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Artificial Neural Networks Show Predictive Promise in Patients with Lower GI Hemorrhage

ABSTRACT & COMMENTARY

Source: Das A, et al. Prediction of outcome in acute lower-gastrointestinal haemorrhage based on an artificial neural network: Internal and external validation of a predictive model. *Lancet* 2003;362:1261-1266.

EVALUATION OF EMERGENCY DEPARTMENT (ED) PATIENTS WITH acute lower gastrointestinal bleeding (LGIB) would be much improved if there was a reliable decision tool that accurately could predict which patients are at risk for recurrent bleeding, death, and need for therapeutic interventions to control hemorrhage. The aim of this study was to develop and validate an artificial neural network (ANN) model to predict these outcomes in LGIB patients and to compare this with the predictive performance of a conventional multiple logistic regression (MLR) model and the BLEED (bleeding, low systolic blood pressure, elevated prothrombin time, erratic mental status, unstable comorbid disease) classification system, a previously validated model.

In the first part of the study, the ANN was trained with 26 prospectively collected clinical variables from 120 patients with LGIB admitted to an academic, urban, U.S. medical center in a 12-month period. For the next six months, data from 70 patients were used for internal validation of the ANN, during which time 19 variables were used to predict outcome. Finally, the ANN model was validated externally and direct comparison was made with an MLR model and the BLEED classification system in 142 patients admitted to an independent institution in another state.

The predictive accuracy (sum of correct predictions divided by total predictions) of the ANN in the internal validation group was significantly better than that of BLEED (predictive accuracy for death, 87% vs 21%; for recurrent bleeding, 89% vs 41%; for intervention, 96% vs 46%) and was similar to that of MLR. During the external validation, the ANN performed well in predicting death (97%; 95% CI 95-99%), recurrent bleeding (93%; 95% CI 89-97%), and need for intervention (94%; 95% CI 90-98%) and it was superior

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to MLR (70%, 73%, and 70%). Although the positive predictive value of the ANN was not high in either validation group, the negative predictive value was high for the three outcome variables in both the internal and external validation groups (98-100%).

■ COMMENTARY BY STEPHANIE B. ABBUHL, MD, FACEP

The ANN's excellent negative predictive value suggests that this tool may have a role in determining a low-risk population of LGIB patients who safely could be discharged for further outpatient evaluation. The next step would be for the ANN to be tested prospectively against unassisted clinical judgment. If found to improve clinical outcome, this decision tool could be of great significance.

One of the most impressive findings in this study was the superior performance of the ANN in the external

cohort of patients, who differed significantly from the internal group, both in the clinical characteristics of the patients and in the second institution's management approach to patients with acute LGIB. This supports the hypothesis that, unlike conventional predictive models, ANN models are more universally applicable.

ANN models use non-linear analysis to reveal previously unrecognized relations between given input variables and an output variable. This method has tremendous appeal due to its potential power to analyze complex interactions, and yet, there is inherent resistance to ANNs in that the network logic cannot be broken down into simple elements of clinical reasoning.

There are other potential barriers to the widespread clinical use of ANN predictive instruments. They typically use more variables than MLR models, and entering 26 clinical variables into a computer is not practical in most EDs at the present time. However, with the increasing use of fully computerized charting systems, one could imagine that most of the variables already would be routinely entered by various members of the ED team and the outcome score would be determined as easily as clicking the mouse on the correct icon. ❖

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Myeloperoxidase: Continuing the Search for the Holy Grail of Cardiac Markers

ABSTRACT & COMMENTARY

Source: Brennan ML, et al. Prognostic value of myeloperoxidase in patients with chest pain. *N Engl J Med* 2003;349:1595-1604.

THE HOLY GRAIL OF ALL EMERGENCY DEPARTMENT (ED) cardiac markers would have a very high sensitivity (you don't want to miss any cases), would be abnormal very early in the course of the disease process, and would not only be diagnostic of the current problem but be prognostic of future morbidity and mortality associated with an abnormal marker. OK ... it also would be cheap and easy to perform without highly specialized equipment, but you can't have everything.

