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How Reliable Is Clinical Examination for Detecting Pelvic Fractures?

Source: Gonzales RP. The utility of clinical examination in screening for pelvic fractures in blunt trauma. *J Amer Coll Surg* 2002;194:121-125.

THE PURPOSE OF THIS STUDY WAS TO PROSPECTIVELY EVALUATE the sensitivity of clinical examination as a screening modality for pelvic fractures in awake, alert blunt trauma patients. Only patients with a Glasgow Coma Score (GCS) of 14-15 were included. An elevated serum ethanol level was not an exclusion criterion. A detailed clinical evaluation was performed before radiography. This included inspection of the pelvis (i.e., abrasions over bony prominences; ecchymosis about the pubis, perineum and scrotum; blood at the urethral meatus); posterior and inward compression of the iliac wings; compression of the symphysis pubis; inspection for limb length discrepancy; hip flexion; inward and outward hip rotation; rectal examination with assessment for gross blood; and assessment for neurologic deficit. The clinical examination was documented on a study form and sealed in an envelope. A single anterior-posterior (AP) x-ray of the pelvis then was performed. All patients were admitted for a minimum 23-hour observation period and re-evaluated prior to discharge.

During a 32-month period, 2176 consecutive blunt trauma patients older than age 14 were evaluated. Ninety-seven (4.5%) of these had pelvic fractures. Two hundred fifty-five patients (12%) had positive clinical examinations, 89 (35%) of which had pelvic fractures. There were seven injuries missed on clinical examination (sensitivity 93%). None of these injuries required surgical intervention, and only two of seven had a change in weight-bearing status following the diagnosis. There were 463 patients who had ethanol levels greater than 100 mg/dL (range 100-480 mg/dL). In this subgroup, 20 fractures were identified, with only one missed on clinical examination (sensitivity 95%). The sensitivity of a single AP radiograph was 87%, with 13 missed injuries. All of these were identified by abdominopelvic computed tomography.

■ COMMENTARY BY MICHAEL A. GIBBS, MD, FACEP

Pelvic ring fractures are the third most common cause of injury-related death, following traumatic brain injury and aortic disruption. Despite advances in care, the mortality in this patient population remains

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between 5% and 10%.¹ So, the underlying message should always be rapid identification and characterization of the pelvic injury and concern with aggressive stabilization.

On the flip side, the results of this trial are consistent with four prior studies demonstrating that a good physical examination can exclude pelvic injury in the majority of alert patients.¹⁻⁴ In this study, the sensitivity of the clinical examination was actually better than radiography ($p < 0.05$). Of interest, elevated ethanol levels did not impact clinical diagnosis.

In 1998, the American College of Surgeons recommended pelvic radiography in "all patients suffering major blunt torso trauma."⁵ While this approach is effective at excluding injury, it comes at the expense of a large number of negative radiographs. In addition to the obvious financial implications, this approach results in unnecessary exposure to radiation, and potential delays in trauma patient evaluation and stabilization. While this trial supplements the current litera-

ture suggesting that low-risk criteria can be employed successfully, all studies to date (including this one) suffer from a relatively small sample size. A large, multicenter trial (such as with NEXUS) should be the next goal. ❖

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Questions & Comments

Please call Allison Mechem, Managing Editor, at (404) 262-5589, between 8:00 a.m. and 4:00 p.m. ET, Monday-Friday.

Angioplasty vs. Thrombolytics in Hospitals without Cardiac Surgical Backup

Source: Thrombolytic therapy vs primary percutaneous coronary intervention for myocardial infarction in patients presenting to hospitals without on-site cardiac surgery. *JAMA* 2002;287:1943-1951.

THE AVAILABILITY OF PRIMARY PERCUTANEOUS CORONARY intervention (PCI) for acute myocardial infarction (MI) largely has been limited to hospitals with immediate surgical backup available in the event of complications. In this study, the authors report the findings of the Atlantic C-PORT (Cardiovascular Patient Outcomes Research Team) trial, which compared PCI vs. thrombolytic therapy for acute MI patients at hospitals that did not have backup cardiac surgery or bypass capability.

