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Blunt Cardiovascular Injury—TEE vs. CT

ABSTRACT & COMMENTARY

Source: Vignon P, et al. Comparison of multiplane transesophageal echocardiography and contrast-enhanced helical CT in the diagnosis of blunt traumatic cardiovascular injuries. *Anesthesiology* 2001;94:615-622.

The authors prospectively compared the accuracy of transesophageal echocardiography (TEE) and helical computed tomography (CT) in 110 consecutive patients with severe blunt chest trauma (ISS 34 ± 14). High-risk patients were defined by the presence of at least one of the following: 1) history of deceleration; 2) ejection or associated fatality; 3) pedestrian struck by vehicle; 4) external signs of major chest injury; 5) chest trauma requiring mechanical ventilation; 6) unexplained shock; or 7) wide mediastinum on chest x-ray. Studies were obtained in random order and results were interpreted independently. Standard definitions of aortic and cardiac injury were employed.

Seventeen patients (15.5%) had vascular injury, and 11 (10%) had cardiac injury. TEE and CT identified all aortic injuries necessitating surgical repair. One innominate artery injury missed by TEE was detected by CT. TEE detected four intimal lesions missed by CT; these all were managed non-operatively. Cardiac lesions were diagnosed in all but two cases by TEE alone. TEE performed as follows: sensitivity, 93%; negative predictive value, 99%; specificity, 100%; positive predictive value, 100%. CT performance, in contrast, was as follows: sensitivity, 73%; negative predictive value, 95%; specificity, 100%; positive predictive value, 100%.

COMMENT BY MICHAEL A. GIBBS, MD, FACEP

During the last three years, several authors have documented the high accuracy of helical CT in diagnosing blunt aortic injury.[1-3] This is the first study to compare CT to TEE prospectively. In this study, TEE had a greater sensitivity for detecting aortic injury, although the clinical significance of the small intimal lesions missed by CT is unclear. CT imaging detected all aortic injuries requiring surgery. The single-arch vessel injury was missed by TEE and picked up by CT.

These injuries are notoriously difficult to detect and some authors believe that formal angiography is the only method that reliably excludes them.

The ability of TEE to pick up associated cardiac lesions and myocardial dysfunction is a significant advantage of the technology. TEE should be considered when this is suspected clinically. A major benefit of TEE is the ability to perform the test in the unstable patient (e.g., in the emergency department, intensive care unit, or operating room). Finally, TEE is very operator-dependent. The investigators in this study had significant experience; this does not generalize to every hospital. Each test has important advantages and limitations. Good clinical judgment and sound management protocols will help us choose which is the right test, and the two often may be complementary. ❖

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Flying FAST—Can You Keep Up?

ABSTRACT & COMMENTARY

Source: Polk JD, et al. The "Airmedical F.A.S.T." for trauma patients—The initial report of a novel application for sonography. *Aviat Space Environ Med* 2001;72:432-436.

The focused abdominal sonogram for trauma (FAST) has become an important tool for the evaluation of the trauma patient. The authors attempt to determine if the technology is applicable in the environment of helicopter medical evaluation. Two flight surgeons flew on board Sikorsky S-76 medical evacuation helicopters and used a Aloka SSD-500 portable ultrasound unit with a Sony UP 890 MD printer attached. The physicians underwent a one-week didactic course and sufficient clinical exposure at an outside facility with an established program in Emergency Medicine Bedside Ultrasound. The established goal for training was 50 FAST exams with five or more positive studies.

There were 100 patients enrolled in the study. Of those, 16 were excluded—eight for excessive body weight, six for hemodynamic instability requiring the physician to perform other clinical interventions, and two for machine unavailability. Of the 84 studies analyzed, four were penetrating trauma patients. There were 13 true positives and three false negatives, leading to a sensitivity of 81%. True negatives accounted for 68 patients. There were no false positives, giving a specificity of 100%. The negative predictive value was 96%. The accuracy was 96%. CT scan identified all three false-negative exams. One false negative was interpreted as negative both by radiology and the flight surgeon within 15 minutes of injury. The CT later revealed 200-300 mLs of hemoperitoneum. All patients who were too hemodynamically unstable to permit the physician sufficient time to complete a FAST exam had hemoperitoneum. The authors conclude that the FAST exam can be obtained in flight with similar quality and consistency as is currently obtained in the emergency department. They suggest that this technology may challenge traditional algorithms for prehospital care.

