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ABSTRACT & COMMENTARY

Clinical Practice Guidelines for Platelet Transfusion

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Dr. Tran reports no financial relationships relevant to this field of study.

This article originally appeared in the January 2015 issue of Critical Care Alert. *It was edited by David J. Pierson and peer reviewed by William Thompson, MD. Dr. Pierson is Professor Emeritus, Pulmonary and Critical Care Medicine, University of Washington, Seattle, and Dr. Thompson is Associate Professor of Medicine, University of Washington, Seattle. Drs. Pierson and Thompson report no financial relationships relevant to this field of study.*

SYNOPSIS: Based on a recent systematic review of the literature, clinical guidelines were developed by the American Association of Blood Banks with the goal of providing platelet transfusion thresholds for adult patients in common clinical scenarios.

SOURCE: Kaufman RM, et al. Platelet transfusion: A clinical practice guideline from the AABB. *Ann Intern Med* 2014 Nov 11 [Epub ahead of print].

The American Association of Blood Banks (AABB) commissioned a panel of 21 experts to develop guidelines on the appropriate administration of platelet transfusion in adult patients based on the best available published evidence. The guidelines were based on a recent systematic review of the literature searching PubMed from 1946 to September 2014 and the Cochrane Central Register of Controlled Trials and Web of Science from 1900 to September 2014. Seventeen randomized, controlled trials and 53 observational studies were included in the final review. The authors aimed to identify platelet thresholds in common clinical situations at which prophylactic platelet transfusion would likely improve hemostasis and benefit the patient.

In summary, the AABB had six recommendations of varying strengths based on

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[INSIDE]

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[ALERT]

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the availability of quality evidence. The AABB recommends the prophylactic transfusion of platelets in the following clinical scenarios:

1. Hospitalized adults with therapy-induced hypoproliferative thrombocytopenia with a platelet count of <= 10 x 10^9 cells/L (10,000 cells/μL) to reduce the risk of spontaneous hemorrhage. Low-dose platelet transfusions (equal to one-half a standard apharesis unit) are equally effective in decreasing bleeding risk but require more frequent transfusions; however, high-dose platelet transfusions (double the standard dose) do not provide additional hemostatic benefit (quality of evidence: moderate, strength of recommendation: strong).
2. Patients having elective central venous catheter (CVC) placement with a platelet count < 20 x 10^9 cells/L (20,000 cells/μL) (quality of evidence: low, strength of recommendation: weak).
3. Patients having elective diagnostic lumbar puncture (LP) with a platelet count < 50 x 10^9 cells/L (50,000 cells/μL) (quality of evidence: very low, strength of recommendation: weak).
4. Patients having major elective non-neuraxial surgery with a platelet count < 50 x 10^9 cells/L (50,000 cells/μL) (quality of evidence: very low, strength of recommendation: weak).
5. The last two recommendations focus on clinical scenarios in which the AABB does not recommend routine prophylactic platelet transfusion:
6. The AABB recommends against routine prophylactic platelet transfusion for patients who are nonthrombocytopenic and have cardiac surgery with cardiopulmonary bypass. Transfusion is suggested if these patients exhibit perioperative bleeding with thrombocytopenia and/or evidence of platelet dysfunction (quality of evidence: very low, strength of recommendation: weak).
7. The AABB cannot recommend for or against platelet transfusion in patients receiving antiplatelet therapy who have traumatic or spontaneous intracranial hemorrhage (quality of evidence: very low, strength of recommendation: uncertain).

■ COMMENTARY

Given that most platelet transfusions are ordered prophylactically to reduce the risk of bleeding in patients with hematopoietic disorders and/or prior to invasive procedures, these recommendations are a helpful guide in managing thrombocytopenia in commonly encountered clinical scenarios. The authors duly note that these guidelines are not meant to be universal standards of care; clinical scenarios can be quite complex, and platelet counts are not representative of platelet function. Development of these guidelines highlights the need for further investigation in this field, as data are limited beyond the indication for prophylaxis against spontaneous hemorrhage in patients with hypoproliferative thrombocytopenia (recommendation #1). The AABB recommendations are mostly based on observational data, often from a single center's experience, and, thus, rely heavily on the panel's expert interpretation and consensus (or lack thereof) on the topic. Although this can result in more biased data, one can envision the potential ethical challenges of doing randomized trials involving prophylactic platelet transfusions prior to procedures. It is reassuring, however, that severe or life-threatening bleeding complications (WHO modified bleeding scale grade 3 or 4) are quite rare in the setting of invasive procedures such as CVC placement or LP. Therefore, the higher platelet transfusion recommendations for interventions involving the central nervous system (< 50,000 cells/μL for LP, < 80,000-100,000 cells/μL for surgeries traditionally) are largely based on the potential for devastating neurologic complications as a result of bleeding rather than actual observed outcomes. ■

ABSTRACT & COMMENTARY

Should Long-acting Bronchodilators Be Used in Acute Exacerbations of COPD?