During the study period, from 1996 through 1999, 11 hospitals in Maryland and Massachusetts without cardiac surgery backup underwent a three-month training period to develop a primary PCI program for acute MI patients. This program included teaching and training of staff, initiation of practice standards, and the development of a quality management program (details are available at <http://www.cport.org>). Hospitals were required to have a coronary care unit, existing cardiac catheterization laboratory, intra-aortic balloon pump capability, ability to measure activated clotting times, and interventional operators with a minimum of 50 interventions per year.

At these sites, acute MI patients requiring reperfusion (ST elevation in contiguous leads or new left bundle-branch block [LBBB] in patients presenting with chest pain of 30 minutes to 12 hours in duration) were randomized to receive either accelerated-dose tissue plasminogen activator

(tPA) (226 patients) or primary PCI (225 patients). Median time for tPA patients (door-to-drug) was 46 minutes, and for PCI patients (door-to-lab/balloon inflation) was 55/101.5 minutes. The investigators report that patients who underwent PCI had significantly lower rates of the combined endpoint of death, recurrent MI, or stroke at hospital discharge (9.8% vs 16.8%), 6 weeks (10.7% vs 17.7%), and 6 months (12.4% vs 19.9%).

This difference was most striking in the rates of recurrent MI. Accordingly, primary PCI patients had lower rates of subsequent cardiac catheterization and PCI (outside the study protocol) after their MI. There was a trend toward a lower rate of subsequent coronary artery bypass graft (CABG) in the primary PCI group as well. Interestingly, nearly twice as many PCI patients required blood transfusion compared with thrombolytic patients.

Based on their findings, the C-PORT investigators conclude that with an intensive development program, primary PCI can be performed safely and effectively in the community hospital setting without immediate cardiac surgery backup capability. Moreover, the authors conclude that such primary PCI is superior to accelerated thrombolytic therapy for the treatment of acute MI in this setting.

■ COMMENTARY BY THEODORE C. CHAN, MD, FACEP

This study represents the second largest randomized trial comparing primary PCI against thrombolytic therapy for acute MI reperfusion. Moreover, the C-PORT study is the only randomized trial in this country performed at hospitals without immediate cardiac surgery backup, once thought to be essential for the emergent mechanical reperfusion strategy.

This study adds to a growing body of literature suggesting that primary PCI results in improved clinical outcomes when compared to thrombolytic therapy.¹ While not a requirement for this study, many of the patients in the PCI group were undoubtedly treated with stents and glycoprotein inhibitors, advances that likely played a role in the superior outcome in the PCI group. Further advances (such as coated stents) may continue to improve clinical outcomes associated with primary PCI.

The findings of this study, however, are limited, primarily by its small sample size. In fact, enrollment fell well below the investigators goal of 2550 subjects initially estimated to be needed by power analysis. As a result, this study sheds little light on the role of hospital volume and its impact on the PCI vs. thrombolytic debate.²

Moreover, no PCI patient actually required emergent CABG or cardiac surgery in this trial. With a larger population, some patients would have suffered these expected, though rare complications, such as perforation or dissection. How these hospitals would have cared for such a

patient remains unclear (interestingly, two patients in the thrombolytic group did require CABG after PCI at another institution).

Finally, it remains to be determined whether large numbers of community hospitals are prepared to dedicate the resources needed to maintain primary PCI programs. The fact that the Atlantic C-PORT trial had to be suspended well short of its enrollment goals because funding could not be secured for its completion is a telling sign. ❖

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Analgesia for Children with Acute Abdominal Pain

Source: Kim MK, et al. A randomized clinical trial of analgesia in children with acute abdominal pain. *Acad Emerg Med* 2002;9:281-287.

RECENT STUDIES HAVE CHALLENGED THE LONG-HELD belief that analgesia may mask symptoms and physical findings among adults presenting to the emergency department (ED) with acute abdominal pain. This has led to recommendations in both the surgical and emergency medicine literature to provide analgesia after initial evaluation in patients with abdominal pain. This is the first study to examine the use of analgesia among children with acute abdominal pain.