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

It was only about 10 years ago that emergency physicians were arguing with anesthesiologists about whether they safely could use paralytic agents for rapid sequence intubation. All the while, flight nurses were paralyzing and intubating patients in the backs of helicopters without the slightest problem. Ultrasound is becoming the next dividing line between the "haves" and the "have nots" in EM. Already, the Residency Review Committee for Emergency Medicine is making ultrasound training a requirement for all programs. Significant numbers of current graduates of EM programs are proficient in ultrasound by virtue of training in this technology and are looking for jobs with a meaningful ultrasound presence in their practice. The portable ultrasound machine is an absolutely perfect match for remote medical care and medical evacuation. Remember the lessons of the past and don't let the future of EM pass you by. ❖

New Treatment for Severe Sepsis on the Horizon

ABSTRACT & COMMENTARY

Source: Bernard GR, et al. Efficacy and safety of recombinant human activated protein C for severe sepsis. *N Engl J Med* 2001;344:699-709.

Severe sepsis with acute organ dysfunction is thought to result from a generalized inflammatory and procoagulant host response to an infection. Endogenous activated protein C is an important modulator of these responses. Reduced levels of protein C are found in the majority of patients with sepsis and are associated with an increased risk of death. This randomized, double-blind, placebo-controlled, phase III trial was conducted to determine whether the administration of recombinant human activated protein C would reduce the rate of death from all causes at 28 days in patients with severe sepsis.

Patients with systemic inflammation and organ failure due to acute infection were enrolled and randomized to receive an intravenous infusion of either placebo or recombinant human activated protein C for 96 hours. Eligibility criteria were extensive, but essentially, patients were included who had known or suspected infection, clinical findings of a predefined systemic inflammatory response syndrome, and one or more organs with sepsis-induced dysfunction. There were numerous exclusion criteria, including, but not limited to: conditions that increase the risk of bleeding, known hypercoagulable conditions, history of a major organ transplantation, chronic renal failure requiring hemodialysis or peritoneal dialysis, cirrhosis, and chronic ascites.

Baseline demographic and severity of disease indicators were similar in the two groups, as were the sites and causes of infection and indicators of coagulation and inflammation. There were 840 patients treated in the placebo group and 850 in the activated protein C group, with 28-day mortality rates of 31% and 25%, respectively (P = 0.005). Treatment with activated protein C was associated with a reduction in the relative risk of death of 19% (95% CI, 6.6-30.5). A consistent reduction in the risk of death in patients treated with activated protein C was noted among subgroups, including the subgroups with protein C deficiency and normal protein C levels. The incidence of serious bleeding was higher in the activated protein C group than in the placebo group (3.5% vs 2.0%; P = 0.06).

COMMENT BY STEPHANIE B. ABBUHL, MD, FACEP

The authors comment in their discussion that, in similar sepsis patients, one life would be saved for every 16 patients treated with activated protein C. Despite that one serious bleeding event could be expected for every 66 patients treated (and most patients with a higher risk of bleeding were excluded), these are rather impressive results. The trial was sponsored by Eli Lilly, but the study design and analysis were well done and the results are promising. There are rumors of probable Food and Drug Administration approval for the as-of-yet-unnamed Lilly drug as early as August 2001. The pharmacy department in our hospital is already concerned about the impact this drug may have on its budget, given expectations that a course of therapy may cost thousands of dollars.

It appears that the biologic activity of activated protein C is at least partly a result of its inhibition of thrombin by inactivating factor Va and VIIIa. This is consistent with the finding that the patients who received the activated protein C had significantly greater decreases in plasma D-dimer levels than the patients who received placebo. Activated protein C also appears to work by decreasing inflammation. This was supported by the finding of significantly decreased interleukin-6 levels in the activated protein C group.

