2:45

800-4 Cardiac Risk Assessment Following Vascular Surgery — Independent Validation of a Bayesian Prediction Model

Gilbert J. L'Italien, Sumita D. Paul, Robert C. Hendel, Mylan C. Cohen, Lee A. Fleisher, Kenneth A. Brown, Stuart W. Zarich, Jeffrey A. Leppo, Kim A. Eagle. *Massachusetts Hospital Boston, MA; Univ. of Massachusetts, Worcester, MA; Deaconess Hospital, Boston, MA; Univ. of Vermont, Burlington VT; Johns Hopkins Univ., Baltimore, MD; Yale Univ., New Haven Ct. Northwestern Univ, Chicago, ILL; Univ. of Michigan, Ann Arbor, MI*

We previously described a Bayesian cardiac risk prediction model developed from a "training" set of 567 vascular surgery pts from 2 medical centers (43rd ACC). Here, we report the results of a validation based on 514 additional pts from 3 centers. The original model permitted sequential estimation of risk of fatal/non-fatal MI based on surgery type (TYPE), TYPE + clinical markers (CLIN): (HxMI, Angina, CHF, Diabetes, age > 70 y, prior CABG), and TYPE + CLIN + dipyridamole thallium data (fixed/reversible defects, ischemic ST changes). Model performance was assessed using receiver operator curves (ROC) and by comparing observed event rates to risk estimates.

1-Specificity
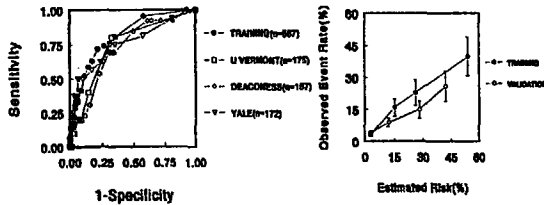
Results are shown above for both the training and validation sets (1,081 patients). *Figure 1:* ROC areas were 81 ± 3% for the training set and 74 ± 9%, 72 ± 7%, and 76 ± 5% for each of the 3 validation sets (p = NS). *Figure 2:* Observed and estimated risks were comparable for the training set ("goodness of fit" p = 0.75), and all 3 validation sets (p = 0.55, 0.10, 0.45, respectively). *Conclusions:* The Bayesian prediction model can reliably estimate the risk of a perioperative cardiac event in both the training and validation sets and is thus generalizable to the vascular surgery population.

3:00

800-5 Evaluation of Ventilation/Perfusion Scintigraphy Using Tc-99m Diethylenetriamine Pentacetic Acid (DTPA) Aerosol in the Diagnosis of Pulmonary Embolism

Nelson P. Trujillo, Jonathan P. Pratt, Sachin Talusani, Robert A. Quaife, David Kumpe, James L. Lear. *University of Colorado Health Sciences Center, Denver, CO*

Ventilation/perfusion (V/Q) scintigraphy has generally been performed using Xenon-133 for ventilation. However, PIOPED and other studies that have employed this technique have raised questions about accuracy in the diagnosis of pulmonary embolism (PE).

We evaluated the accuracy of V/Q scintigraphy using Tc-99m DTPA aerosol, as opposed to Xenon-133, in the evaluation of suspected PE. The use of Tc-99m DTPA offers potential advantages: greater resolution and the ability to perform ventilation imaging in the same eight views as those of the perfusion study.

Diagnostic criteria developed specifically for Tc-99m DTPA aerosol were prospectively applied to 2922 patients being evaluated for suspected PE over a six year period. Of these patients, 16% had normal V/Q scans, 56% had low probability scans, 10% had indeterminate scans, 9% had medium probability scans, and 9% had high probability scans. The total percent of scans in normal, high, or low categories was 81%, compared to 61% in PIOPED. Pulmonary angiography was performed on 264 patients. Pulmonary embolic disease was identified in 0/1 (0%) of normal scans, 3/59 (5%) of low probability scans, 13/54 (24%) of indeterminate scans, 35/94 (43%) of medium probability scans, and 53/56 (95%) of high probability scans. Estimated incidence of PE in the total population was 15%.