By David J. Pierson, MD

This article originally appeared in the January 2015 issue of Critical Care Alert. *It was peer reviewed by William Thompson, MD. Dr. Pierson is Professor Emeritus, Pulmonary and Critical Care Medicine, University of Washington, Seattle, and Dr. Thompson is Associate Professor of Medicine, University of Washington, Seattle. He is the editor of* Critical Care Alert. *Drs. Pierson and Thompson report no financial relationships relevant to this field of study.*

SYNOPSIS: In this study of administrative data from patients admitted to 421 U.S. hospitals with acute chronic obstructive pulmonary disease (COPD) exacerbations, 41% received long-acting bronchodilators, which are not recommended in this setting. Comparison with patients who did not receive the long-acting agents showed no evidence for clinical or economic benefit from their use.

SOURCE: Lindenauer PK, et al. Use and outcomes associated with long-acting bronchodilators among patients hospitalized for chronic obstructive pulmonary disease. *Ann Am Thorac Soc* 2014 Aug 28. [Epub ahead of print].

This was a retrospective cohort study of 421 U.S. hospitals participating in the Premier Inpatient Database. It focused on patients hospitalized with exacerbations of chronic obstructive pulmonary disease (COPD) between January 1, 2010 and June 30, 2011. Its purpose was to determine the frequency with which long-acting bronchodilators (LABDs, which are approved and recommended for use in long-term management of stable patients) are used in this setting.

The Premier Inpatient Database includes approximately 15% of admissions to acute care U.S. hospitals, and it has been used extensively in comparative effectiveness research for COPD. The authors reviewed data for all patients older than age 40 with a principal discharge diagnosis consistent with acute COPD exacerbation, who were also treated with systemic corticosteroids. Patients were excluded if they were intubated (in which case LABDs could not be administered), transferred, or discharged within 2 days. The primary outcome variable was a composite measure of treatment failure (invasive mechanical ventilation, in-hospital death, or readmission within 30 days); secondary outcomes included length of stay and hospital costs. The authors used propensity score analysis to compare patients who received LABDs to those who did not, in addition to multiple other statistical means for reducing confounders.

Of the 77,378 patients included in the analysis (mean age 69; 58% female; 77% white), 31,725 (41%) received LABDs during their hospital stay. Of the patients, 48% of these received long-acting beta agonists alone, 21% received tiotropium alone, and 31% received both. Treatment failure, as defined for this study, occurred in 13.4% of patients, including 2.2% who required invasive mechanical ventilation, 3.4% who received noninvasive ventilation, 1.8% who died, and 8.6% who were readmitted within 30 days. Patients treated with LABDs tended to be younger, to have a slightly lower comorbidity score, and to have been admitted previously for COPD exacerbations (all statistically significant differences). These patients also received inhaled corticosteroids in the hospital much more often than patients not treated with LABDs (82% vs 12%; $P < 0.0001$).

In the propensity-matching analysis (which could be done for 81% of the LABD-receiving patients) there were no significant differences in treatment failure, a composite measure of complications, length of stay, or hospital costs between the two groups. Secondary analysis revealed no outcome associations for either type of LABD, separately or in combination, nor for cardiovascular complications, in comparison with patients receiving short-acting bronchodilators alone. The authors conclude that LABDs are commonly prescribed to patients hospitalized with acute COPD exacerbations, but that this is not associated with improved clinical or economic outcomes.

■ COMMENTARY

Drugs shown to be effective in, and FDA-approved for, use in one pulmonary condition tend to metastasize to other conditions with similar features for which both evidence for clinical effectiveness and approval for use are lacking. The widespread prescription of montelukast for patients with COPD, and of anticholinergic agents in the long-term management in asthma, come to mind as examples. Long-acting bronchodilators — both beta agonists and anticholinergics — have been shown effective in the long-term management of COPD, but not in acute exacerbations. The present study's finding that 41% of COPD patients hospitalized for acute exacerbations received long-acting agents suggests that this is another example of this "indication creep."