In the near future, there is a good chance we will be treating patients in the emergency department with activated protein C for severe sepsis. Two things will be important for us to consider as we try to decide who to treat with this expensive new drug: First, how much should we (or will we) deviate from the extensive exclusion criteria in the study, and what will the serious bleeding complication rate be in those patients? I suspect it will be significantly higher. Second, how much should we deviate from the inclusion

criteria to treat patients with sepsis that is less than severe? It is interesting to note that at the time of initial treatment, more than 70% of the patients were in shock and 75% were already on mechanical ventilation. It is going to be difficult to make some of these decisions based on the limited data we have and in light of the substantial cost that this new therapy probably will incur. ❖

Meperidine vs. Ketorolac for Biliary Colic

ABSTRACT & COMMENTARY

Source: Dula DJ, et al. A prospective study comparing I.M. ketorolac with I.M. meperidine in the treatment of acute biliary colic. *J Emerg Med* 2001;20:121-124.

To evaluate the potential efficacy of ketorolac (previously untested in biliary colic), Dula and colleagues studied 30 patients in an academic emergency department (ED) in Pennsylvania. All had right upper quadrant pain and tenderness to palpation, with ultrasound-documented gallstones. Patients with fever, narcotic or non-steroidal anti-inflammatory drug (NSAID) allergy, who were on warfarin therapy, or who were pregnant were excluded. Patients were evaluated by means of a 10-point visual analog pain scale before and 30 minutes after injection of analgesia. A global assessment score was completed two hours later at the time of ED discharge, and by telephone follow-up in 7-14 days. Ages ranged from 18 to 65 years (mean = 42). Females comprised 80% of cases. Patients were randomized prospectively in double-blind fashion to either meperidine (MEP) 1.5 mg/kg intramuscular (IM) (maximum dose: 100 mg) or to ketorolac (KET) 60 mg IM.

Average initial pain scores were 7.6 and 7.3 for MEP and KET, respectively. Pain relief score at 30 minutes was reduced to 3.9 for MEP vs. 3.8 for KET (P = 0.96); scores at discharge two hours later were 1.8 for MEP vs. 1.9 for KET (P = 0.79). At 30 minutes, rescue medication (MEP 1 mg/kg) was required for four of 14 patients (29%) in the MEP group vs. two of 16 (12%) in the KET group (P = 0.38). All patients achieved pain relief sufficient for ED discharge. Over a two-week follow-up period, emergency cholecystectomy was required for two patients in each group. The authors conclude that KET is as effective as MEP for pain relief in acute biliary colic.

COMMENT BY MICHAEL FELZ, MD

Each agent reduced pain scores by 50% at 30 minutes and by 70% at two hours, such that no patient required hospital admission. KET was associated with less need for rescue medication than MEP, but not to the level of statistical significance. The authors postulate that NSAIDs such as KET, by blocking cyclooxygenase, inhibit prostaglandins responsible for pain, cystic duct inflammation, and local smooth muscle spasm, and that these properties account for ketorolac's efficacy in biliary colic. In contrast, the pharmacologic properties of opioids such as MEP and morphine involve centrally-mediated analgesia, with central nervous system sedation and spasm of the sphincter of Oddi as possible side effects. To support these claims, Dula and associates cite an earlier series of 60 patients with acute biliary colic in whom another NSAID, diclofenac (Voltaren), not only achieved pain relief in 85% of cases, but also markedly reduced the incidence of cholecystitis, hospitalization, and urgent cholecystectomy. Whether these therapeutic and preventive benefits extend to KET is intriguing but, as yet, unproven. So what is the bottom line? KET is not our newest ED bullet, but perhaps we have a brand new target: symptomatic gallstones. ❖

Special Feature

What's New in Antibiotic Therapy for Acute Otitis Media

By Theodore C. Chan, MD, FACEP

Otitis media (om) is the most frequently diagnosed childhood disease in the United States. Approximately one-half of all infants experience their first OM episode by 6 months of age, and at least 90% of children have one or more bouts by age 2. In 1995, the cost of OM treatment in this country was estimated at $3.8 billion annually.[1,2]

OM can be divided into several classifications. Acute otitis media (AOM) indicates the presence of a middle ear effusion (MEE) with acute inflammation of fewer than three weeks' duration. OM with effusion (OME), previously known as serous, mucoid, nonsuppurative, or secretory OM, is the presence of MEE without signs of acute inflammation. Chronic OM implies a chronic middle ear infection with perforation of the tympanic membrane (TM) that results in drainage. Recurrent OM requires three or more AOM episodes within six months, or four or more within 12 months.