The stated goals of this randomized, double-blind, placebo-controlled study were to examine the effect of intravenous morphine (MS) on pain reduction, physical examination, and diagnostic accuracy in children with acute abdominal pain. The study included children 5-18 years of age with abdominal pain of fewer than five days duration with a pain score greater than 5 on a vertical visual analog scale (VAS), the need for vascular access, and the need for surgical consultation as determined by the pediatric emergency medicine (PEM) physician. Exclusion criteria included hypotension, morphine allergy, pregnancy, prior abdominal surgery, refusal of analgesia, sickle cell disease, inflammatory bowel disease, and suspected biliary or pancreatic problems (to account for the questionable effect of morphine on the sphincter of Oddi).

After study consent was obtained, the PEM physician and the surgical consultant independently performed and

documented the physical exam and provisional diagnosis. Each marked the location of tenderness on a nine-zone grid representing the areas of the abdomen. Laboratory and other studies were ordered by agreement of the two physicians, and results were not reviewed until after the post-medication assessment and data sheets were completed. The study medication (either MS 0.1 mg/kg or normal saline) was then administered as randomized by the hospital pharmacy.

Fifteen to 30 minutes after the study medication was administered, the same physicians independently re-examined the patients and documented the location of tenderness and a final diagnosis. The final disposition was then made by the PEM physician and attending surgeon after reviewing the examination and diagnostic test results. Admitted patients were followed for complications, hospital course, and discharge diagnosis. Discharged patients received a follow-up telephone interview at 48 hours and a questionnaire, to be completed one week after ED discharge, about persistent pain and subsequent physician evaluations.

In a two-year period, 60 patients met the final study criteria (29 receiving MS and 31 receiving saline). The groups were similar in age, sex, ethnicity, pre-study VAS score, mean area of tenderness, and time interval between physician assessments. The median difference in the reduction of pain score between the two groups was 2 ($p = 0.002$). The decrease in the mean number of areas of tenderness with morphine was significant for the PEM physicians but not the surgeons. No decrease in mean areas of tenderness occurred in the saline group.

Twenty-one patients in the MS group and 23 patients in the saline group required exploratory laparotomy ($p = \text{NS}$). The mean duration of time from triage to surgery in the MS and saline groups were 7.2 and 6.6 hours ($p = \text{NS}$), respectively. The diagnostic accuracies between the PEM and surgical consultants pre-MS were 21/29 and 23/29, respectively. After MS, the accuracies were identical for both physician groups at 24/29. The study sample was not large enough to report significant adverse events.

The authors conclude that MS significantly decreases pain without affecting diagnostic accuracy or time to surgical intervention among children presenting to the ED with acute abdominal pain. ❖

■ COMMENTARY BY JACOB W. UFBERG, MD

This small, but well-done study demonstrates that we can expand to children (age > 5 years) what we have known to be true for adults for some time. The judicious use of analgesia among patients with abdominal pain will not obscure the diagnosis, and actually may help identify patients with nonsurgical causes of abdominal pain.

This study had one major limitation—the fact that the surgeons were able to examine patients both before and after analgesia. The surgical consultants were aware of the initial exam, and had that information when performing the post-medication exam. This does not represent a real-life situation in which the surgical consultant will have to make a decision based only on the post-MS exam.

Hopefully, this report is a stepping-stone to larger, multi-center pediatric studies that will demonstrate the benefits of analgesia to diagnostic accuracy as well as to patient comfort and satisfaction. We also must hope that some of these studies will be published where a majority of our surgical colleagues will read them. ❖

Prognostic Value of Cardiac Troponin-T in Patients with Renal Insufficiency

Source: Aviles RJ. Troponin-T levels in patients with acute coronary syndromes, with and without renal dysfunction. *N Engl J Med* 2002;346:2047-2052.

THE AUTHORS PRESENT A SECONDARY ANALYSIS OF data from the GUSTO-IV study, which was intended to assess the value of abciximab in patients with acute coronary syndrome (ACS). Patients were enrolled if they had one or more episodes of angina while at rest that lasted at least five minutes and were associated with new ST-segment depression, and/or had an abnormal cardiac troponin-T (cTn-T) value. Serum creatinine was measured and creatinine clearance was calculated. The primary endpoint was death and/or myocardial infarction (MI) within 30 days of enrollment. The risks of reaching the endpoint were adjusted for confounding variables including age, electrocardiogram (ECG) abnormalities, history of coronary disease, and diabetes.