A natural tendency to step up pharmacologic management — adding new agents while continuing those already in use — during a worsening of the patient's condition, as well as administrative pressure to make sure that established outpatient regimens are not lost track of when patients are hospitalized, may contribute to this disappointingly high rate of non-recommended drug administration. ■

ABSTRACT & COMMENTARY

Prior Authorization versus Prospective Audit with Provider Feedback: Does the Effectiveness of the Core Antimicrobial Stewardship Strategies Differ?

By Timothy C. Jenkins, MD

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Dr. Jenkins reports no financial relationships in this field of study.

This article originally appeared in the January 2015 issue of Infectious Disease Alert. *It was edited by Stan Deresinski, MD, FACP, FIDSA, and peer reviewed by Patrick Joseph, MD, FIDSA, FSHEA. Dr. Deresinski is Clinical Professor of Medicine, Stanford University, Associate Chief of Infectious Diseases, Santa Clara Valley Medical Center, and Dr. Joseph is Associate Clinical Professor of Medicine, University of California, San Francisco, Chief of Epidemiology, San Ramon (CA) Regional Medical Center. Dr. Deresinski has served as a one-time consultant for Cubist and Bayer, and Dr. Joseph is laboratory director for Genomic Health and Siemens Corp.*

SYNOPSIS: In a single academic medical center, changing from a strategy of prior authorization to prospective audit with feedback led to significantly increased total antibiotic use and use of agents with a broad spectrum of gram-negative activity.

SOURCE: Mehta JM, et al. Comparison of prior authorization and prospective audit with feedback for antimicrobial stewardship. *Infect Control Hosp Epidemiol* 2014;35(9):1092-1099.

Infectious Diseases Society of America (IDSA) guidelines for developing antimicrobial stewardship programs refer to two core antimicrobial stewardship strategies: prior authorization and prospective audit with provider feedback.[1] With prior authorization, use of selected antibiotics requires approval from a stewardship team member; whereas prospective audit with feedback involves post-prescription review of antibiotic regimens by a stewardship team member with real-time recommendations to providers regarding antibiotic choice, dose, and duration of therapy. Both strategies have been shown to reduce antibiotic use in hospitals; however, the most effective approach has not been established.

In this study by Mehta and colleagues at the Hospital of the University of Pennsylvania, these two stewardship strategies were compared using a pre-intervention post-intervention study design. During the pre-intervention period, prior authorization was required for commonly used broad-spectrum antibiotics including cefepime, piperacillin/tazobactam, vancomycin, and antifungals. In June 2009, the prior authorization requirement for cefepime, piperacillin/tazobactam, and vancomycin was removed. Instead, prospective audit with provider feedback for all patients receiving these three antibiotics was performed each weekday. Importantly, the prior authorization requirement for other broad-spectrum antibiotics and antifungals was continued during the post-intervention period; these agents thus served as control groups. The authors evaluated changes in the trends of total antibiotic use, use of agents with broad gram-negative activity, antifungals, and length of hospital stay during 24-month periods before and after the change in the stewardship strategy.

Over 55,000 inpatients received antimicrobial therapy over the entire study; severity of illness was similar in both time periods. Use of antibiotics with broad gram-negative activity declined at a rate of -4.00 days of therapy (DOT) per 1000 patient days (PD) per month during the pre-intervention period. During the post-intervention period, use of these agents increased by 0.80 DOT/1000PD per month, for a slope increase of 4.80 DOT/1000PD per month after the change in the stewardship strategy ($p < .001$). Specifically, use of cefepime and piperacillin/tazobactam was declining during the pre-intervention period but increased by 3.21 DOT/1000PD per month ($p = .003$) after the transition to prospective audit with feedback. For the other antibiotics with broad-spectrum gram-negative activity for which prior authorization was required in both time periods, there was no significant change between the periods.

Use of vancomycin declined during the pre-intervention period but significantly increased after the transition to prospective audit with

feedback (0.89 DOT/1000PD per month, p = .005). Interestingly, use of antifungal agents (one of the control groups) declined during the pre-intervention period but also increased during the post-intervention period (2.42 DOT/1000PD per month, p = .001). Total length of hospital stay and length of stay after the first dose of antibiotics were declining during the pre-intervention period but increased significantly after the change in stewardship strategy.

■ COMMENTARY

Both prior authorization and prospective audit with feedback have been shown to be effective strategies to reduce unnecessary antibiotic use in hospitals.[1] In this academic medical center, changing from prior authorization to prospective audit with provider feedback for cefepime, piperacillin-tazobactam, and vancomycin was associated with increased use of these agents as well as increased overall antimicrobial use.

