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INSIDE

Glasgow: The Power Is in the Motor

ABSTRACT & COMMENTARY

Source: Healey C, et al. Improving the Glasgow Coma Scale score: Motor score alone is a better predictor. *J Trauma* 2003;54:671-680.

THE GLASGOW COMA SCALE (GCS) HAS SERVED AS AN ASSESSMENT tool in head trauma, as a measure of physiologic derangement in outcome models, and often is used to rapidly assess neurologic status. Its value as a predictor of survival never has been prospectively validated. The authors used a large trauma data set (National Trauma Data Bank, N = 204,181), and compared the predictive power and calibration of the GCS to its component scores (motor, eye, verbal). The authors discovered that different combinations summing to a single GCS score often have very different mortalities. For example, the GCS score of 4 can represent any of three motor/verbal/eye combinations: 2/1/1 (survival 0.52), 1/2/1 (survival = 0.73), or 1/1/2 (survival = 0.81). In addition, the relationship between GCS score and survival is not linear, but decreases linearly from a GCS of 15 to 11, remains unchanged to a score of 7, and then decreases linearly again to a score of 3. The motor component of the GCS, by contrast, not only is related linearly to survival, but also preserves almost all the predictive power of the GCS. The authors conclude that the motor component of the GCS contains virtually all the information of the GCS itself, offers advantages over the other components (e.g., can be measured in intubated patients), and is much better behaved statistically than the GCS. They further state that the motor component of the GCS should replace the GCS in outcome prediction models.

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

The GCS is a score from 3 to 15, right? Wrong! It's actually a collection of 120 different combinations of neurological abnormalities. A GCS of 13 could be someone who withdraws to pain, or speaks in incomprehensible words, or opens his or her eyes to painful stimuli, or is confused and only opens his or her eyes to speech. However, it's hard to imagine that every single one of those patients has the same survival rate or severity of outcome. In fact, the 120 combinations end up being represented by a few scores

with greater frequency than the others because of the specific pattern with which trauma patients deteriorate as measured by the scale. In this database of 204,181 patients, 80% of patients had a GCS of 15, 6% had a GCS of 14, 6% had a GCS of 3, and the rest of the scores were represented with a frequency of 1% or less. Thus, most patients exhibit a score of 15, 14, or 3. Furthermore, this study demonstrates that survival is the same for GCS scores in the range of 7 to 11, although it does decrease linearly (as expected) for all other scores. Thus, it appears that GCS is a good tool only for predicting outcome when the score lies between 11 and 15 or between 3 and 7. The differences in the middle scores are meaningless.

Why is this? It turns out the strength of the correlation with survival is exclusively in the motor score. As the motor component goes from 6 to 1, survival decreases linearly. As the eye and verbal scores decrease, survival remains the same until the lowest possible score. The original authors of the GCS first intended it to be a three-score system, but later modified it to be a complete additive score. They never had a large number of patients to prospectively validate their findings. For example, when the score goes below 8 in a head trauma patient, we historically have taken that as a predictor of a bad outcome and instituted airway intervention. This probably makes little sense, because according to this large analysis, a score of 8 is no worse than a score of 7, 9, 10, or 11. One clearly can see the confounding issues (intoxication or behavioral abnormalities) in the verbal and eye components and why the motor scale makes clinical sense as well as statistical sense as a useful tool alone.

In conclusion, if you're using the GCS, you had better pay more attention to the motor scale, or use the motor scale exclusively. Every time the patient drops a point on that scale, it means something important. ❖

Emergency Medicine Alert, ISSN 1075-6914, is published monthly by Thomson American Health Consultants, 3525 Piedmont Rd., NE, Bldg. 6, Suite 400, Atlanta, GA 30305.

Vice President and Group Publisher: Brenda Mooney.
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Managing Editor: Allison Mechem.
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GST Registration Number: R128870672.

Periodicals postage paid at Atlanta GA 30304. **POSTMASTER:** Send address changes to ***Emergency Medicine Alert***, P.O. Box 740059, Atlanta, GA 30374.

Back issues: $44. One to nine additional copies, $212 each; 10 to 20 additional copies, $159 each.

