Why Risk Assessment Models are Ineffective in Predicting Venous Thromboembolism in Plastic Surgery Patients

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Shaikh et al claim that combining the American Society of Anesthesiologists Physical Status Classification System (ASA) and Caprini scores improves the ability to predict venous thromboembolism (VTE) in plastic surgery patients. The authors’ Table 9 reports the sensitivity and specificity for both risk assessment models individually, and then a combined test using ASA and Caprini scores. The authors report a sensitivity of 86.6% for the combined test. No data are presented to support this dramatically improved index. According to the authors, such a combined screening test would be positive if the patient had both an ASA score ≥3 and a Caprini score ≥5. In fact, combining methods can only decrease the test sensitivity because the subset of patients meeting high-risk criteria for both models would be less than the number identified using either individually. The maximum possible number of true positives for the combined test would be 13, for a sensitivity of 54.2%, and this level would only be achieved in the unlikely event that all 13 patients with an ASA score ≥3 also had Caprini scores ≥5.

Similarly, the authors report a greatly improved specificity for the combined test, 87.0%. Specificity is defined as true negatives/true negatives + false positives. A true negative for the combined screening test would be a patient who has a Caprini score of 1 to 4 and an ASA score of 1 or 2, with no VTE. The maximum possible number of true negatives for the combined test cannot exceed 620, the number of Caprini 1 to 4 patients with no VTE. The subset of patients who are both Caprini 1 to 4 and ASA <3 and have no VTE can only be fewer than 620. Specificity for the combined test would be <620/1574, or <39.4%. Combining methods can only decrease sensitivity and specificity.

The separation of patients into low-risk and high-risk groups using Caprini scores of 1 to 4 vs ≥5 did not produce a statistically significant difference in risk of VTE (P = .3087). No doubt these negative findings were unexpected by the investigators, who consider Caprini scores to represent the “standard,” but are they surprising? Caprini scores do not correlate significantly with known relative risk values for VTE. These scores do not consider the nature of the procedure (as noted by the authors) or the type of anesthesia, both important risk considerations.

As recognized by the authors, ASA Class 3 patients have a severe medical condition, such as poorly controlled hypertension or diabetes. ASA Class 4 patients are in constant danger of dying and ASA Class 5 patients are moribund. Such patients are rarely candidates for elective plastic surgery, limiting the practicality of ASA scores to assess VTE risk.

Higher odds ratios were mistakenly assigned to the lower Caprini score groups in the authors’ Tables 7 and 8. Depending on how the Caprini scores are grouped, the P-values comparing scores are reported as 0.3087, 0.0675, 0.0675, and 0.0266. The P-value provided in the authors’ Table 7 (0.0675) is erroneously duplicated from the authors’ Table 6; the same P-value cited in the text is 0.1008, although my own calculation of this value using a
The chi-square test\(^6\) is 0.134. The \(P\)-value for a comparison of odds ratios is listed as 0.0246 in the authors’ Table 8, but a nonsignificant value of 0.246 is provided in the text.\(^1\) An asterisk is attached to the other \(P\)-value in the authors’ Table 8 comparing groups by Caprini scores but the footnote is missing. My own chi-square test\(^6\) yielded a \(P\)-value of 0.073, not 0.0266 (this value is also incorrectly assigned to a 2-tier comparison in the abstract\(^1\)).

Counterintuitively, none of the 36 patients with Caprini scores >10 developed a VTE.\(^1\) If a cutoff of >10 had been used instead of 9, the highest-risk group would actually have zero risk. Patients with “high-risk” Caprini scores of 5 to 8 had a 1.5% (13/861) risk of VTE, no different from the overall incidence.\(^1\)

The false positive rate for using ASA scores \(\geq 3\) to identify patients who will develop a VTE is 96.3% (337/350).\(^1\) The false positive rate using Caprini scores \(\geq 5\) is 98.2% (954/971).\(^1\) These very high false positive rates (approximately 97%) for patients deemed to be at high risk are remarkably consistent across 3 major studies of plastic surgery patients.\(^1,7,8\) In truth, neither ASA scores nor Caprini scores can reliably predict affected individuals, unless one accepts that approximately 97% of such predictions are wrong.\(^3\) Sensitivity is equally unacceptable. Risk stratification using Caprini scores \(\geq 7\) fails to detect almost half (48%) of all affected patients.\(^7\) Using a cutoff of \(\geq 6\) misses 42%.\(^1\)

It is time to accept what the data are telling us. Instead of using ineffective methods that are supposed to predict affected individuals, we can use Doppler ultrasound to screen for deep venous thromboses (which start small and distal\(^6\)) before they propagate and embolize. One cannot argue that this problem is a serious one and at the same time not deserving of our most reliable method of detection.

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**REFERENCES**