The incidence of AOM has risen markedly in the last two decades. Tympanostomy tube insertion rates have increased four-fold since the 1970s.[2] This dramatic rise is in part due to the growing use of day care for younger children. Other risk factors include: age less than 2 years, male gender, passive tobacco smoke, bottle-feeding, craniofacial abnormalities, and family history. Despite the ubiquity of the disease, current management and treatment of AOM remains controversial. In particular, there is growing debate as to whether antibiotics are indicated and which regimen is most effective.

Are Antibiotics Necessary to Treat AOM?

While viruses are isolated in fewer than one-half of all cases, most episodes of AOM are initially precipitated by viruses.[3] Viral infection of the upper respiratory epithelium leads to inflammation, bacterial colonization, and eustachian tube dysfunction. In turn, these factors cause the formation of MEE, inflammation, and bacterial invasion—all of which which precipitate AOM. As a result, AOM primarily is thought of as a bacterial illness requiring antibiotics. However, bacteria are isolated in only about 70% of cases.[4] Spontaneous resolution occurs in anywhere from 50-80% of cases. As a result, many have questioned the utility of antibiotics.[5] In fact, use of antibiotics varies greatly worldwide. While nearly all U.S. children receive antibiotics, as few as one-third are treated with antibiotics in parts of Europe.[6] Large comparison studies assessing the efficacy of antibiotics suggest only marginal benefit in terms of cure rates and prevention of complications.[6,7] In an analysis of trials involving more than 5400 patients, Rosenfeld reported that seven children would need to be treated in order to prevent one treatment failure.[8] Twenty children would need antibiotics to reduce pain temporarily for one.[9] Moreover, rates of vomiting, diarrhea, rashes, and other side effects are increased markedly.[6]

In many European countries, physicians have adopted a policy of "watchful waiting," in which early therapy is withheld for uncomplicated AOM. If symptoms persist beyond 24-72 hours, or if complications develop, antibiotics are then administered. Antibiotic use has been reduced by nearly two-thirds and there is evidence of decreased bacterial resistance in these regions.[7] While "watchful waiting" has generally been restricted to children age 2 and older, there are some data suggesting that this practice may be safe and effective in younger children (6 months to 2 years).[10] However, these studies must be interpreted with caution due to the wide variability in outcome parameters and inclusion criteria (such as the method of AOM diagnosis). Many of these investigations studied only short-term outcomes and did not assess for recurrent infections, hearing loss, or other long-term complications.

There is good historical evidence that antibiotics have had a tremendous beneficial impact. Complications, such as meningitis and mastoiditis, occurred in nearly 20% of children in the pre-antibiotic era. With the advent of antimicrobial therapy, this rate has dropped to as low as 1-3%.[11] Moreover, reports in the mid-1990s of a rising incidence of mastoiditis in Europe have led to some concern.[12] Finally, while comparative studies suggest that the impact may be modest, antibiotics do result in improved cure rates of up to 90-95% over observation alone.[8] As a result, in this country, antibiotic therapy continues to be a mainstay of treatment for AOM.

Antibiotic Agent and Regimen: Which Is Best?

Therapy has focused on efficacy for the three main bacterial pathogens: *Streptococcus pneumoniae, Haemophilus influenzae,* and *Moraxella catarrhalis*. Standard-dose amoxicillin for 10 days has been considered first-line therapy for a long time. Alternatives have included trimethoprim-sulfamethoxazole, erythromycin-sulfisoxazole, and amoxicillin-clavulanate. The growing use of newer cephalosporins (e.g., cefaclor, cefuroxime, cefpodoxime, cefixime, cefprozil, loracarbef, and ceftriaxone), as well as the development of new macrolide antibiotics (e.g., azithromycin and clarithromycin) have led to a reconsideration of optimal therapy. These newer antibiotics often have advantages over standard amoxicillin in terms of ease of dosing, compliance, and administration.[13]

One of the chief advantages of the newer antibiotics is the potential for short-course therapy. Little data support the standard 10-day course, which has been carried over from penicillin therapy for streptococcal pharyngitis. Shorter three- to seven-day courses of antibiotics such as azithromycin and some cephalosporins (cefaclor, cefpodoxime, cefprozil), as well as single or three daily injections of ceftriaxone, have been studied and found to be highly efficacious.[13-15]

Studies comparing different antibiotics and short-course therapies must be interpreted cautiously. Because of the high spontaneous cure rate for uncomplicated AOM, it is easy to prove equivalence, but difficult to demonstrate clinical superiority of one regimen over another. As a result, in Rosenfeld's analysis of 5400 patients, there was no clinical advantage with newer antibiotics when compared to standard amoxicillin.[8] In addition, in many of the studies of short-course therapy, children at high risk for complicated infections were excluded, limiting applicability.

