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AKI provides a serious advantage for SCr as a (functional) biomarker compared with a damage biomarker like NGAL. This is statistically defined as “incorporation” bias. The accuracy of damage markers will inevitably be lower compared with SCr that is incorporated into the definition of the endpoint. That is precisely the reason to propose a separate scoring system, such as the cardiac surgery–associated NGAL score (CSA-NGAL score), to increase the sensitivity of AKI diagnosis overall and also to cover the detection of what used to be subclinical AKI. The additional value of adding another functional biomarker along with SCr, such as plasma cystatin-C, to a diagnostic model for AKI based on the study by Spahillari et al,⁴ remains questionable.

Finally, another important aspect of the clinical implication of AKI biomarkers that must be addressed is whether they can help identify patients at the bedside without the risk of subsequent development of AKI.

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DOES A GOOD BEGINNING MAKE A GOOD END? THE IMPORTANCE OF BIOCOMPATIBILITY To the Editor:

We carefully read the interesting article by Allen and colleagues¹ suggesting that the most important goal of sternal closure is rigid fixation for both physiologic and economic reasons. They demonstrated significant improvement of sternal healing and fewer sternal complications in patients with sternal closure with rigid plate fixation than with conventional wire cerclage fixation. In their study, a simple computed tomographic scoring scale was applied to the various computed tomographic appearances and indicated that the sternal union rates with rigid fixation were 40.8% at 3 months and 80.2% at 6 months (15.7% and 67.0% with wire cerclage, respectively). Gradual healing was demonstrated by 6 months postoperatively; however, approximately 20% demonstrated incomplete healing with rigid fixation. Our first question is thus is there any other way to achieve union in addition to rigid fixation, or is it satisfactory?

We consider that from the viewpoint of long-term outcomes, biocompatibility as well as the mechanical properties plays a key role in the success of implants applied in the thoracic cage. On the basis of this concept, we have enriched insights about osteoinductive biomaterials. In plastic or orthopedic surgery, improvement of osteosynthesis has been reported with the additional use of bone graft and artificial osteoinductive materials on rigid fixation. These options have already been investigated in sternotomies by several authors. One author in our group² previously reported that bioabsorbable and rigid material that gradually changes to bony tissue showed mechanical strength comparable to that of titanium. Another³ demonstrated that an additional sternum-stabilizing procedure may reduce the incidence of postoperative sternal infection with the use of bioabsorbable material on conventional sternal wiring. The importance of biocompatibility was also implied by the exclusion criteria in the report of Allen and colleagues¹ that the patients with intraoperative use of

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nonabsorbable hemostatic agents whose residual matters would impair bone healing were excluded. Bridging the radiolucent gap by osteoinductive materials might be a potent adjuvant treatment in addition to the rigid fixation.

The second-generation fixation device used in the report of Allen and colleagues¹ achieved excellent long-term outcomes without any late complications requiring plate removal as late as 6 months after the fixation.¹ Implant failures from metal fatigue, less flexibility, and chronic pain are likely to occur after chest wall osteosynthesis, however, especially in osteoporotic or obese patients with anteriorly placed implants,⁴⁻⁶ which suggests that long-term observation longer than 6 months may be necessary to validate the rigid fixation. One of these causes is associated with repeated and concentrated load at one point on a plate, and to minimize potential harmful effects, biomaterials with good biocompatibility and optimal mechanical properties that can correspond to the flexible respiratory movements are therefore desirable, and they will also facilitate repeated sternotomies because of the minimal reactions to the normal tissues.

Finally, we have one question concerning reoperation. The method reported by Allen and colleagues¹ requires at least 10 screws on one side of the sternum. In reopening cases, rigid fixation has to be achieved again with the potholed sternum caused by the first screwing. Because reopening after rigid fixation was not described in detail,⁶ we request the technical details regarding reopening and refixation.

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STEEL AND BONES: A PERFECT UNION?

Reply to the Editor:

The principles of fracture and osteotomy management include reapproximation and stabilization through rigid fixation of the bone.

The study by Allen and colleagues¹ suggests that strict adherence to these principles through application of rigid plate fixation (RPF) can lead to both improvement in radiographic sternal healing (primary end point) and lower rates of sternal complications (secondary outcome) compared with traditional wire cerclage (WC). This suggests that RPF leads to enhanced mechanical stabilization and immobilization of the bone compared with WC.

Yutaka and colleagues highlight an important aspect in bone wound healing: biocompatibility and osteoconduction. The most common materials with osteoconductive properties include calcium sulfate and calcium phosphate, allowing for the process of passive bone tissue regeneration.² However, the search for the perfect biomaterial to promote bone healing and to restore function while remaining biologically stable dates back to the 18th century in the field of restorative dentistry.³ The use of ceramics to restore the physical appearance and function of teeth continues to evolve from using cadaveric teeth to injectable biocompatible bone substitutes that promote osteoconduction.^{4,5} Similar to dentistry, situations arise in trauma and orthopedics when there is a need for osteoconductive material to treat fractures associated with tissue loss or contaminated wounds (ie, compound fractures or osteomyelitis).⁶