Subscriber Information

Customer Service: 1-800-688-2421

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Subscription Prices

United States: $265 per year (Resident rate: $132.50)
Canada: $295 per year plus GST (Resident rate: $147.50)
Elsewhere: $295 per year (Resident rate: $147.50)

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Etomidate Appears to Be Safe in Children

ABSTRACT & COMMENTARY

Source: Guldner G, et al. Etomidate for rapid-sequence intubation in young children: Hemodynamic effects and adverse events. *Acad Emerg Med* 2003;10:134-139.

ETOMIDATE, AN IMIDAZOLE DERIVATIVE COMMONLY used for rapid sequence intubation (RSI) in the emergency department (ED), is indicated for this purpose in patients 10 years and older. Despite this fact, it frequently is used for both procedural sedation and RSI in more diverse pediatric patient populations. The objective of this study was to enumerate and quantify any adverse effects associated with its use for RSI in a ediatric patient population. Conducted at Loma Linda University Hospital, this retrospective, implicit chart review examined the records of all patients ages 0 to 10 years who underwent RSI using etomidate as the induction agent during a period of approximately five years. The stated goals of the study were three-fold: 1) to evaluate the frequency of the immediate adverse events of vomiting, seizures, and myoclonus; 2) to look for adverse hemodynamic effects; and 3) to assess for the delayed adverse effects of adrenocorticoid suppression or recurrent seizures.

All data abstractors underwent training on practice medical records, and results were recorded on standard-

ized data collection forms. Study variables were explicitly defined, and 15% of charts underwent duplicate review to confirm inter-rater reliability. A kappa of at least 0.6 was the standard (indicating good inter-rater reliability).

The authors identified 105 children who had undergone RSI. Average age was 3 years (± 2.9). The median dose was 0.32 mg/kg (± 0.12) of etomidate. Fifty-seven percent of intubations were for trauma, 20% for non-traumatic respiratory distress, and 13% were non-traumatic altered mental status. Of the 105 intubations, four had immediate adverse events documented (3.8% of patients, 95% CI 1.0-8.8%). There was one case of transient desaturation during RSI (single successful attempt), and three cases of emesis after induction with etomidate (one prior to intubation and two after). Approximately half of the study patients (52 of 105) had adequate documentation of blood pressure and pulse prior to RSI and within 10 minutes after. From these cases the results showed an average increase in systolic blood pressure of 4 mmHg (95% CI -3.3 mmHg to 11 mmHg) and an average increase in diastolic blood pressure of 7 mmHg (95% CI -3.1 mmHg to 11 mmHg). The mean change in pulse was an increase of 10 bpm (95% CI 4.0-17.4 bpm). In the authors' search for delayed sequelae, they found no cases of adrenal insufficiency nor did they identify any new-onset seizures.

COMMENTARY BY ANDREW D. PERRON, MD

The use of etomidate as an induction agent in RSI has become widespread in emergency medicine. Its use is advocated due to its rapidity of onset, brevity of action, and minimal effects on cardiovascular stability. A number of studies in adult emergency patient populations have demonstrated this to be true. In clinical practice, etomidate frequently is used on pediatric patient populations for RSI, as these benefits also are assumed to apply to this group. Supportive literature is relatively sparse, however. In a previous retrospective review on this subject, Sokolove et al found a similar lack of effect on blood pressure or adrenal function in 100 pediatric patients induced with etomidate.[1] Other studies of etomidate used in adult populations have reported frequent episodes of myoclonus, with a reported incidence of up to 70%.[2] This series found no episodes of myoclonus, a fact the authors rightly suspect is related to the concomitant administration of a paralytic with the etomidate. Anesthesia literature has suggested a connection between the use of etomidate and seizures. However, studies in adult ED populations almost universally have not found this complication to occur, and this study follows this trend. Finally, the incidence of vomiting approximates that seen in other studies, and is similar to the incidence associated with other induction agents.