Of 7800 patients enrolled, 7033 were fully evaluable. cTn-T was abnormally elevated (≥ 0.1 ng/dL) in 52%. Among patients with creatinine clearance values below 58 mL/min, an elevated cTn-T was predictive of increased risk of MI or death, with an adjusted odds ratio of 2.5 (95% CI, 1.8-3.3). This was similar to the risk among patients with higher creatinine clearances, who had an adjusted odds ratio of 1.7 (95% CI, 1.3-2.2). Elevation of cTn-T proved independently predictive of risk across the entire spectrum of renal function. The authors conclude that cTn-T levels are useful prognostic markers in patients with ACS regardless of renal function.

■ COMMENTARY BY DAVID J. KARRAS, MD, FACEP
Cardiac troponins are known to be excellent markers of

MI and appear to detect microinfarctions better than creatine kinase with muscle and brain subunits (CK-MB). In patients with ACS, therefore, elevations in cardiac troponin-I and cTn-T provide valuable independent prognostic information regarding the risk of short-term adverse cardiac outcomes, even in the absence of frank MI.¹ Because troponins are cleared by the kidneys, however, the utility of the test in patients with underlying renal insufficiency has been questioned. The authors of this powerful study have demonstrated that abnormal elevation of cTn-T yields the same prognostic information in patients with renal impairment as it does in patients with normal renal function. ❖

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Special Feature

Popliteal (Baker's) Cyst

By Richard A. Harrigan, MD, FAAEM

THE DIFFERENTIAL DIAGNOSIS OF THE PAINFUL, swollen calf is one that frequently is encountered in the emergency department (ED). The clinician must consider deep venous thrombosis (DVT), cellulitis, calf muscle (i.e., soleus, gastrocnemius, plantaris) tear or rupture, ruptured superficial venous varicosity, hematoma, compartment syndrome, fasciitis, and dissecting or ruptured popliteal cyst (PC).¹ It is the latter diagnosis that is less well-defined in our texts and literature—*Emergency Medicine: Concepts and Clinical Practice* devotes a single paragraph to this entity.² The following review will discuss the anatomic and pathophysiologic basis, along with the clinical presentation of the PC—in both its intact and ruptured forms. Diagnostic features, including imaging options, as well as associated complications and treatment of this entity also will be described.

Anatomy and Pathophysiology

In 1877, Baker elaborated upon what had been described earlier that century by Adams—synovial cysts of the knee. Thereafter, the eponymous Baker's cyst has been the term attributed to these cystic structures arising in the popliteal space.¹⁻⁷ Enlargement of the gastrocnemius-semimembranosus bursa, one of six bursa found in the popliteal fossa, is widely accepted as the origin of the majority of these popliteal cysts. (See *Figure 1*.) As with most bursa, it may communicate with the joint, and thus as joint fluid is elaborated, it will flow into the bursa. A “one-way, valve-like” effect has been

