The players take their seats

The exercise had four groups of about nine people, each working at different tables as the events unfolded. The groups were health / medical, law enforcement, fire / emergency medical services, and government. An audience of about 150 people was on hand to observe and evaluate the exercise.

"The whole purpose was to determine our strengths and weaknesses through the disaster that happened," says Ball, who served as facilitator and discussion leader of the health / medical group. "The planning committee will meet and analyze what we learned from this, and then we will bring back everybody who participated."

The scenario was divided into three phases: incubation, response, and recovery. Each phase received about an hour of discussion at the tables, and all players received updated information at the same time. **(See tabletop tips, p. 2.)** The scenario was necessarily arbitrary but designed to

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test the state's resources at many levels, Price notes.

"Anytime, you are dealing with tabletop exercises there are a lot of assumptions and artificialities built in just to make it flow," he says. "We ask [participants] to bring their emergency operations procedures and plans, and to actually react based upon their plan."

While the exercise is still being analyzed, the mental health needs for medical providers became apparent in playing out the scenario. Part of the problem is the historic perception that health care workers must not succumb to the emotional toll of patient care, Ball says.

"Even in surgery today, if we lose a patient on the table, there is nothing really in place to talk about the trauma the practitioners are going through," she says. "We just think that we are these stalwart people and we can't crumble under emotional strains. That was one of the [identified] weaknesses."

In contrast, firefighters and emergency medical service workers had a more thorough stress debriefing process than their hospital-based counterparts.

"Within the hospitals themselves we really don't have the mental and spiritual health that we need," she says.

Moreover, the scenario projected widespread "psychological manifestations" in the affected area, with students withdrawing from school and residents reluctant to return to their homes. Bioterrorism response planners brainstormed about how to fight the problem, including bringing in celebrities and public officials to show it was safe to return to the stricken area.

The scenario included a short delay in determining the etiological agent, with chaos building before plague was confirmed as the infecting pathogen. Even with the new emphasis on bioterror education, that scenario is fairly realistic because so few clinicians have seen infections caused by the potential bioterrorism pathogens.

"The first problem was what kind of a bug was it?" Ball says. "Where do we send the cultures, and how fast can we get them back?

The scenario also had many students leaving on spring break. Given the anticipated exodus of people from the community — particularly into the neighboring states of Kentucky and West Virginia — there was no attempt to set up mass quarantine areas, Price says. Instead the national stockpile of antibiotics was called up and confirmed or suspect cases were treated and isolated.

"We looked at the issue of quarantine and determined it was not really feasible," he says. "You would have these large [quarantine] circles everywhere. We moved more toward isolation [of patients] at that point."

While identifying a weakness in mental health care, the planners found communications were strong between groups, there were no turf battles, and additional resources became available quickly.

"One of the strengths that we found was that we were able to get supplies in and to call in extra people," Ball says. "We were able to pull in lots of people very rapidly. We are learning how to work more with all of the other diverse factions."

Indeed, the exercise was set in a rural area so that resources would be taxed, reaching thresholds that would trigger state response, Price adds.

"We're better prepared today than we were yesterday," he says. ■

Bioterror tips for running a tabletop

Planners of a recent bioterrorism tabletop exercise in Columbus, OH, **(see cover story for more information)** offered the following tips for participants in the exercise:

- The scenario is plausible, and events occur as they are presented.
- There are no hidden agendas or trick questions.
- All players receive information at the same time.
- There is not a "textbook" solution. Varying viewpoints and possible disagreements are anticipated.
- Respond based on your knowledge or current plans and capabilities.
- Current agency or department policies and procedures should not limit discussion and development of key decisions.
- The outcome is neither intended to set precedents or reflect an organization's final position on specific issues.
- Assume cooperation and support from other responders and agencies.
- Speak up! Talk to your colleagues and ask questions. This is your chance to learn how other agencies in your community would respond in an emergency. ■

Dire straits: Plague released at concert

Tabletop scenario from first case to aftermath

Highlights of a recent bioterrorism tabletop exercise run by planners in Ohio **(see cover story for more information)** included the following timeline of events:

Sunday, March 17, 2002, Portsmouth, OH

8:00 a.m.: At the emergency department (ED) of Southern Ohio Medical Center (SOMC), a doctor has just come on duty and sees her first patient, a 22-year-old woman. The patient's sister says the woman has been complaining of chest pain and has a temperature of 102 degrees F. The sister worries that the patient may have caught the "bug" through her position at the Shawnee State University (SSU) dormitory mailroom where she works part time. A rapid flu test shows a negative result.

The physician is suspicious in light of the national anthrax cases five months earlier and orders a sputum and blood culture. Transport assistance is requested for sending the cultures to the Ohio Department of Health (ODH) laboratory for anthrax testing. The woman is admitted. The Portsmouth City Health Department and Scioto County District Board of Health are notified of the situation. In turn, the ODH and Ohio Emergency Management Agency (EMA) duty officer are called.

2:00 p.m.: The 22-year-old woman admitted to SOMC earlier this morning develops severe respiratory complications and dies. A full autopsy is ordered, and the physician awaits the preliminary results of the sputum and blood cultures. As the day progresses, local emergency medical services (EMS) become overwhelmed with patients presenting with flu-like symptoms. People presenting with the most severe symptoms, including high fever and difficulty breathing, are hospitalized; however, with many more sick waiting in the ED, the hospital beds and wards are filling rapidly.

5:00 p.m.: Traffic around SOMC becomes impassible, and several ambulances are severely hindered. Medical facilities request security assistance from local law enforcement agencies.

10:00 p.m.: Six patients admitted during the day with the severe flu-like symptoms also die. New cases continue to arrive at SOMC with an increase in the number of patients reporting each hour.