Etomidate rapidly is becoming the de facto drug of choice for RSI in the ED in a wide variety of clinical situations. While a relatively large number of good adult studies have shown this, the literature in the pediatric population is sparse. Although the manufacturer has yet to recommend etomidate for RSI in patients younger than 10 years of age, the available literature suggests that it has a very favorable risk-benefit profile, and can be used safely in this group. ❖

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Nitroprusside May Benefit Patients with Heart Failure and Aortic Stenosis

ABSTRACT & COMMENTARY

Source: Knot UN, et al. Nitroprusside in critically ill patients with left ventricular dysfunction and aortic stenosis. *N Engl J Med* 2003;348:1756-1763.

For decades, conventional teaching has dictated that patients with aortic stenosis and congestive heart failure should not be treated with vasodilators because of the concern of life-threatening hypotension. In this prospective observational study, 25 patients with severe aortic stenosis and left ventricular systolic dysfunction were treated with intravenous nitroprusside (NTP). Patients were included who met the following criteria: admitted to the intensive care unit (ICU) for invasive monitoring of heart failure; ejection fraction of 35% or less, severe aortic stenosis with a valve area of 1 cm^2 or less on echocardiogram; and a depressed cardiac index of 2.2 L/min/m^2 or less. The only exclusion criterion was hypotension, which was defined as the need for any inotropic or vasopressor agent, or a mean systemic arterial pressure of less than 60 mmHg.

After baseline variables were recorded, the patients were treated with intravenous NTP in a dose titrated to a mean arterial pressure between 60-70 mmHg. The cardiac index and other variables then were measured at six and 24 hours after initiation of NTP. At baseline, the mean cardiac index was 1.60 ± 0.35 L/min/m^2. After six hours of NTP at a mean dose of 103 ± 67 ug/min, the cardiac index had increased to 2.22 ± 0.44 L/min/m^2 ($p < 0.001$). After 24 hours, the cardiac index had increased further to 2.52 ± 0.55L/min/m^2 ($p < 0.001$). The increase in cardiac index was found in patients with both high-gradient and low-gradient aortic stenosis. NTP was well tolerated and had minimal side effects. All patients continued to receive NTP until surgery, conversion to medical therapy, or death. There were five in-hospital deaths and one death after discharge; all were reviewed and did not appear related to NTP.

COMMENTARY BY STEPHANIE B. ABBUHL, MD, FACEP

Another long-standing dictum gets put to the test and challenged with scientific data. This study shows that even with a severely stenotic aortic valve, the failing heart can increase cardiac output when afterload is reduced. NTP rapidly and markedly improved cardiac function in patients with severe left ventricular dysfunction and severe aortic stenosis.

What we don't know from this study is if the findings can be generalized to patients with aortic stenosis who have normal left ventricular function. The authors suggest that since the normal ventricle is much less sensitive to afterload than the failing ventricle, the benefits of NTP may not outweigh the potential risks. However, given the results of this study, this certainly is an area that needs reexamination and further research.

We also don't have a head-to-head comparison of NTP with a positive inotropic agent, so it remains unclear how an agent such as dobutamine would compare. The authors note that dobutamine has been studied and appears safe in similar patients with no coronary artery disease. However, in patients with coronary disease (as in the majority of patients in this study), there are increased complications with dobutamine, including arrhythmias and ischemia.

Patients with aortic stenosis and heart failure have an especially high risk of death and present a challenge to the emergency physician. While the use of NTP was successful in this study with invasive monitoring, its use in the emergency department without a Swan-Ganz catheter would be ill-advised. However, if more studies replicate and possibly broaden this experience, we may find ourselves considering vasodilator in patients with aortic stenosis in the near future. ❖