Fractionated creatine phosphokinase (CK), myoglobin, and the troponins have demonstrated clear benefit in the diagnosis and risk stratification of patients presenting to the ED with potential acute coronary syndromes (ACS). A noted limitation of these cardiac markers is their lack of early sensitivity in acute myocardial infarction (MI), which does not rise to 80% until approximate-

ly eight hours from the onset of chest pain in the acute MI patient, and ultimately reaches 100% at approximately 12 hours. The objective of this study from the Cleveland Clinic was to determine if myeloperoxidase, an enzyme released by activated leukocytes and found to be present at elevated levels in ruptured coronary plaques, could be a useful cardiac marker for patients presenting to the ED with chest pain.

The authors provide the background that myeloperoxidase levels have been found to be elevated in patients with angiographically documented coronary artery disease, and particularly within culprit lesions prone to rupture. As part of their chest pain (CP) protocol, 604 sequential patients presenting with chest pain to an ED had CK, troponin, and myeloperoxidase levels assayed. Patients were followed to determine final diagnosis (i.e., acute MI, unstable angina, suspected coronary syndrome, or non-cardiac etiologies) and then followed an additional six months to determine subsequent events (i.e., death, MI, or need for cardiac intervention). The results reported by the authors show that the mean time from CP onset to presentation was four hours and the final diagnoses were MI in 23%, unstable angina pectoris in 17%, suspected coronary syndrome in 37%, and noncardiac CP in 21%. Initial plasma myeloperoxidase levels independently predicted risk of MI and ACS during the acute presentation and also predicted the risk of major adverse cardiac events within 30 days and six months. Notably, the myeloperoxidase levels seemed to identify patients at risk for future (within six months) cardiac events even in the absence of myocardial necrosis (i.e., CK and troponin were negative).

■ **COMMENTARY BY ANDREW D. PERRON, MD,
FACEP**

When was the last time you brought your children to a toy store? They invariably see something they like, promise you that it will be their favorite toy forever, and that they'll give all their old toys to charity. I usually give in, only to find the same item a week later buried in a toy chest with an old Rubik's cube, a pet rock, and a Cabbage Patch doll. So is myeloperoxidase the real deal or the latest mood ring ("sees all/tells all") in biological markers of cardiac disease? I don't know yet.

This is potentially an important paper if the findings can be reproduced elsewhere. This test, if the results are accurate, has all the hallmarks of a useful diagnostic adjunct: 1) It provides independent information about risk, both in the short- and long term; 2) it is associated with a significant increase in risk for adverse events (relative risk = 2-3 times baseline); and 3) it has a receiver-operating-characteristic (ROC) curve with a moderately

high sensitivity throughout the range of specificity. My main concern regarding the applicability of this data to my ED population relates to the study patient characteristics. As noted above, the final diagnosis was acute MI in 23%, and unstable angina/suspected coronary syndrome in 55%! All non-cardiac causes of chest pain accounted for only 21% of patients. This is consistent with neither my clinical experience nor with published data regarding ED chest pain etiologies, where AMI accounts for fewer than 15% of cases, and cardiac etiologies in general for 30-40%.¹ If this is a selected population (as it seems to be), I am unsure what the characteristics and applicability of the test will be in a population where the incidence of acute MI/ACS is considerable lower. I eagerly await the results of such a study, and will make my decision regarding myeloperoxidase at that time. ❖

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Sorting Out Sepsis with a New Serum Marker

ABSTRACT & COMMENTARY

Source: Galetto-Lacour A, et al. Bedside procalcitonin and C-reactive protein tests in children with fever without localizing signs of infection seen in a referral center. *Pediatrics* 2003; 112:1054-1060.