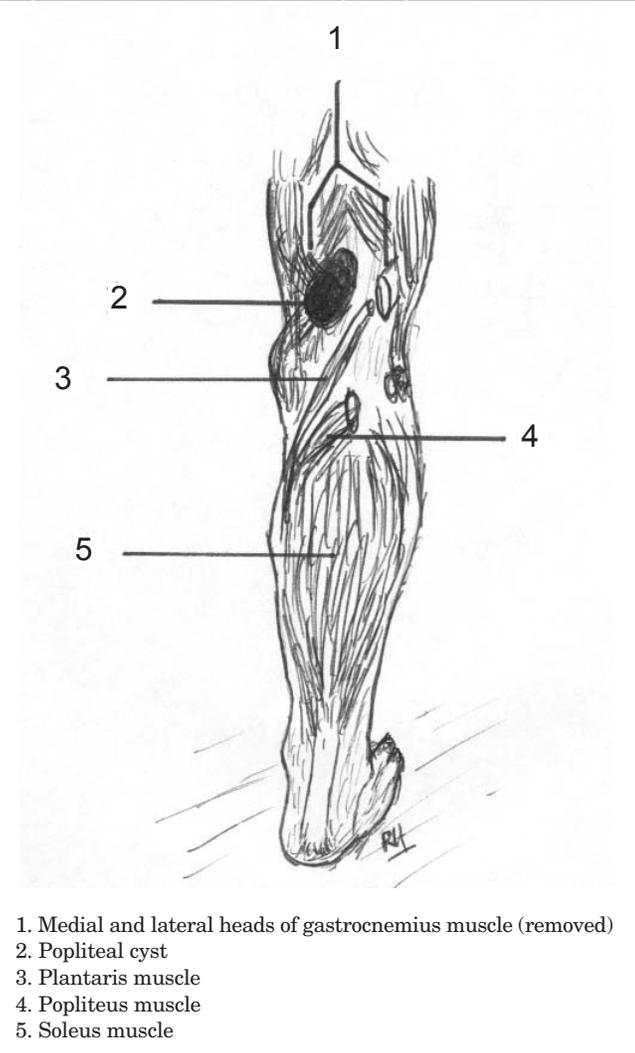
observed when studying joint injection of dye; knee flexion opens this valve and allows joint fluid to flow into the bursa; during extension of the knee, this valve is closed by contraction of the gastrocnemius and semimembranosus muscles. Whereas this unidirectional effect on fluid flow from knee joint to gastrocnemius-semimembranosus bursa is the cause of many PCs, other bursa have been implicated less frequently. Moreover, noncommunicating cysts also have been described—these being attributed to primary expansion of the bursa itself. Lastly, in some cases, a PC is actually a simple herniation of the posterior synovium of the knee.^{3-5,7} (See *Table 1*.)

PCs feature a bimodal peak age distribution: 4-7 years, and 35-70 years. The younger spike typically is not associated with joint disease and trauma, whereas the older variant—the more common—often has been associated with effusion-generating disease: osteoarthritis, rheumatoid arthritis, and knee trauma, especially medial meniscus tear (posterior horn) and chondral lesions.⁵⁻⁷ Thus, the PC seen in pediatric patients is generally a primary process without associated joint pathology, whereas the adult variety is usually a secondary process where the cyst communicates freely with the joint in the one-way manner outlined above. Joint effusions, from whatever cause, seem to be operative in the formation of the adult or secondary type, in which increasing volume of effusion leads to distention of the PC.⁴⁻⁷ Cyst incidence in adults increases with age, and it appears that, anatomically, the communication between the joint space and the bursa similarly increases with age.⁵

Clinical Presentation

The clinical appearance of PCs depends upon whether they are intact, dissecting, or ruptured. An intact PC may be asymptomatic, as has been demonstrated by arthrography and magnetic resonance (MR) imaging series; the former technique may overestimate the frequency, however, because the procedure itself distends the joint and may create a small PC.⁵ When symptomatic, intact PCs are typically mildly so, with patients noting discomfort behind the knee, stiffness, fullness, or swelling—all characteristically worsened by activity.^{3,5,7} PC symptomatology may be masked by that of the diseased joint.⁵ Physical examination may reveal posterior knee tenderness and a palpable popliteal mass, usually found on the medial side.⁷ This mass should be rounded, smooth, fluctuant, and will transilluminate. It is more evident and firm with the knee in full extension; on flexion, it becomes softer and less prominent, a finding referred to as Foucher's sign.^{3,5,7} The majority of the mass should be distal to the flexion crease of the knee; pulsatility suggests popliteal artery aneurysm, as does bruit—although a distended cyst may have a pulsatile

Figure 1. Posterior View of the Right Leg



1. Medial and lateral heads of gastrocnemius muscle (removed)
2. Popliteal cyst
3. Plantaris muscle
4. Popliteus muscle
5. Soleus muscle

quality. Most are unilateral.³ Excessive warmth, pain, and tenderness suggest infection of the cyst, which is rare. Case series reflect *Staphylococcus aureus* to be the most common pathogen in cases of infected cyst, although a variety of organisms, including tubercular, have been implicated.⁸ Lateral popliteal fossa location with a similar clinical picture is consistent with popliteus bursal enlargement. A PC may still exist without palpable evidence; thus physical examination has both limited sensitivity and specificity.⁵