Special Feature

Techniques for Removing Nasal Foreign Bodies

By Theodore C. Chan, MD, FACEP

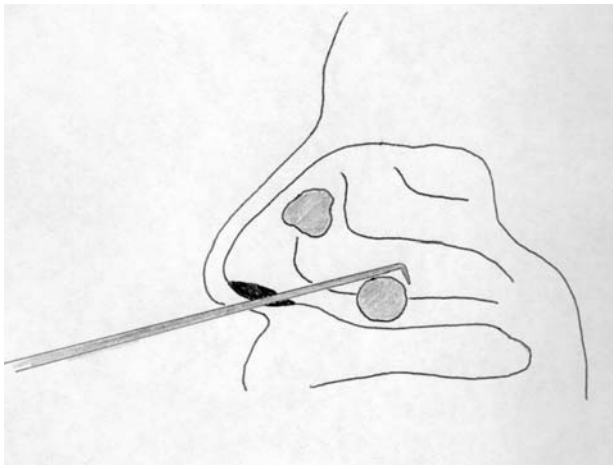
Patients with foreign bodies in the nose commonly present to the emergency department (ED). These foreign bodies include a wide range of small objects limited only by the imagination, and include inanimate materials (e.g., toy parts, rocks, beads, paper, chalk, sponges, and batteries), vegetable matter (e.g., corn, peas, and nuts), and animate objects (e.g., worms, cockroaches, and other insects). Objects can be found in any portion of the nasal cavity, though most commonly on the floor below the inferior turbinate or immediately anterior to the middle turbinate.[1] *(See Figure 1.)*

Patients typically are school-age children or younger, or developmentally delayed adults who insert objects into their noses out of curiosity and play. Adults and children alike may insert items in an attempt to relieve nasal irritation or epistaxis. On occasion, patients may not report any history of insertion or symptoms related to the foreign body. Incidental or occult objects have been reported in patients for prolonged periods of time.[2]

Patients commonly present with pain or discomfort associated with the foreign body, though this has been reported to occur in fewer than half of cases.[3] In addition, unilateral, malodorous nasal discharge may be present and may be the only clue to the presence of a foreign body in occult cases. Other clinical manifestations are related to complications, including unilateral nasal obstruction, respiratory symptoms, epistaxis from trauma, and infection, including sinusitis. Rare complications include the development of rhinolith concretions from calcium and magnesium deposits, as well as erosion into contiguous structures such as the sinuses and soft palate.

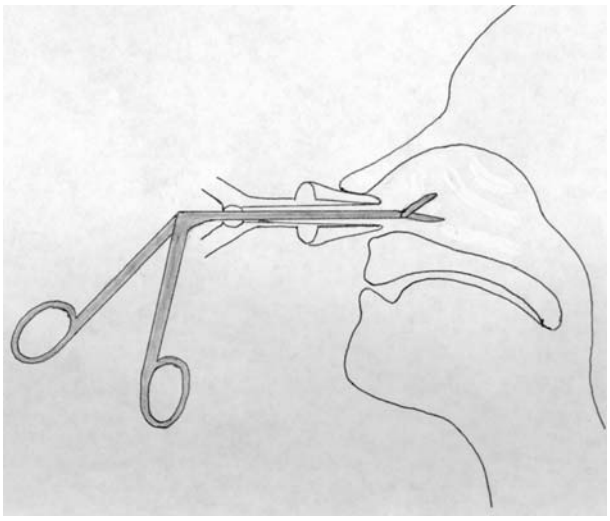
Removal can be quite simple or present a significant challenge, depending on the type, size, location, and friability of the foreign body, as well as the age of the patient and his or her ability to cooperate with examination and removal.[3,4] A variety of techniques and instruments have been used to remove foreign bodies from the nasal passages.

Figure 1. Common locations of foreign bodies, and removal using a hooked probe



Foreign bodies commonly become lodged below the inferior turbinate and anterior to the middle turbinate. This figure illustrates removal of a foreign object with a hooked probe.

Figure 2. Removal of foreign object using alligator forceps



A foreign body is removed using alligator forceps and nasal speculum.

The emergency physician can remove most objects with little or no sedation (depending on the patient). Two large case series have reported successful removal rates of greater than 90% in the ED.[5,6]

More difficult cases generally should be referred to an ear-nose-throat (ENT) specialist for removal with an operating microscope. One key exception to this rule is the patient with a small button battery foreign body. In these cases, moisture within the orifice creates an electrolyte bath for the battery with the potential for creating an electrical current, hydroxide formation, and subsequent tissue electrolysis. In addition, leakage can cause liquefactive necrosis and significant organ injury.[7,8] In these cases, immediate removal is necessary.

Another special circumstance occurs with myiasis, or the presence of animate objects (such as screw worms and larvae). This condition occurs more commonly in warm, tropical climates and areas with poor hygiene. In many cases, removal can be accomplished after first killing the offending insect (such as with chloroform solution), followed by more standard removal techniques including curettage, direct instrumentation, suction, and irrigation.