This study is novel in that it is the first to directly compare these two core antimicrobial stewardship interventions. The conclusions that can be drawn are somewhat limited given the single-center, pre-intervention/post-intervention study design. In addition, use of antifungals (a control group in which prior authorization was required in both periods) increased during the post-intervention period, raising the possibility that factors other than the change in the stewardship strategy may have impacted prescribing patterns. Nevertheless, the findings are intriguing and suggest that there could be important differences in the effectiveness of the two core stewardship strategies currently recommended by the IDSA.

It seems intuitive that an optimal stewardship approach might be to combine prior authorization and prospective audit with feedback, given their complementary nature. Initial prior authorization helps to ensure an appropriate indication exists for broad-spectrum, toxic, or expensive antibiotics and that these agents are optimally dosed, while prospective audit with feedback 48 to 72 hours later and beyond promotes de-escalation of therapy and shorter treatment courses. However, since not all stewardship programs may have the capacity to perform both interventions, the question of whether prior authorization or prospective audit with feedback is more effective remains relevant. Although the answer to this question may depend on a number of factors specific to the individual institution or stewardship program, the present study demonstrates that multicenter studies comparing these two strategies are warranted. ■

Reference

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ABSTRACT & COMMENTARY

Increase in Sudden Death with ARBs or ACE Inhibitors and Co-trimoxazole

By Richard R. Watkins, MD, MS, FACP

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Dr. Watkins reports no financial relationships relevant to this field of study.

This article originally appeared in the January 2015 issue of Infectious Disease Alert. *It was edited by Stan Deresinski, MD, FACP, FIDSA, and peer reviewed by Patrick Joseph, MD, FIDSA, FSHEA. Dr. Deresinski is Clinical Professor of Medicine, Stanford University, Associate Chief of Infectious Diseases, Santa Clara Valley Medical Center, and Dr. Joseph is Associate Clinical Professor of Medicine, University of California, San Francisco, Chief of Epidemiology, San Ramon (CA) Regional Medical Center. Dr. Deresinski has served as a one-time consultant for Cubist and Bayer, and Dr. Joseph is laboratory director for Genomic Health and Siemens Corp.*

SYNOPSIS: In a case-control study, older patients who received an angiotensin converting enzyme inhibitor or an angiotensin receptor blocker along with co-trimoxazole had an increased risk of sudden death (unadjusted odds ratio 1.83, 95% confidence interval 1.50 to 2.24). Hyperkalemia is hypothesized to be the underlying mechanism.

Source: Fralick M, et al. Co-trimoxazole and sudden death in patients receiving inhibitors of renin-angiotensin system: Population-based study. *BMJ* 2014 Oct 30;349:g6196.

Angiotensin converting enzyme (ACE) inhibitors and angiotensin receptor blockers (ARBs) are commonly prescribed drugs with a number of clinical indications. One of their side effects is hyperkalemia, which occurs in approximately 10% of patients who receive them and can be life-threatening. Co-trimoxazole (trimethoprim/sulfamethoxazole) is frequently used to treat urinary tract infections (UTIs) and also increases serum potassium concentration. Fralick and colleagues sought to determine if co-prescription with an ACE inhibitor or ARB and co-trimoxazole was associated with a higher risk of sudden death compared to other antibiotics prescribed for UTIs.

The investigators conducted a case-control study of Ontario residents aged 66 years or older prescribed an ARB or ACE inhibitor between 1994 and 2012. The primary endpoint was sudden death within 7 days of an outpatient prescription for co-trimoxazole, ciprofloxacin, norfloxacin, nitrofurantoin, or amoxicillin. Patients were excluded who received any other antibiotic in the 14 days preceding the index date. For each case, the investigators randomly assigned up to 4 controls that were matched for age, sex, and the presence or absence of kidney disease and diabetes, which are known risk factors for sudden death. They adjusted for covariates associated with the risk for sudden death by creating a disease risk index derived from a multivariable regression model based on an extensive list of medical comorbidities. To approximate the absolute risk of sudden death with co-trimoxazole, the investigators conducted a supplementary analysis to determine the number of sudden deaths within 14 days of receiving either co-trimoxazole or amoxicillin.