One argument for short-course therapy is the problem of resistance from selective antibiotic pressure. Increasing bacterial drug-resistance has caused concern that standard therapy may be inadequate and could lead to treatment failures and adverse outcomes. Concern has been greatest with regard to the dramatic rise of penicillin- and multidrug-

resistant *Streptococcus pneumoniae* (DRSP), which has been reported at rates as high as 35% in certain regions.[16] AOM from the pneumococcus, the most common bacterium isolated, remains the least likely to spontaneously resolve and most likely to develop complications.[17]

Despite emerging resistance (as many as 80-100% of *Moraxella catarrhalis* isolates are beta-lactam resistant), the rise in treatment failures has been less dramatic. In vitro resistance of MEE isolates does not invariably result in in vivo clinical treatment failure. Moreover, the most clinically recalcitrant cases occur in those in whom both bacteria and viral pathogens, rather than just resistant bacteria, are isolated from the MEE.[18]

New Antibiotic Recommendations

As a result of these concerns, the Centers for Disease Control and Prevention (CDCP) and the American Academy of Pediatrics (AAP), along with the DRSP Therapeutic Working Group of the CDCP, recently published guidelines for the use of antimicrobials for AOM.[19,20]

The CDCP-AAP guidelines support the routine use of antibiotics for AOM. However, in an effort to reduce selective antibiotic pressure, the group recommends that short-course therapy of 5-7 days be considered in children 2 years or older with uncomplicated AOM. Short-course therapy, however, was not recommended for children at increased risk of treatment failure (< age 2, TM perforation, or history of chronic or recurrent AOM).

Despite resistance concerns, amoxicillin remains the first-line antimicrobial agent. However, in order to increase middle ear antibiotic concentrations to combat DRSP, the CDCP-AAP guidelines recommended increasing the dose from the standard 40-45 mg/kg/d to 80-90 mg/kg/d (or 3-3.5 mg in adults). The use of "high-dose" amoxicillin was emphasized for regions in which DRSP prevalence is high, and also as an option for recurrent AOM or treatment failures. In addition, to improve compliance, high-dose amoxicillin can be administered twice daily.

Alternatives and second-line therapies included both standard and high-dose amoxicillin-clavulanate, though the dose should be calculated to limit clavulanate to less than 10 mg/kg to reduce the risk of gastrointestinal side effects. Newer formulations have reduced the dose of clavulanate to ease this concern. Of the extended cephalosporins, cefuroxime was noted to have excellent in vitro activity against the DRSP and other pathogens, but concerns were raised regarding palatability and compliance. While the working group had concerns regarding the activity of cefprozil and cefpodoxime, other investigators have argued that compliance and ease of dosing make these cephalosporins attractive.[5]

The group also recommended the use of single daily parenteral ceftriaxone in cases of treatment failure or when compliance was a concern. While some studies have suggested three daily injections are more efficacious than single-day treatment, the guidelines recommended an initial dose, followed by recheck in 24-48 hours. If symptoms have resolved, no further therapy is warranted. Otherwise, repeat dosing could be administered on the second and third days.[21]

Other investigators and the CDCP-AAP group expressed concern regarding the lack of in vivo and in vitro studies supporting the efficacy of other cephalosporins (cefaclor, cefixime, loracarbef, and ceftibuten).[5,19,20] Because of growing pneumococcal resistance to trimethoprim-sulfamethoxazole, use should be limited to regions in which the drug is known to be effective. In addition, macrolides were not selected as initial therapy because of growing resistance of DRSP. Importantly, macrolide resistance is absolute and cannot be overcome by increased dosages. Despite these concerns, these antibiotics still may be considered, particularly for patients who are beta-lactam allergic.[21]