PEDIATRIC FEVER IS WORRISOME, ESPECIALLY IN YOUNG children. White blood cell (WBC) and band counts traditionally influence clinical decisions, but with broad variability. C-reactive protein (CRP) has assumed prominence in some centers, as well. Since 1993, measurement of procalcitonin (PCT), a proinflammatory peptide akin to interleukin-6 and tumor necrosis factor-alpha, has proven to be of value in detecting serious infections such as sepsis or meningitis. PCT reaches peak levels more rapidly than CRP (6 hours vs 12) after onset of illness and may herald invasive infection at an earlier stage. To evaluate the utility of rapid (20 minutes by bedside technique) PCT determination in pediatric practice, Galetto-Lacour and colleagues analyzed a cohort of ill children seen at an academic emergency department in Switzerland.

Ninety-nine patients ages 7 days to 36 months with rectal temperatures exceeding 38°C with no identifiable focus of infection were studied at University Children's Hospital, Geneva. Those on antibiotics with fever lasting

more than seven days or with immunodeficiencies were excluded. All cases were tested with WBC and differential, CRP, PCT, and cultures of blood and urine. Toxic children (n = 17) underwent lumbar puncture. Patients with positive urine cultures greater than 10⁵ colony forming units underwent renal scanning with technetium-99 dimercaptosuccinic acid (DMSA) for cortical defects consistent with pyelonephritis. Of all cases, 40 (40%) were admitted for intravenous antibiotics. Of the 60 sent home, 36 (61%) received antibiotics. Average temperature for each group was 39.5°C (38-41°C).

Serious bacterial infections (SBI) were documented in 29 (29%) patients — four had bacteremia (three *Streptococcus pneumoniae*, one *Streptococcus agalactiae*), two had lobar pneumonia, 21 had pyelonephritis (90% *Escherichia coli*), one had mastoiditis, and one had retropharyngeal abscess. Benign infection was diagnosed in the remaining 70 (71%) children—52 with viral syndromes, 11 with cystitis, three with aseptic meningitis, and four with acute otitis media at 48-hour follow-up.

At a cutoff point of 0.5 ng/mL for detection of SBI, sensitivity (sens), specificity (spec), negative predictive value (NPV), and positive predictive value (PPV) of PCT were 93%, 74%, 96%, and 60%, respectively. For a CRP cutoff of 4 mg/dL, sens, spec, NPV, and PPV were 79%, 79%, 90%, and 61%, respectively. For WBC exceeding 15,000, sens was 52%, spec 74%, NPV 78%, and PPV 45%. For band counts greater than 1500, sens, spec, NPV, and PPV were 11%, 93%, 72%, and 38%, respectively. The probability of SBI in 54 children with PCT values less than 0.5 ng/mL was only 3%, vs. a 68% likelihood of SBI in 19 cases with PCT exceeding 2.0 ng/mL. The authors conclude that, in children younger than age 3 who have fever without source, a rapid assay for PCT is superior to measurement of WBC and band counts in detection (or exclusion) of SBI.

■ COMMENTARY BY MICHAEL FELZ, MD

I was unaware that PCT levels correlate with pediatric infectious syndromes, and that a new bedside device can measure this marker within 20 minutes. The statistical performance of this new infection predictor was as good as or better than CRP measurement, outperformed WBC in every parameter, and was superior to band counts in each measurement except specificity. The NPV of 96% for PCT is particularly noteworthy in excluding SBI, while the 93% sensitivity highlights this test's strength in detecting cases of SBI. While the incidence of pyelonephritis in this study seems high, the authors acknowledge that prior studies reported similarly high rates when DMSA scanning was included.