The primary result was that co-trimoxazole was associated with a significantly increased risk of sudden death within 7 days compared to amoxicillin (unadjusted odds ratio [OR] 1.83, 95% confidence interval [CI] 1.50 to 2.24), which persisted after adjustment using the disease risk index (adjusted OR 1.38, 95% CI 1.09 to 1.76). Furthermore, ciprofloxacin was also associated with a risk of sudden death (adjusted OR 1.29, 95% CI 1.03 to 1.62), while no increased risk was found with nitrofurantoin or norfloxacin. The secondary analysis also found an increased risk of sudden death with co-trimoxazole relative to amoxicillin (adjusted OR 1.54, 95% CI 1.29 to 1.84), but no risk from the other antibiotics. This corresponded to approximately three sudden deaths with the co-trimoxazole compared to one sudden death in those prescribed amoxicillin per 1000 prescriptions dispensed. Finally, in the supplementary analysis, congestive heart failure (a known risk factor for sudden death) was removed from the disease risk index and afterward the calculated risks were no different from the primary analysis.

■ COMMENTARY

This study showed an increased risk of sudden death in patients prescribed ACE inhibitors or ARBs with co-trimoxazole and, to a lesser extent, ciprofloxacin, but not other antibiotics frequently prescribed for UTIs. The authors hypothesized that the increased risk from co-trimoxazole was due to unrecognized arrhythmic death due to hyperkalemia in a susceptible population. It is known that co-trimoxazole-induced hyperkalemia can occur quickly and produce life-threatening arrhythmias. Ciprofloxacin can prolong the QT interval, leading to torsades de pointes, and often occurs early in a course of therapy. In the current study, the risk for sudden death from ciprofloxacin was attenuated by day 14.

As mentioned in an accompanying editorial, a major strength of the study was the large sample size that allowed for adequate power to study a rare clinical outcome (sudden death).[1] However, there are important limitations to the study that deserve emphasis. First, the investigators did not have any data on serum potassium concentration or creatinine. Second, unmeasured confounders could have contributed in unclear ways to the observed association. Third, there may have been misclassification regarding the diagnosis of sudden cardiac death that led to bias. For example, the discordant results for sudden death between norfloxacin and ciprofloxacin (both quinolones) make this finding questionable. Fourth, although hyperkalemia leading to sudden death is an attractive hypothesis, the potassium-sparing drug spironolactone has been shown to decrease mortality when added to an ACE inhibitor in patients with congestive heart failure.[2] Finally, the authors did not have any information about the dosing of co-trimoxazole, which precludes a dose-response analysis.

The study by Fralick and colleagues calls to mind the oft-quoted dictum that association does not imply causation. This is especially true for observational studies. Nevertheless, these researchers have alerted the medical community about a potentially serious drug interaction. Co-trimoxazole is generally well-tolerated, effective, and inexpensive, and ARBs and ACE inhibitors are commonly prescribed. It seems unwarranted to restrict all patients on ARBs and ACE inhibitors from receiving co-trimoxazole. While waiting for higher quality evidence, a reasonable approach

at present may be to monitor serum potassium over the course of therapy and switch the co-trimoxazole if hyperkalemia develops. ■

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ABSTRACT & COMMENTARY

Paradoxical Low-flow, Low-gradient AS

By Michael H. Crawford, MD

This article originally appeared in the January 2015 issue of Clinical Cardiology Alert. *It was peer reviewed by Susan Zhao, MD. Dr. Crawford is Professor of Medicine, Chief of Clinical Cardiology, University of California, San Francisco. He is the editor of* Clinical Cardiology Alert. *Dr. Zhao is Director, Adult Echocardiography Laboratory, Associate Chief, Division of Cardiology, Department of Medicine, Santa Clara Valley Medical Center. Dr. Crawford and Dr. Zhao report no financial relationships relevant to this field of study.*

SOURCE: Clavel MA, et al. Paradoxical low-flow, low-gradient aortic stenosis despite preserved left ventricular ejection fraction: New insights from weights of operatively excised aortic valves. *Eur Heart J* 2014;35:2655-2662.

Low-flow, low-gradient aortic stenosis (AS) is usually associated with reduced left ventricular (LV) performance. When LV systolic function is normal, it has been labelled "paradoxical." Such patients have considerable concentric LV hypertrophy and a restrictive physiology with a normal LV ejection fraction (EF) but low stroke volume. The prognosis of these patients compared to those with similar severity of AS but normal stroke volume is unclear from the literature, raising the questions of whether AS severity can be determined accurately. Thus, these investigators from Quebec, Canada, hypothesized that aortic valve weight after excision at surgery would be a surrogate for AS severity, and sought to compare it in the paradoxical low-flow, low-gradient (PLF-LG) patients vs AS patients with normal flow and high gradients (NF-HG). They studied two groups: 250 patients with severe AS (valve area ≤ 1.0 cm^2 and index ≤ 0.6, n = 33) and either paradoxical AS or high-flow, high-gradient AS (n = 105) undergoing surgical aortic valve (AV) replacement, and 150 patients with moderate-to-severe AS with NF-HG undergoing AV replacement during coronary bypass surgery. The latter group was used to define a valve weight cutoff for severe AS using echo Doppler as the standard.