Removal Techniques

Direct Instrumentation. The most common removal technique for nasal foreign bodies is direct instrumentation by grasping the object anteriorly and removing it. Grasping instruments include alligator forceps, long bayonette forceps, and mosquito and hemostat clamps. This technique particularly is useful for solid, anteriorly placed objects.

The object should be well-visualized prior to removal. Use of topical vasoconstrictors or anesthetics may aid both in visualization and removal. In addition, with smaller objects, an alligator forceps can be inserted through the otoscope head (by sliding the magnification window to the side) or through the nasal speculum, and removal performed under direct visualization. *(See Figure 2.)*

Complications from this technique include accidentally pushing the object posteriorly, increasing the risk for obstruction and aspiration. As such, this technique is less useful for large, smooth, round, and posteriorly situated objects. In addition, friable objects may be less amenable, as they could fall apart once grasped.

Hooked Probes. Another method of instrumentation involves the use of hooks (right-angle or curved), curettes, wire loops, or even molded paper clips to remove the foreign body. In this case, the probe tip is passed behind the object, turned such that the hook is now posterior to the object, and then pulled forward — with the object — out of the nares. *(See Figure 1.)*[1,9] Objects must be located anteriorly and be small enough to allow the hook to pass behind it. In addition, friable objects may fall apart on removal. Complications include mucosal damage and bleeding from injury caused by the probe and object.

Balloon Catheters. Similarly, balloon catheters such as a small Foley (5, 6, or 8 F) or Fogarty catheter have been used to removal nasal foreign bodies.[10] The deflated catheter is lubricated (2% lidocaine jelly) and inserted through the nasal cavity posteriorly past the foreign body. The balloon then is inflated with 0.5-2 cc of air or water. The catheter is withdrawn, pulling the

object out of the nare with the balloon. A greater than 90% success rate has been reported, with no complications using this technique; it may be particularly useful for posteriorly placed objects.[11] Potential complications are similar to those of the hooked probes, including tissue damage and epistaxis.

Suction. Suction catheters can be used to directly remove the foreign body. Most commonly, a Frazier tip or Schunkt-neck suction catheter is hooked up to 100-140 mmHg suction and directed at the foreign body for removal. Suction best is utilized for large, round, smooth objects that allow for a solid seal to be formed between the suction device tip and foreign body. Complications include tissue damage from instrumentation in the nasal cavity and inadvertently pushing the object posteriorly.[3]

Positive Pressure. A number of methods have been described to essentially blow the foreign body out of the nasal cavity. Forced exhalation can be utilized by cooperative patients and adults. In this technique, the patient is asked to take a deep breath in by mouth, then to forcefully exhale with the unaffected nostril occluded with lateral pressure. This forced exhalation of air out of the affected nare causes the object to be dispelled simultaneously. It is important that the unaffected nostril be occluded without causing septal deviation and occlusion of the affected side.

The mouth-to-mouth or "parent's kiss" technique is a variant of this same idea that can be used on children. In this case, the caregiver or parent holds the supine child in his or her arms, stabilizing the chin and holding the mouth open with one hand and occluding the unaffected nostril with the fingers of the other hand. The caregiver forms a tight seal between his or her mouth and the child's mouth (as if to give a kiss), and then promptly delivers a rapid, forceful puff of air into the child's mouth. This action causes glottic closure and rapid expulsion of air out the affected nare, hopefully along with the object. Marked success has been reported with this technique.[12,13] A similar technique has been described using a bag-valve-mask device in which the mask forms a seal only with the mouth of the patient. In this case, the bag then is used to deliver the forceful puff of air into the mouth.[14]

Positive pressure delivered through the unaffected nostril, rather than the mouth, also has been described. In this case, air pressure is delivered through a male-male oxygen tube adapter attached to oxygen at 10-15 L/min and inserted into the unaffected nostril. Air pressure from this device (termed a "Beamsley Blaster") is used to force the object out of the affected nare.[15] All these positive pressure techniques are best suited for large, posterior foreign bodies that occlude the nasal passage, making them amenable to forceful exhalation. Theoretical complications include barotrauma, but no significant injuries have been reported thus far with these techniques.