Perhaps the PCT assay will ascend to pediatric promi-

nence in this country, as it has in Switzerland. Another recent analysis¹ of PCT in 445 febrile infants evaluated in a multicenter study in Spain demonstrated performance characteristics exceeding those of CRP for detection of SBI. The bottom line: PCT also could stand for “pretty convincing test.” ❖

Reference

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Special Feature

Anterior Shoulder Dislocation: Uncommon Reduction Techniques for a Common Injury

By Jacob W. Ufberg, MD

Introduction

THE SHOULDER HAS THE GREATEST RANGE OF MOTION of any of the body's joints, and thus is prone to dislocation. Fifty percent of all joint dislocations involve the shoulder, with anterior dislocations making up 90-96% of shoulder dislocations.¹ The most common mechanism of injury is extreme abduction, external rotation, extension, and a posteriorly directed force against the humerus. Forceful abduction or external rotation alone also can cause dislocation, as can direct blows to the posterior humerus, forced elevation and external rotation, or a fall on the outstretched hand.² Among patients with recurrent dislocations, the mechanism may be surprisingly minor, such as external rotation of the shoulder while rolling over in bed.³

Most emergency physicians are familiar with several methods of reduction of anterior shoulder dislocations, such as traction-countertraction, scapular manipulation, external rotation, the Milch technique, and the Stimson technique of hanging weights. No technique is 100% effective, and approximately 5-10% of anterior shoulder dislocations will prove irreducible in the emergency department (ED).⁴ There are multiple factors to consider when deciding which technique to use, including the availability of assistants, whether or not sedation/analge-

sia is necessary, and the treating clinician's experience with the various techniques. This article will discuss the diagnosis of anterior shoulder dislocation, the need for diagnostic imaging, and the management of anterior shoulder dislocations using three less commonly known alternative techniques.

Diagnosis

Clinical. Many shoulder dislocations are clinically apparent. The injured patient frequently supports the affected extremity with the other arm, and leans toward the side of injury. The arm often is held in slight abduction and external rotation. The shoulder loses its normal, rounded appearance, and the acromion process may appear prominent. An anterior fullness may be palpable, and a defect may be seen and felt in the area where the humeral head normally resides.

It is imperative to perform a complete neurovascular examination of the affected arm. The axillary nerve is the most commonly injured nerve,⁵ and its sensory component can be tested by checking for sensation over the lateral aspect of the upper arm in the regimental badge area. Motor testing of this nerve is extremely difficult, due to the injury. The neurologic exam also should include a complete assessment of the other major nerves to the affected arm, as other injuries may occur infrequently.⁵ Vascular injury to the axillary artery is rare, and may be assessed by checking for an expanding hematoma and by comparing the radial artery pulses between the affected and unaffected extremity.

Diagnostic Imaging. Anterior dislocation of the shoulder easily can be diagnosed by plain radiography using the standard anteroposterior (AP) view. Additionally, the scapular Y view and the axillary view often are performed. These views are useful in diagnosing posterior dislocation, but rarely add to the AP view in obvious anterior dislocation.

Fractures may be detected in up to 35% of anterior shoulder dislocations. The most common of these fractures is that of the greater tuberosity.⁶ The Hill-Sachs deformity (a notch in the posterolateral area of the humeral head) and the Bankart lesion (a disruption of the inferior aspect of the glenoid rim) also are commonly seen on pre- or post-reduction radiographs. While these fractures may affect the long-term outcome of patients with anterior shoulder dislocations, they rarely affect immediate ED management.

This lack of immediate consequences of most radiographic findings has led some to question the need for pre- or post-reduction radiographs in all cases. Several authors suggest that minimally traumatic, recurrent, clinically obvious dislocations may be reduced without the need for prior radiographs.^{7,8} Some argue that pre-reduction films are necessary to document any possible proxi-

mal humerus fracture, but that post-reduction films are of little value.^{7,9} However, many authorities continue to recommend both pre- and post-reduction radiographs, as humeral neck fractures are a known complication of the reduction of anterior shoulder dislocations.⁶

Management

Premedication. The obvious benefits of reduction without premedication include reduced ED length of stay, reduced staff requirements, and avoidance of complications associated with sedation and analgesia. However, most patients who are anxious, uncooperative, have muscle spasm, or who are in a great amount of pain will require premedication. In general, if reduction is attempted without pharmacologic assistance, only one attempt should be made before resorting to some type of premedication. This decision should be made on a case-by-case basis by the treating clinician. One alternative is the administration of intra-articular lidocaine to patients in whom there is a reason to avoid sedation and analgesia. Studies by Kosnik and Orlinsky demonstrate significant pain relief during reduction using intra-articular lidocaine.^{10,11} However, both studies indicated increased patient satisfaction with sedation and analgesia, and Orlinsky's study indicated increased physician-perceived muscle relaxation with sedation and analgesia. It is reasonable to conclude that intra-articular lidocaine is a viable alternative among patients who decline, or who have a contraindication to, intravenous sedation and analgesia.