If the PC is dissecting, it may present with escalating signs and symptoms localized to the calf as well as the posterior aspect of the knee. If the cyst ruptures, painful swelling and warmth of the calf will ensue, thus mimicking DVT and muscle tear. Some authors do not differentiate between dissection and rupture.⁹ PC rupture has been labeled the “pseudothrombophlebitis syndrome,” highlighting the difficulty in distinguishing this entity from DVT based purely on history and physical examination.^{1,7,9} Historically, ruptured PC-induced calf symptoms

Table 1. Differential Diagnosis of Posterior Knee Swelling

- | | |
|--|-----------------------------|
| • Popliteal (Baker's) cyst | • Lymphadenopathy |
| • Lipoma | • Popliteal artery aneurysm |
| • Hematoma | • Varicose veins |
| • Ganglion cyst | • Deep venous thrombosis |
| • Abscess | • Hemangioma |
| • Malignancy (e.g., fibrosarcoma, liposarcoma) | • Arteriovenous fistula |

Table 2. Complications Associated with Popliteal Cysts⁴⁻⁹

- Dissection
- Rupture
- Deep venous thrombosis (venous compression by PC)
- Lower leg ischemia (arterial compression by PC)
- Posterior tibial nerve entrapment
- Posterior compartment syndrome
- Anterior compartment syndrome
- Infection

are preceded by symptoms related to the cyst itself; yet it should be remembered that PCs may be asymptomatic, or minimally so. Homan's sign, infamous due to its insensitivity and lack of specificity for DVT, will likely be positive in dissecting or ruptured cysts. A crescent-shaped purplish discoloration distal to the malleoli in the presence of a swollen, tender calf favors the diagnosis of ruptured PC over DVT. Rarely, cyst rupture may track up the thigh, or rupture of the lateral popliteus cyst may extend down the anterolateral aspect of the lower leg.⁵ (See Table 2.)

Diagnostic Imaging Options

Although arthrography has traditionally been the gold-standard imaging procedure for popliteal cysts, newer non-invasive options have supplanted it. A variety of imaging studies can be used to detect intact PCs: arthrography, ultrasound, MR imaging, and computed tomography (CT) scan are those with the best literature support.^{1,5,7,10,11} Ultrasound has emerged as a favored test, for reasons of accuracy, ease, and utility in differentiating not only an intact PC from other popliteal pathology, but also ruptured PC from DVT.

Ultrasonic appearance of a PC is a round or ovoid avascular, nonechogenic mass with a well-defined border located medially in the popliteal fossa. It may have some hypoechoic material and septations in it due to hemorrhage and necrosis; bright echoes suggest proliferation of the synovial lining. Cysts bigger than 1-2 cm in diameter are distinguishable from the midline hypoechoic popliteal artery. False negative studies may result from total rupture and deflation of the cyst, filling of the cyst with echogenic debris, and diameter too small for detection. Ultrasound is especially good at distinguishing popliteal artery aneurysm (the most common site of peripheral aneurysms) from PC, as well as defining the dimensions of solid structures (e.g., tumors).^{7,11}

Duplex sonographic imaging is important in the diagnosis of ruptured PC, in that it has become the ED test of choice for the main competing diagnostic entity: DVT. Applying the “worst first” doctrine, DVT should first be excluded, and then PC can be sought while doing the same test. If the cyst is decompressed totally, it may be difficult to find, but calf extension of the cyst features indistinct cyst borders together with the proper history (sudden onset calf pain) and no evidence of DVT. The clinician must be cautious, however, in that DVT and PC may coexist.^{1,5,7,9,10} Imaging techniques may be complementary and can be combined in difficult cases.⁵

Treatment

Treatment of a symptomatic, unruptured PC generally is conservative; in secondary PC, treatment should be directed toward decreasing the effusion associated with the underlying knee disorder. Intra-articular steroid injection after arthrocentesis has been recommended, along with ice, elevation, and anti-inflammatory medications. Less frequently, the cyst itself is aspirated and injected. Operative intervention is reserved for more severely symptomatic cases. In either case, orthopedic referral is appropriate. Treatment of ruptured PC is directed at symptom relief.⁵⁻⁷ ❖

