

# Calcium Administration on Separation from Cardiopulmonary Bypass: Looking Beyond a Facilitated Weaning!

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To the Editor,

Weaning from cardiopulmonary bypass (CPB) to a spontaneous performance of the cardiovascular system is essentially a complex process. Effective and safe weaning management strategies continue to be formulated and evaluated to ensure a smooth separation from CPB aimed at optimizing the patient outcomes. A range of pharmacotherapy is often employed during weaning including inotropic and vasopressor infusions to augment myocardial and cardiovascular functioning. In addition, many practitioners administer calcium salts during weaning, albeit the rationale supporting this routine administration has often been debated.

Most of the studies support the premise that a mild hypocalcemia results following CPB. However this degree of hypocalcemia has not been found to remarkably impair the cardiovascular performance.<sup>1</sup> Literature outlines that supplementing calcium has a positive impact on the postbypass mean arterial pressure and systemic vascular resistance, particularly relevant in context of post-CPB vasoplegia.<sup>1</sup> Several authors also propose a concomitantly increased ventricular cardiac index (CI) with calcium, while some others fail to demonstrate an accentuated CI.<sup>2</sup> Despite a systolic function augmentation, the negative effects of calcium on diastolic function by causing ventricular stiffness is revealed in literature which raises peculiar concerns in setting of difficult weaning owing to diastolic dysfunction.<sup>1</sup> With regards to the right ventricle (RV) function, calcium administration is believed to support the RV performance without discernible elevation of pulmonary vascular resistance.<sup>3</sup>

The administration of calcium during weaning is compounded by certain important caveats necessitating attention. First and foremost is the impact of calcium on the myocardium that has suffered an ischemic insult, as calcium overload hypothesis has been centrally implicated in ischemia-reperfusion injury and post-CPB myocardial stunning.<sup>1</sup> The theory of the “calcium-paradox” as supported by the experimental settings, can further affect the myocardial function adversely.<sup>4</sup> The other concern regarding calcium administration in

scenario of a pressure-overload hypertrophy emanates from the risk of “stone-heart” syndrome.<sup>5</sup> Moreover, calcium is believed to negatively interact with the concurrent catecholamines by attenuating the response to  $\beta$ -sympathomimetics.<sup>6</sup>

In addition to the cardiovascular effects, the consequences on the other organs need to be evaluated in a meticulous manner. A significant compromise in the internal mammary and radial artery graft flow begets ventricular supply-demand mismatch primarily accounted by the calcium-induced vascular spasm.<sup>7</sup> A heightened risk of pancreatic cellular injury limits liberal use of calcium supplementation.<sup>8</sup> However, these extracardiac effects of calcium merit further focused research. Many researchers argue that appropriate doses can limit the extent of pancreatic insult while promoting the clotting mechanisms aimed at minimizing postoperative bleeding, which is a pertinent issue following congenital cardiac surgery in cyanotics particularly in setting of an increased blood product transfusion requirement.<sup>9</sup>

To conclude, calcium homeostasis in a cardiac surgery contemplated on CPB is complicated with many influencing factors such as hemodilution, acid-base alterations, citrated blood transfusions, albumin concentration, and prime constituents. Calcium administration at weaning is associated with a myriad of cardiac and extracardiac effects. However, several evidence gaps exist in the supplementation of calcium on CPB separation. These include the effect of calcium administration on post-CPB vasoplegia, interaction with calcium-channel sensitizers, and formal assessment of adverse effects such as pancreatic cellular injury, in close conjunction with the patient-specific clinically pertinent long-term outcomes following high-risk cardiac surgery beyond a facilitated weaning from bypass. Bridging these evidence breaches could account for a more scientific, and judicious weaning regime enterprising a safe, optimal, individualized, and effective calcium administration.

## Conflicts of Interest

None.

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