New/Uncommonly Used Reduction Techniques

Spaso Technique. This technique is performed with the patient lying flat in the supine position. The clinician holds the affected extremity around the wrist or distal forearm and gently lifts the arm vertically until the arm is pointed directly up toward the ceiling. While maintaining gentle vertical traction on the arm, the clinician slowly rotates the arm externally at the wrist. Reduction, which may require several minutes of traction, generally will be noted by the familiar "clunk." However, reduction may be subtle.

This technique has a reported success rate of 87.5%,¹² although little literature has appeared since this technique was first reported in 1998.¹³ This technique is useful, as it requires little force, is simple to perform, and does not require any assistants.

Chair Technique. Nordeen and Westin have reported different variations on this simple and effective technique.^{14,15} In Nordeen's technique, the patient is seated sideways in a chair with the dislocated extremity draped over the backrest of the chair. While the clinician holds the wrist in the supinated position, the patient is instructed to stand up slowly, pausing when it is too painful to

continue, until reduction is accomplished. The reported success rate in Nordeen's study was 72%.¹⁴

Westin reported a technique in which the patient is seated in a chair. The affected arm is flexed 90° at the elbow, and a cloth loop is made from stockinette and placed around the proximal forearm. The clinician places one hand on the humeral head to exert pressure, while the other hand is used to maintain flexion at the elbow. Then the clinician places one foot in the loop and provides firm, gradual downward traction while an assistant stabilizes the patient's torso. Westin reported a 97% success rate and performed 93% of reductions without sedation or opioid analgesia.¹⁵

While both these techniques are simple and may be effective in many patients, they may prove difficult among patients requiring sedation, analgesia, and monitoring. The Nordeen technique requires the patient to cooperate and stand up, while the Westin technique requires maintaining seated position, both of which may be difficult in the sedated patient.

Self-Reduction Technique. Aronen reported this simple technique, in which the patient performs his or her own reduction. Because the patient applies the force necessary to reduce the dislocation, the patient can control the amount of force being used to maintain tolerable levels of pain. In this technique, the patient is seated on a stretcher in the upright position. The patient is positioned with the ipsilateral knee flexed to approximately 90° and the foot flat on the stretcher. The patient is instructed to clasp the hands around the ipsilateral knee with the fingers interlocked. The patient then leans back slowly until the elbows are straight. Then, the patient applies steady, gradual pressure by leaning back and extending at the hip and knee. This created both a traction and a countertraction force for reduction, which may take several minutes.¹⁶ The advantages of this technique lie in its simplicity. No equipment, or even a stretcher, is necessary. The self-reduction technique may be attempted on sports fields or wherever the injury may have occurred, as reduction generally becomes more difficult as time passes. The patient can control the amount of pain by pausing during the reduction to allow muscle spasm to resolve before applying further pressure.

Post-reduction Care

After reduction, limited passive range of motion may be checked to ensure reduction clinically. Restoration of the normal contour of the shoulder and dramatic decrease in pain also may be clues to a successful reduction. The need for post-reduction radiographs is discussed in the section on diagnostic imaging.