With changing resistance patterns and ongoing research, it is likely that optimal antimicrobial therapy for AOM will continue to evolve. There is growing evidence for both the efficacy and safety of quinolones in children. New antibiotics being developed, including ketolides and oxazolodinones, may play an important role in the future. Moreover, research on non-antibiotic therapies (such as oligosaccharides and xylitol that prevent bacterial colonization), as well as new prophylactics (like the pneumococcal vaccine and antiviral drugs), is promising, and may lead to a day when routine antibiotic therapy no longer is indicated definitively for AOM.[22] ❖

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CME Questions

8. When comparing helical CT and transesophageal echocardiography (TEE) for assessment of blunt chest trauma with suspected cardiovascular injury:
a. TEE and CT both detected all injuries necessitating operative intervention.
b. TEE was used only if transthoracic echocardiography was indeterminate.
c. CT performed equally well with and without contrast enhancement.
d. CT outperformed TEE in cases of myocardial dysfunction.

9. In the experience reported by Polk and colleagues on the use of airmedical FAST ultrasonography:
a. the scans were performed by trained ultrasound technicians.
b. excessively thin patients had to be excluded.
c. specificity exceeded sensitivity.
d. diagnostic peritoneal lavage was performed in all cases to verify sonographic results.

10. Which of the following is *incorrect* about the treatment of severe sepsis with recombinant human activated protein C?
a. When compared to placebo, treatment with activated protein C was associated with a reduction in the relative risk of death of 19% (95% CI, 6.6-30.5).
b. The incidence of serious bleeding was higher in the activated protein C group than in the placebo group (3.5% vs 2.0%).
c. The administration of activated protein C was associated with a reduction in plasma D-dimer levels, suggesting that the biologic activity of activated protein C may be in part a result of inhibition of the generation of thrombin.
d. The administration of activated protein C was associated with a reduction in the serum levels of interleukin-6, suggesting an anti-inflammatory effect.
e. Patients without a protein C deficiency at baseline did not have a significant reduction in risk of death when treated with activated protein C.

11. In acute abdominal pain from gallstones, parenteral ketorolac provides analgesia that is:
a. superior to that of meperidine.
b. less effective than that of meperidine.
c. equivalent to the relief achieved with meperidine.
d. of no clinical benefit.

12. According to the recent CDCP-AAP guidelines on antimicrobial therapy, first-line treatment for AOM should be:
a. azithromycin.
b. amoxicillin.
c. ceftriaxone.
d. clindamycin.