These results indicate that V/Q scintigraphy using Tc-99m DTPA aerosol 1) is useful in the diagnosis of pulmonary embolic disease and 2) has accuracy which is superior to published results using Xenon-133, including PIOPED. We believe that Tc-99m DTPA aerosol should replace Xenon-133 in V/Q scintigraphy for the diagnosis of suspected pulmonary embolism.

3:15

800-6 Anticoagulation Monitoring: Accurate Results With Patient Self-Testing in a Multicenter Trial

Richard Becker, Daniel Becker, Maureen Andrew, Jack Ansell, Douglas Triplett, Catherine Cimini, Frank LaDuca, and the Oral Anticoagulation Study Investigators. *Thrombosis Research Center, University of Massachusetts Medical Center, Worcester, MA*

A novel whole blood Prothrombin Time (PT) system (ProTIME Microcoagulation System, International Technidyne Co., Edison, NJ), was tested in five anticoagulation clinics to assess the patient's ability to collect and test a finger-stick blood sample (FS) and to assess the accuracy of the ProTIME result (INR) with the lab plasma assay. FS and venous samples (VS) were obtained from control volunteers (n = 65) and patients receiving warfarin (n = 230). Written, video, and verbal instruction was provided by a Health Care Professional (HCP). Once collected, blood was automatically tested in triplicate with concurrent control tests. VS was sent to the hospital lab for testing (ISI ranging 1.2 to 2.1). A sample of the plasma was shipped to a reference lab where the assay was repeated (Recomboplastin, ISI = 1.0). The HCP noted patient attempts necessary to obtain a ProTIME result. The first attempt was successful for 83% of the patients. An additional 10% were successful in the second try. Most graded the monitor "Easy" to use (85%) while few identified it "Difficult" (7.5%). Participants preferred the FS sampling method (92%). No difference was detected between ProTIME results of VS and FS (Student's t Test). The ProTIME INR was significantly correlated to the reference lab (r = 0.94 for VS and r = 0.93 for FS). The correlation of FS to each hospital site ranged from r = 0.89 to r = 0.93. *Conclusion:* Patients prefer and can readily test themselves with the ProTIME Monitor yielding test results that are highly correlated to the laboratory.

801 Coronary Artery Care: Effects to Improve Efficiency

Wednesday, March 27, 1996, 2:00 p.m.–3:30 p.m.
Orange County Convention Center, Room 224C

2:00

801-1 The Effect of Public Release of Bypass Surgery Mortality Data on Procedural Access in the Elderly: New York State

Eric D. Peterson, James G. Jollis, Elizabeth R. DeLong, S. Robert Collins, Lawrence H. Muhlbaier, Daniel B. Mark. *Duke University Medical Center, Durham, NC*

New York (NY) State has released provider-level bypass surgery (CABG) mortality data since 1989. Some speculate that this policy may force higher-risk patients, particularly the elderly, to go out-of-state for CABG or to forgo intervention. Using Medicare data, we examined CABG use in and outside NY. We tested (1) whether the % of patients aged ≥ 65 years who received CABG outside NY increased from 1987 to 1992 and (2) whether CABG use declined in NY in higher-risk patients, defined as those aged ≥ 70 years with acute MI (AMI), versus US practice patterns during this period.

	1987	1988	1989	1990	1991	1992
NY Medicare CABG recipients, n	5488	5784	6148	7093	8279	9075
Out-of-State CABG, %	13.2	15.0	14.8	13.1	13.3	11.6
NY Pts aged ≥ 70 yr with AMI + CABG, %	4.4	5.8	6.3	8.8	7.7	8.1
US Pts age ≥ 70 yr with AMI + CABG, %	6.9	8.4	9.2	10.5	10.4	11.1

The % of NY's elderly migrating out-of-state for CABG has declined since the release of provider profiling data. In addition, an increasing % of NY's high-risk elderly patients with AMI received CABG over this period in parallel with national practice patterns.

Conclusion: Public release of provider-level CABG mortality data in NY does not appear to have limited access to CABG procedures for the elderly.