Immobilization of the affected shoulder should be adequate to prevent external rotation or abduction of the

shoulder. This can be accomplished with a sling and swath or a commercially available shoulder immobilizer. The duration of immobilization differs among different patient groups. Younger patients should be instructed to follow up within 1-2 weeks, and immobilization generally is maintained for approximately 3-4 weeks. Older patients will be immobilized for a considerably shorter period of time, and should be instructed to follow up within 5-7 days to allow for early mobilization.⁶

Orthopedic follow-up for all patients with anterior shoulder dislocation should be ensured, as the incidence of concurrent rotator cuff injury is significant, especially among older patients with anterior shoulder dislocations.¹⁷ Many patients will re-dislocate at some future point. Patients with a first shoulder dislocation prior to age 20 will have a recurrence rate of 80-92%, as opposed to a recurrence rate of 10-15% among patients who first dislocate after age 40.⁶ ❖

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10. Myeloperoxidase:

- a. is specific but not sensitive for acute myocardial infarction.
- b. is very specific but carries low sensitivity for pulmonary embolism.
- c. seems highly sensitive for acute myocardial infarction, and also has predictive value regarding long-term prognosis for adverse cardiac events.
- d. seems highly sensitive for pulmonary embolism, and also has predictive value regarding long-term prognosis for thromboembolic events.

11. The study on an artificial neural network (ANN) to predict outcome in acute lower gastrointestinal hemorrhage patients found all of the following to be true except:

- a. The ANN model had a high negative predictive value for the three outcome variables of recurrent bleeding, death, and need for therapeutic intervention to control hemorrhage.
- b. The ANN model was both internally and externally validated.
- c. ANNs use non-linear analysis.
- d. The ANN model has been shown to improve clinical outcome in a prospective trial comparing clinical judgment alone with ANN-assisted clinical judgment.

Physician CME Questions

7. **Anterior shoulder dislocation usually is diagnosed easily by which of the following methods?**
 - a. A thorough history and physical exam
 - b. An anteroposterior radiograph of the shoulder
 - c. An axillary-view radiograph of the shoulder
 - d. A scapular Y-view radiograph of the shoulder
 - e. All of the above
8. **Which of the following statements is true?**
 - a. Older patients with their first anterior shoulder dislocations are more likely to suffer dislocations again than younger patients.
 - b. Younger patients should be immobilized for shorter periods of time than older patients after anterior shoulder dislocation.
 - c. Older patients always should have surgical repair after anterior shoulder dislocation.
 - d. Older patients should have early orthopedic follow-up after anterior shoulder dislocation to ensure early immobilization.
9. **For the diagnosis of serious bacterial infection in children with fever without source, serum procalcitonin levels:**
 - a. are elevated in viral syndromes just as in bacterial illness.
 - b. are superior to WBC counts and CRP measurements.
 - c. are inferior to band counts.
 - d. have no predictive value for invasiveness of infection.

12. Anterior shoulder dislocations are associated with:

- a. axillary nerve injury.
- b. long thoracic nerve injury.
- c. subclavian artery pseudoaneurysm.
- d. cephalic vein thrombosis.

13. In the study by Brennan and colleagues on myeloperoxidase levels in chest pain patients, one characteristic that raises the question of generalizability to your ED population is:

- a. the low incidence of acute MI and acute coronary syndrome in the study population.
- b. the low incidence of pulmonary embolism in the study population.
- c. the high incidence of acute MI and acute coronary syndrome in the study population.
- d. the high incidence of pulmonary embolism in the study population.

Answer Key:

- | | |
|-------|-------|
| 7. e | 11. d |
| 8. d | 12. a |
| 9. b | 13. c |
| 10. c | |

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.

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.