Nasal Wash. A variant of the positive pressure techniques is the nasal wash. With this technique, the patient is seated upright with the neck in neutral position. A bulb syringe filled with approximately 7 mL of sterile normal saline is inserted into the unaffected nostril and advanced several centimeters until a tight seal is formed. The syringe is then forcibly squeezed and the object is propelled with the flow of saline out of the affected nostril. Small case series have reported excellent results (including with friable objects) with no complications.[16] However, potential complications include risk of aspiration and reflux of saline and nasal contents into the Eustachian tubes and sinuses.[17] Given these potential risks, this technique should not be performed on infants younger than 6 months old or those with airway or neurologic impairment. In addition, this type of irrigation should be avoided with batteries, as well as vegetative matter that might swell and expand.

Adhesives. Cyanoacrylate glue and tissue adhesive can be used to remove difficult foreign bodies from the nose.[18] A small amount of the glue is placed on the cut surface of a hollow plastic swab stick or blunt end of a wooden cotton swab and placed directly on the object for 60 seconds. The stick and object then are removed gently from the nostril. This technique is best suited for solid objects that can be "glued" to the stick. Complications include glue adherence to the nasal mucosa and traumatic injury to the nasal cavity. ❖

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Physician CME Questions

8. Which of the following components of the Glasgow Coma Scale appears to be the best outcome predictor?
a. Motor
b. Sensory
c. Verbal
d. Eye opening

9. Recent literature suggests etomidate appears to be safe:
a. only in adults.
b. only in adults and children older than 10 years.
c. in children of all ages as well as adults.
d. only when used in the operating room.

10. Regarding the study using nitroprusside in patients with aortic stenosis and heart failure, all of the following are true *except:*
a. Vasodilators have been considered contraindicated in patients with severe aortic stenosis because of concern about life-threatening hypotension.
b. Nitroprusside significantly increased cardiac function over a six-hour period in study patients with severe aortic stenosis and heart failure.
c. Nitroprusside appeared safer and more effective than dobutamine in the treatment of heart failure in patients with severe aortic stenosis.
d. Decreasing systemic vascular resistance appears to directly lead to proportional improvements in cardiac output in patients with severe aortic stenosis and heart failure.

11. Button batteries in the nasal cavity can cause significant tissue destruction and should be:
a. removed only under general anesthesia.
b. removed only by irrigation and nasal wash technique.
c. removed by an ENT specialist only.
d. removed immediately.
e. referred for operative surgical removal.

12. All of the following are examples of the positive-pressure technique to remove nasal foreign bodies *except*:
a. Fogarty balloon catheter removal.
b. forced exhalation removal.
c. "Parent's kiss" removal.
d. mouth-to-mouth removal.
e. Beamsley Blaster removal.

Answer key:

8. a **11. d**
9. c **12. a**
10. c

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.

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.