2:15

801-2 Potential for Cost Savings in High Cost Coronary Bypass Surgery Patients: A New York State Analysis

Patricia A. Cowper, Elizabeth R. DeLong, Eric D. Peterson, Edward L. Hannan, Kevin T. Ray, Michael Racz, James G. Jollis, Daniel B. Mark. *Duke University Medical Center, Durham, NC*

To assess potential for cost savings, we examined the extent and sources

of variation in resource use for coronary artery bypass surgery (CABG) in 20 New York (NY) hospitals in 1992 (n = 10,080). Patient (pt) level costs, exclusive of professional fees, were calculated using hospital-specific, department cost to charge ratios and were leveled for hospital-specific factors (e.g. teaching costs, input costs). Preoperative risk factors were obtained from the NY Cardiac Surgery Reporting System. Mean cost and LOS (± SD) were $14,448 ± $8,606 and 13.5 ± 8.6 days. Pt factors explained 27% of variation in cost and 30% in LOS, with ↑ resource use associated with ↑ age, female gender, ↓ ejection fraction, CHF, prior heart surgery and stroke. Hierarchical modeling revealed that individual hospitals explained 63% of residual variation in cost, after adjusting for pt factors. The range of predicted cost among hospitals for a typical pt (65 year old white male; 3 diseased vessels; ejection fraction 50–59%) was $9,000–$23,000 (see figure).
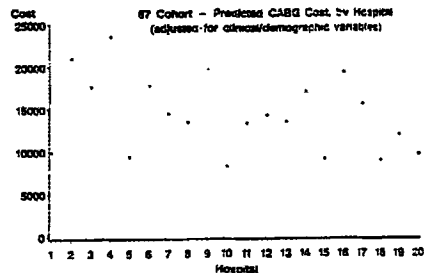
Conclusions: After adjusting for pt risk factors and differences in input costs, considerable variation in CABG costs remained among NY hospitals. This inter-hospital variation identifies the potential for substantial cost savings in some hospitals.

2:30

801-3   Validation of a Clinical Prediction Rule for Predicting Left Ventricular Function Post Acute Myocardial Infarction in a Community Hospital Setting

Ken Tobin, Robert Stomel, Daniel Harber, Dean Karavite, Kim Eagle. *Botsford General Hospital, Farmington Hills, MI; University of Michigan Medical Center, Ann Arbor, MI*

Previously, we (KE) reported that if a post myocardial infarction patient meets four simple clinical and/or ECG criteria, their left ventricular ejection fraction (LVEF) is ≥ 40% with a positive predictive value of 0.98. These criteria were (1) no history of congestive heart failure (CHF), (2) an ECG without either a LBBB, paced rhythm, or left ventricular hypertrophy (LVH) with strain, (3) an index MI that is not an anterior Q-wave, and (4) no history of a prior Q-wave MI outside the current ischemic zone. In order to validate this in the community hospital setting, we identified 213 patients admitted with the primary discharge diagnosis of acute myocardial infarction (AMI) (ICD Code 410.01–410.91) between 6/23/93–3/7/95. All patients in the study met standard clinical and enzymatic definitions for acute infarction and had undergone at least one measure of LVEF such as echocardiography, ventricular angiography or gated blood pool scan. Of 213 patients, the clinical rule predicted that 83 (39%) would have LVEF ≥ 40%. Of these 83 patients, 71 had an ejection fraction ≥ to 40%, for a positive predictive value of 86%. Of the 12 patients that were incorrectly predicted to have preserved LV function, 67% (8/12) had an index non-Q anterior MI with an average CK peak of 1300 U/L.

Conclusion: This simple clinical prediction rule has a positive predictive value of 86% when applied in the community hospital setting. It appears that patients with extensive anterior non Q-wave MI may be one group where the rule is inaccurate. We believe that when a technology-based assessment of left ventricular function is considered in the post-MI patient, this prediction rule may allow a more cost effective selection of patients for whom the test will be especially helpful and that as many as 40% of patients may require no testing at all.

2:45

801-4   Predictors of Increased Length of Stay of Patients Undergoing Coronary Intervention Procedures

Lari Harrell, Robert Piana, Alexander Pedan, Andrew Selwyn, Thomas Lee, Igor F. Palacios. *Cardiac Unit, Massachusetts General Hospital, Brigham and Women's Hospital (Partners Inc), Harvard Medical School, Boston*