Monday, March 18

8:00 a.m.: Overnight, a public health emergency was declared in Scioto County. A request was made by Scioto County Health, via the Scioto County EMA and elected officials for state support in the growing crisis.

A Level 2 emergency status is reached in Scioto County. The state assessment room is activated to support the events in Scioto County.

10:00 a.m.: The preliminary tests of clinical specimens taken from the 22-year-old woman who died Sunday are complete. The ODH Lab notifies the local health departments that the specimens have tested negative for *Bacillus anthracis.* The laboratory begins rule-out testing for other pathogens.

3:00 p.m.: Epidemiological evidence points to an event three days earlier as a common activity of the majority of new patients. On Friday, March 15, a popular regional band performed at SSU in Portsmouth. The band is well known for use of visual enhancements. Approximately 2,000 students and community members attended the concert.

4:00 p.m.: Hospital supplies are insufficient to meet demand. Fifteen additional patients have died, and 111 are listed in critical condition. Reports now include similar symptoms among several health care workers and first responders. SOMC hospital beds are full.

5:30 p.m.: ODH Lab staff notifies Scioto County local health officials that the 22-year-old patient's cultures are preliminarily positive for *Yersinia pestis.* Local health officials inform local health care professionals and EMS personnel that, in order to prevent the spread of disease, patients having confirmed pneumonic plague should be isolated until sputum cultures are negative for *Y. pestis* bacilli.

Those suspected of having pneumonic plague should be isolated for 48 hours after antibiotic treatment begins.

Wednesday, March 27

It has been 10 days since the first victims arrived at SOMC and local clinics. There have been no further cases of illness identified in Scioto County in the past seven days.

Waiting for signs of recovery

Resources begin to flow into the area as a result of national public outreach. Visitors, however, avoid the area and the impact of the event on the local economy becomes apparent as local businesses are slow to reopen.

The psychological manifestations associated with this event are widespread. Although school reopens, many students withdraw from classes for the quarter. Local residents, still frightened and shocked, look to local and state officials for guidance as they attempt to return to normalcy. ■

Winds of war: Researchers track airborne anthrax

A strikingly rapid and wide dispersion

Struck by the surprising level of aerosolization after merely opening an envelope, Canadian researchers are now using a spore surrogate to study how airborne anthrax silently spreads within an office building, *Bioterrorism Watch* has learned.

Researchers are using *Bacillus globigii* spores to simulant the movements of *Bacillus anthracis* in a one-story research building at the Defence Research Establishment Suffield (DRES) at the Canadian Forces Base in Suffield, Alberta, says **Kent Harding,** chief scientist at DRES. "We will be looking at movement between actual offices along corridors using the *B. globigii* as a simulant. It is a spore-like material that is a well-accepted simulant used to assess and challenge biological detection apparatus." The DRES is on the cutting edge of bioterrorism research; scientists there were studying the dispersion of anthrax from envelopes prior to Sept. 11 and its aftermath. In response to an anthrax hoax mailing in Canada in February 2001, the DRES conducted a study last year using an 1,800 cubic foot test chamber to represent an office space. "We had a hoax letter in this country that closed down a major federal office building," he says. "We were interested in [determining] had it been a real infectious material in the envelope, what was the extent of the risk? We went to the scientific literature and really didn't find anything."

It was hypothesized that opening an envelope constituted a "passive form of dissemination" that would produce minimum aerosolization of spores unless additional energy was added via panic behavior or strong airflows, the researchers stated.[1]

"Our scenario was in a chamber, which was conducive to studying the movement of materials on air currents." Harding says. "An individual was given a stack of envelopes and told to keep opening them until powder fell out. When that happened, [he or she] stood quietly by the desk and didn't move for 10 minutes. We just looked at the movement of material around the room, just simply as a consequence of opening the envelope and pulling out a piece of standard 8½ by 11 paper folded in three." Almost immediately upon opening the envelope, a significant aerosol concentration was observed in the area of the "desk." It declined slowly over the 10-minute sampling period, but the high-resolution slit sampler plates used to measure the release became densely packed with bacterial colonies. In the study, significant numbers of respirable aerosol particles were released upon opening envelopes containing 0.1 g or 1.0 g of *B. globigii* spores. A potentially deadly dose could be inhaled within seconds of opening an anthrax spore-filled envelope. Also, the aerosol quickly spread throughout the room so that other workers, depending on their exact locations and the directional airflow within the office, would likely inhale doses. There was very heavy contamination on the back and front of clothing worn by the test subject.

"There was a large dose presented to the person opening the envelope, which was not unexpected," Harding says. "But what was surprising was the very rapid and extensive movement around that room simply as consequence of the movement of normal air currents. It distributed around the room very quickly and in fairly high quantity."

The researchers also found that the spores could escape from a sealed envelope, a phenomenon that caught U.S. investigators off-guard during the 2001 attacks. "We did note that in a standard envelope sealed in the usual way — just with licking the glue on the back of — that there are substantial openings on the back of the envelope," he says. "In fact, the 'envelope people' design them that way so you can get a letter opener inside. Spores did escape from those openings, but we never quantified that and never referred to it to anything more than an anecdotal manner."

The Centers for Disease Control and Prevention (CDC) in Atlanta was apparently unaware of the study during the initial stages of the U.S. anthrax attacks. Whether it would have made any difference is impossible to say, though some wonder if it would have resulted in more aggressive treatment of postal workers.[2] Regardless, the CDC decision to administer antibiotics to a broad range of people, not just those in the immediate exposure area, is reinforced by the study, Hawkins says. The Canadian researchers have now fully briefed the CDC about the study and their ongoing research.

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