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Physician CME Questions

- What is the approximate mortality associated with major pelvic trauma?**
 - < 1.0%
 - 3-5%
 - 5-10%
 - > 20%
- In the Gonzalez study, alcohol intoxication decreased the sensitivity of clinical examination for the detection of pelvic fracture.**
 - True
 - False
- In patients with acute coronary syndrome who have renal insufficiency, cardiac troponin values:**
 - are of little significance.
 - are less reliable than in patients with normal renal function.
 - are highly useful markers of adverse cardiac outcomes.
 - must be interpreted using different reference standards.
- Ruptured popliteal cysts:**
 - mimic DVT.
 - are frequently pyogenic.
 - are usually bilateral.
 - are best seen on plain film radiography.
- The differential diagnosis of ruptured popliteal cyst includes:**
 - muscle tear.
 - deep venous thrombosis.
 - cellulitis.
 - All of the above
- Treatment options for symptomatic popliteal cysts include:**
 - heparin.
 - oral colchicine.
 - intraarticular steroid injection following effusion drainage.
 - intraarticular colchicine injection following effusion drainage.
- The judicious use of analgesia among children with acute abdominal pain:**
 - improves pain scores but decreases diagnostic accuracy.
 - increases door-to-operating room time.
 - improves pain scores without affecting diagnostic accuracy.
 - increases the mean number of areas of tenderness on exam.
- In the Atlantic C-PORT trial comparing primary PCI with thrombolytic therapy for acute MI, investigators concluded:**
 - primary PCI was superior in hospitals without emergency cardiac surgery backup.
 - thrombolytic therapy was superior in those patients requiring cardiac surgery.
 - primary PCI and thrombolytic therapy were equivalent.
 - primary PCI was superior in hospitals with high volumes of emergency cardiac surgery.

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.

Marcapasos in an Older Woman

By Ken Grauer, MD

Figure. 12-lead postoperative ECG obtained from an 87-year-old woman with dyspnea.

Clinical Scenario: An 87-year-old Hispanic woman had a postoperative electrocardiogram (ECG) performed as part of her evaluation for dyspnea that developed following abdominal surgery. There was no chest pain. A permanent cardiac pacemaker (“*marcapasos*”) had been implanted years earlier for some type of rhythm disorder. Her 12-lead ECG is shown above. Does it appear that the pacemaker is functioning appropriately? Can you identify two *other* findings on this ECG that may be relevant to her clinical situation?

Interpretation: With exception of two spontaneous beats (labeled *X* and *Y*), the lead II rhythm strip at the bottom of the tracing shows regular pacer spikes at a rate of 70 beats/minute. Each pacer spike reliably *captures* the ventricles (evidenced by the fact that each pacer spike is followed by both a QRS complex and T wave). Sensing function of the pacer is also appropriate, as judged by the finding of a constant R-to-spike interval (interval from spontaneous beat until the next pacer spike) that is appropriately the same as the inherent pacer rate. The key to detecting the findings of concern on this tracing

lies with focusing on the two spontaneous beats (*X* and *Y*)—and in viewing QRS morphology of these spontaneous beats in each of the three simultaneously recorded leads. Despite not being certain of the underlying spontaneous rhythm (impossible to determine if a P wave precedes beats *X* and *Y* in lead II)—what *can* be said is that spontaneous QRS morphology in leads II and aVF, as well as in leads V₄, V₅, and V₆ show ST segment coving, slight ST segment depression, and moderately deep and symmetric T wave inversion. Serial Troponin I values were found to be positive for acute infarction.

The second ECG finding of concern on this tracing is more subtle, and relates to the appearance of the T wave of several paced complexes. Although ST segment/T wave morphology in paced complexes is rarely indicative of specific pathology, one is struck by the peaked appearance of many of the paced beats in this tracing. In further support of our suspicion, the T wave appearance in the spontaneous beat seen in lead aVL is peaked enough to merit checking serum electrolytes, which revealed moderate postoperative hyperkalemia. ❖

In Future Issues:

Nasogastric vs. Intravenous Hydration of Dehydrated Children