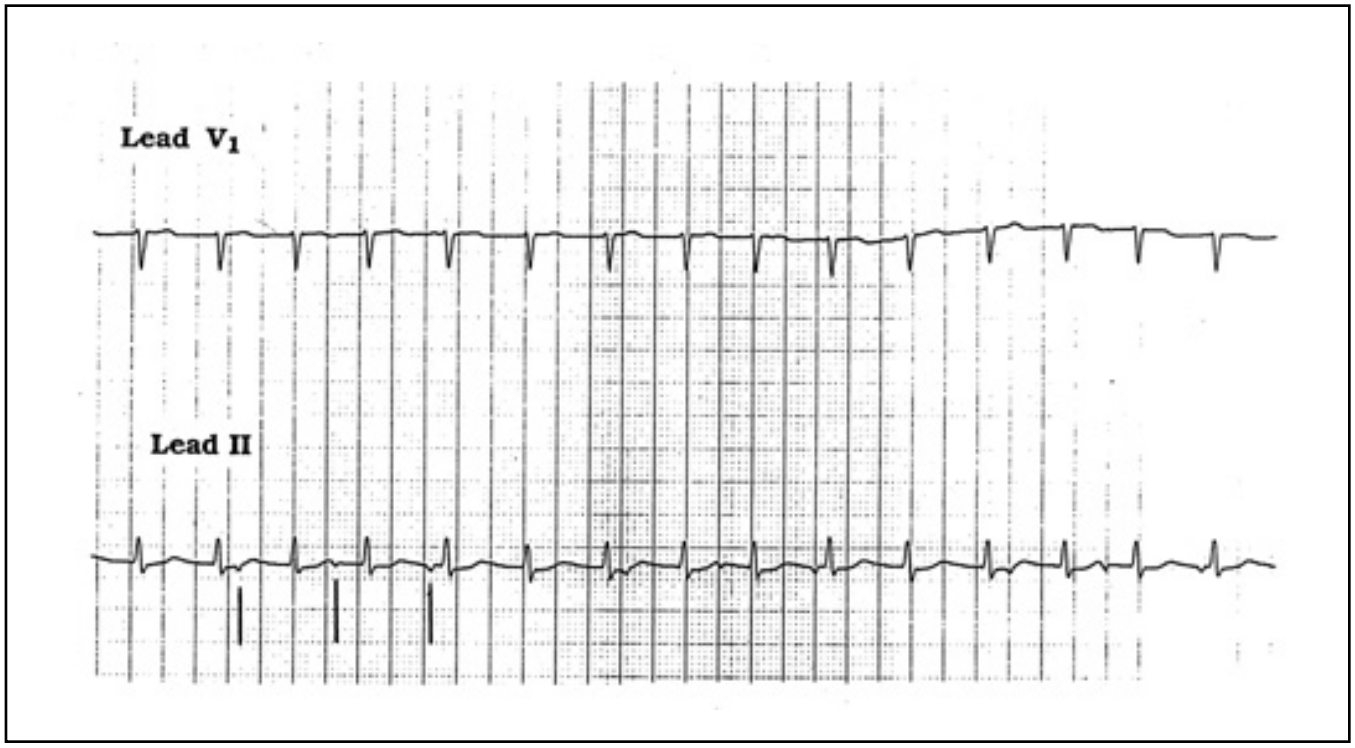
13. Which of the following is true regarding *Streptococcus pneumoniae* and AOM?
a. It is more likely to resolve spontaneously than AOM caused by *Haemophilus influenzae*.
b. Macrolide resistance can be overcome by increasing antibiotic levels in the middle ear.
c. Drug resistance has been limited primarily to European countries.
d. High-dose amoxicillin is recommended as a treatment to address drug-resistant serotypes.

14. Which of the following is *not* a commonly recognized pathogen for AOM?
a. *Moraxella catarrhalis*
b. *Streptococcus pneumoniae*
c. Viral species
d. *Staphylococcus aureus*

15. When treating recurrent AOM, which one of the following is a good antibiotic choice?
a. Amoxicillin/clavulanate
b. Trimethoprim/sulfamethoxazole
c. Azithromycin
d. Erythromycin/sulfisoxazole

Any Marriages in the Tachycardia?

By Ken Grauer, MD



Clinical Scenario: The telemetry tracing shown in the Figure was obtained from an acutely ill, 49-year-old man who had just returned to the intensive care unit following valvular heart surgery. How would you interpret the rhythm in this tracing? What are the three most common causes of this rhythm disturbance?

Interpretation: This is a difficult tracing to interpret. However, use of a deductive approach greatly facilitates arriving at the correct answer. The five key parameters for rhythm interpretation are assessing for P waves (the presence and nature of atrial activity); determining QRS width (distinction when possible between ventricular and supraventricular rhythms); calculating heart rate; determining regularity; and when P waves are present, assessing for a relationship ("marriage") between P waves and QRS complexes (to determine if P waves are conducting). The memory aid, "*Watch your P's and Q's—and the three R's,*" facilitates recall of these five key parameters. The rhythm in the Figure is clearly supraventricular (as determined by the fact that the QRS complex is narrow). The rate is rapid and the rhythm almost (but *not* completely) regular. Atrial activity is present—however, the PR interval continually changes, suggesting AV dissociation. Putting together these findings results in an interpretation of junctional tachycardia (at a rate of about 125/minute) with AV dissociation. The most common causes of accelerated junctional rhythm or junctional tachycardia are digitalis toxicity, inferior infarction, and post-operative state, especially when the patient has undergone cardiovascular surgery.

A subtle additional point about this rhythm revealed by close inspection (measured with calipers) is slight variation in the R-R interval. Despite this, the *atrial* rhythm remains regular throughout the rhythm strip (use calipers to verify this, beginning with the 3 short vertical lines). It is likely that the slightly early occurring beats in this tracing (the 4th, 9th, and 14th QRS complexes) are "capture" beats being conducted by P waves that occur during a non-refractory portion of the cardiac cycle. ❖

In Future Issues:

Choices for Rate Control in Atrial Fibrillation