In the present era of health care reform there is a need to decrease cost in patients undergoing coronary intervention procedures. Since post-procedure length of stay (LOS) is an important determinant of cost, the present study

was undertaken to determine factors responsible for increased LOS. A total of 1646 patients underwent 1792 coronary interventional procedures to treat 2353 lesions at the Massachusetts General Hospital and the Brigham and Women's Hospital from 1/1/94 to 12/31/94. There were 1139 males and 507 females, mean age 64 ± 12 years. Median LOS was 4 ± 5 days. Demographic, comorbid, procedural and post-procedure adverse event variables were included in a stepwise multiple linear regression analysis. Independent predictors of LOS include blood transfusion (p = 0.001), elective by-pass surgery (CABG) (p = 0.001), vascular repair (p = 0.001), hospital acute renal failure (p = 0.001), total number of procedures (p = 0.001), history of myocardial infarction (p = 0.001), ACC/AHA type C lesion intervention (p = 0.001), stent utilization (p = 0.001), diabetes mellitus (p = 0.001), emergent CABG (p = 0.001), evolving myocardial infarction (p = 0.001), cerebrovascular disease (p = 0.01) and congestive heart failure (p = 0.01). The R value of the model was 0.6. Conclusion: This model demonstrates the complexity of patients undergoing coronary interventions and the factors surrounding their process of care. Intervention on select predictors offers the opportunity to model LOS, decrease cost and improve quality of care.

3:00

801-5   The Impact of Stress Testing on Subsequent Invasive Cardiac Procedures

David E. Wennberg, Mirle A. Kellett, John D. Dickens, David J. Malenka, Leonard M. Keilson, Robert B. Keller. *Maine Medical Center, Portland ME; Maine Medical Assessment Foundation, Augusta, ME*

There has been considerable interest in explaining the variable use of invasive cardiac procedures, however, the role of stress testing has been relatively ignored. Because most patients being evaluated for chest pain initially undergo a stress test, we hypothesized that geographic variation in invasive procedures would largely be explained by the variable use of stress testing. Methods: Twelve coronary angiography service areas were constructed for Medicare beneficiaries in Northern New England. Age/sex adjusted utilization rates were developed for three procedure categories: total stress test, coronary angiography and revascularization. Total stress tests were further stratified into non-imaging and imaging procedures (e.g., thallium). Tests done in follow-up to invasive procedures were excluded (e.g. stress test following revascularizations). Linear regression was used to assess the relationship between procedure categories. Results: A tight relationship was found between total stress test rates and the rates of subsequent coronary angiography (R^2 = 0.61, p < 0.005). Most of the variance was explained by imaging stress tests (R^2 = 0.50, p < 0.02). A very strong relationship was found between coronary angiography and revascularization (R^2 = 0.82, p < 0.0001). Finally, a clear relationship between total stress tests and subsequent revascularizations was also found (R^2 = 0.55, p < 0.006). Conclusion: the population based rates of diagnostic testing largely explained the variance associated with subsequent therapeutic interventions. Our results suggest that local testing intensity is an important determinant of the variable use of invasive cardiac procedures.

3:15

801-6   Cost vs Outcome for Redo Coronary Surgery vs Coronary Angioplasty for Clinical Recurrence After Coronary Surgery

William S. Weintraub, Patrick D. Mauldin, Edmund Becker, Ellis L. Jones, Douglas C. Morris, Spencer B. King III, Robert A. Guyton, Joseph M. Craver. *Emory U School of Medicine, Atlanta GA*

Coronary revascularization after prior coronary surgery was studied in 4174 patients: PTCA in 2613 and redo CABG in 1561. PTCA patients were more often female (20% vs 16%, p = 0.002), fewer had prior myocardial infarction (MI) (56% vs 62%, p = 0.0003) or congestive failure (9% vs 15%, p < 0.0001). Patients were similar in age (61 ± 10), hypertension (48%), diabetes (22%)

	PTCA	Redo CABG	P Value
In Hospital			
Mortality	1.2%	6.8%	<0.0001
Stroke	0%	2.8%	0.27
Myocardial Infarction	1.5%	5.4%	<0.0001
Length of Stay (days)	3 ± 4	11 ± 12	<0.0001
Cost (1000's)	$8.5 ± 7.3	$24.2 ± 17.3	<0.0001
5 Years			
Survival	80%	76%	<0.0001
Corrected Survival	81%	78%	NS
MI Freedom	79%	80%	<0.08
CABG Freedom	95%	74%	<0.0001
PTCA Freedom	90%	58%	<0.0001
Recurrent Angina	48%	41%	0.0002