V_2 in the Mirror

By Ken Grauer, MD

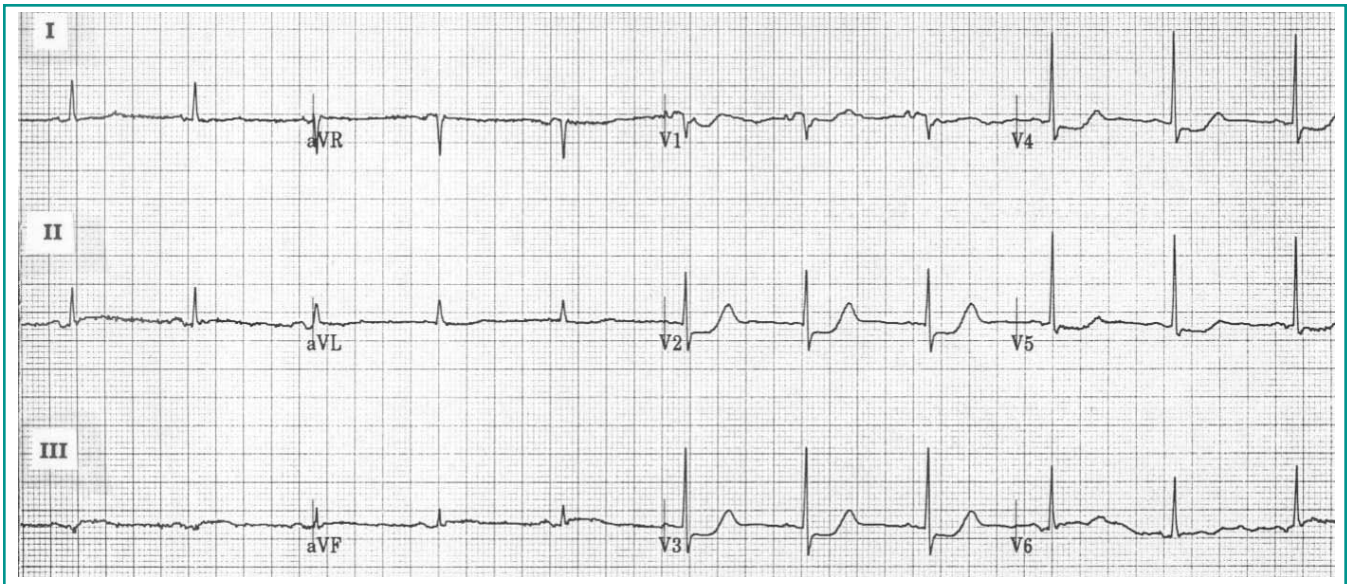

Figure. 12-lead ECG obtained from a 90-year-old woman with shortness of breath

Clinical Scenario: The ECG in the Figure was obtained from a 90-year-old woman admitted to the hospital for shortness of breath. In view of this history, how would you interpret her 12-lead ECG? Can you also account for the finding of early transition (R wave becoming taller than the S wave between leads V_1 and V_2)?

Interpretation: The rhythm is sinus at a rate of about 65 beats/minute. PR, QRS, and QT intervals are normal. Mean QRS axis is +25°. There is low voltage in the limb leads, and no ECG evidence of chamber enlargement. There appears to be an isolated Q wave in lead III, although low QRS amplitude makes this difficult to determine. As already noted, transition occurs early (between leads V_1 to V_2), with a dominant R wave (Rs complex) in lead V_2. However, the most striking finding on this 12-lead ECG is the flat (if not slightly downsloping) ST depression in precordial leads V_2 through V_5.

The clinical history provides an important clue for arriving at the correct ECG diagnosis in this case. This clue is based on the premise that silent myocardial infarction (MI) occurs in at least one-third of all MIs, with this entity being most common in diabetic patients and the elderly. Half of all patients with "silent" MI have no symptoms at all. In such patients, the diagnosis of infarction sometimes only will be made retrospectively when a follow-up ECG shows changes that suggest infarction has taken place since the last ECG was obtained. The other half of patients with "silent" MI do not have chest pain, but instead manifest *other* symptoms (i.e., shortness of breath, change in mental status, malaise, gastrointestinal symptoms, etc.). Of these nonchest pain symptoms associated with "silent" MI, shortness of breath is the most common, especially in older patients. This diagnosis, therefore, needs to be ruled out for the 90-year-old woman who presents with acute shortness of breath in this scenario.

Acute posterior infarction most often results from sudden occlusion of the right coronary artery. As a result, acute posterior MI most often also is associated with acute inferior MI—a finding suggested by the admittedly subtle but definitely present ST segment covering and elevation in leads III of the ECG in the Figure (possibly also with a Q wave in this lead III). None of the standard leads on a 12-lead ECG directly assess the posterior wall of the left ventricle. As a result, we invoke "mirror-image" leads, namely V_1, V_2, and/or V_3, when looking for signs of acute posterior MI. A positive "mirror test" is present in leads V_2 and V_3 of this tracing—in that turning this ECG over and holding it up to the light will reveal Q waves and ST segment elevation (the mirror image of the tall R wave and ST depression seen in leads V_2 and V_3 of the Figure). ❖

In Future Issues:

Highlights from the Society for Academic Emergency Medicine 2003 Annual Meeting