Baseline data showed that PLF-LG patients had more dyslipidemia and coronary artery disease. PLF-LG patients had smaller LVs with lower mass than NF-HG patients. Interestingly, BNP levels and AV area were not different between these two AS groups. There were more patients with bicuspid valves in the NF-HG group (42% vs 15%, P = 0.003). AV weight was higher in the NF-HG group compared to the PLF-LG group (P = 0.02), but when dichotomized by sex, the difference was not significant in women. Using the established AV weigh cutoff from the 150 patients with moderate-to-severe AS undergoing coronary artery bypass grafting (CABG) plus AV replacement, severe AS was present in 70% of the PLF-LG group and 86% of the NF-HG patients. This finding was also only significant in men. The authors concluded that a majority of patients with PLF-LG AS have severe stenosis as defined by valve weight after surgery, and the valve gradient may underestimate stenosis severity in such patients.

■ COMMENTARY

This is a novel approach to studying patients with low-flow, low-gradient AS. A major issue in studying these patients is determining the gold standard for measuring AS severity. Many studies in the area suffer from measurement errors, failure to take body size into consideration, and lack of a more in-depth analysis of orifice area. They chose the weight of the aortic valve excised at surgery as compared to a comprehensive Doppler-echo evaluation to establish a weight cutoff for severe AS in patients with moderate-to-severe AS undergoing CABG and AV replacement. They then applied this cutoff to selected patients presumed to have severe AS who had an isolated AV replacement by surgery. The patients selected were divided into two groups: NF-HG and PLF-LG, the latter being paradoxical because their left ventricular ejection fraction (LVEF) was normal. More than 80% of the NF-HG patients of either sex had severe AS by valve weight and 65-80% of PLF-LG patients, depending on sex,

had severe AS. These finding validate their selection criteria for surgery, but, more importantly, highlight the fact that patients with normal LVEFs with low-flow, low-gradient AS on echo often have severe AS and benefit from valve replacement.

How do we identify the PLF-LG patients who have severe AS? The authors suggest a multimodality approach. Clinically, these patients often have considerable hypertrophy with small cavity sizes, normal LVEF, but reduced longitudinal function and high valve-arterial impedance. The first step is a comprehensive echo-Doppler approach to quantifying AV area, which could include dobutamine stress testing to identify pseudo AS and transesophageal echo to measure orifice area. If there is still uncertainty, a CT scan to quantify AV calcium content could be helpful. In this study, brain natriuretic peptide was not particularly useful. Also, in this study, only echo-Doppler AV area at rest was used to clinically characterize the patients and make surgical decisions. So this multimodality approach has not been prospectively tested. ■

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CME QUESTIONS

1. According to the consensus guidelines from the American Association of Blood Banks, which of the following patients meet the criteria for prophylactic transfusion of platelets to prevent clinically important bleeding?

   a. A hospitalized adult with chemotherapy-induced thrombocytopenia with a platelet count of 15,000 cells/μL

   b. A patient in the ICU having a central venous catheter placed with a platelet count of 28,000 cells/μL

   c. A patient having an elective diagnostic lumbar puncture with a platelet count of 42,000 cells/μL

   d. A patient undergoing a diagnostic paracentesis with a platelet count of 48,000 cells/μL

   e. All of the above

2. **In patients hospitalized for a COPD exacerbation, the use of long-acting bronchodilators led to:**

   a. Decreased risk of treatment failure

   b. Improved economic outcomes

   c. Decreased risk of complications

   d. All of the above

   e. None of the above

3. **In patients with low-flow, low-gradient, but a normal LVEF, what percentage have severe AS by valve weight?**

   A. 25%

   B. 50%

   C. 70%

   D. 90%

CME OBJECTIVES

Upon completion of this educational activity, participants should be able to:

- discuss pertinent safety, infection control and quality improvement practices;
- explain diagnosis and treatment of acute illness in the hospital setting; and;
- discuss current data on diagnostic and therapeutic modalities for common inpatient problems.