A Code from a Cause

By Ken Grauer, MD

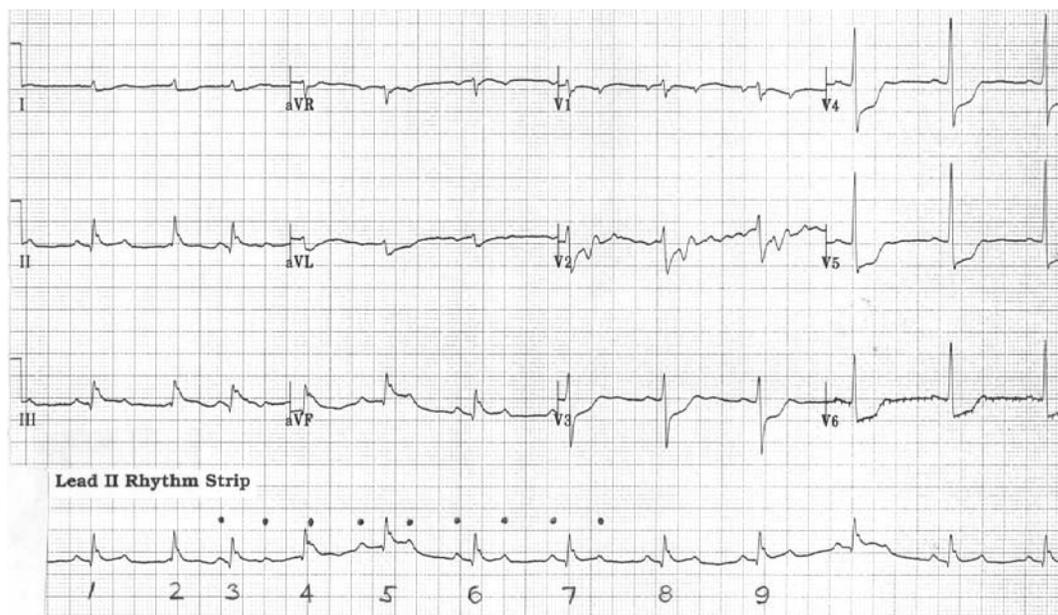


Figure. 12-lead ECG and lead II rhythm strip obtained from a 62-year-old woman shortly before her cardiac arrest.

Clinical Scenario. The ECG in the Figure was obtained from a 62-year-old woman who was admitted for chest pain. She was doing poorly from a clinical standpoint at the time this tracing was obtained, and suffered a cardiac arrest shortly thereafter. How would you interpret her precode ECG that is shown in the Figure?

Interpretation. This is a complex tracing. Dots in the lead II rhythm strip suggest that after some initial irregularity, 2:1 AV conduction becomes established. We suspect that the rhythm is 2° AV block, mostly Type I (Wenckebach) with atrial tachycardia at a rate of 140/min. It is difficult to be certain if beats No. 2 and 4 represent junctional escape or Wenckebach conduction with a long preceding PR interval—but the presence of normal QRS width and the suggestion of acute inferior infarction (subtle but real ST segment elevation in leads II, III, and aVF) are most consistent with a Mobitz I etiology for the 2:1 AV block. Marked ST segment depression exists in virtually all other leads on the tracing. This suggests extensive, evolving acute infarction that also may involve the posterior wall or signal anterolateral ischemic changes. The combination of acute infero-postero wall infarction with extensive reciprocal ST segment depression in conjunc-

tion with atrial tachycardia and 2:1 AV block explain why the patient soon suffered a cardiac arrest. ❖

SARS Audio Program Updates Guidelines

What would happen today if a patient with suspected or probable SARS were admitted to your hospital? To help you prepare for the threat, Thomson American Health Consultants offers a recording of the audio conference: *The Resurgence of SARS: Why Your Hospital May Not Be as Prepared as You Think*. Let our experts help you with practical tips and solutions to detect first cases and protect other patients and health care workers.

Our speakers are **Allison McGeer, MD**, director of infection control at Mount Sinai and Princess Margaret Hospitals in Toronto, who dealt firsthand with SARS patients; and **Susan E. Shapiro, PhD, RN, CEN**, a Postdoctoral Fellow in Risk Assessment and Intervention Research with Individuals and Families at Oregon Health & Science University School of Nursing in Portland. Your fee of \$199 includes presentation materials, additional reading, and one hour of CE, CME, or Critical Care credit. For information or to purchase, call customer service at (800) 688-2421 or contact us via e-mail at customerservice@ahcpub.com.

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