2024 Servoregultion (Cardioplegia)

Permission to print:	Yes
Category	Pump Servoregulation
Category 2	cardioplegia
Severity	Good Catch No Harm Incident
Duration of incident:	minutes
Description:	During bypass for a routine CABG procedure using Del Nido cardioplegia (aortic cross clamp on, temp 33.8 degrees and just starting to rewarm), the main arterial roller pump stopped with no alert, no alarm and no notification from the console control desk display (S5). Prior to the pump stopping, the perfusionist had taken a blood sample for blood gas/ACT, changed cardioplegia pump settings to be ready for Hot Shot and adjusted HCU temperatures. Perfusionist had just taken an ACT sample and then noticed the main arterial pump was not running, and the venous reservoir full. The perfusionist tried to turn up the arterial flows on the main pump but it remained at zero. There was no alarm or notification on the console. (In hindsight an additional icon on the arterial pump displet indicating a controlled pump may have gone unnoticed). The perfusionist immediately started hand cranking, successfully bringing patient pressures back up, and called for the backup perfusionist. Two backup perfusionists were available and immediately came to assist, the first backup perfusionist noticed the console stated 'runaway pump failure', and began troubleshooting the main pump by restarting the pump and going through the pump settings. None of these actions could get the main pump to run (this was while the primary perfusionist was still hand cranking). In the meantime, the second back up perfusionist grabbed a backup replacement pump from outside the theatre and began exchanging the pump. After 4 minutes of hand cranking there was 2 minutes of downtime while pumps were being exchanged. Bypass was re-established and the case was completed. The patient had no direct impact and was discharged after appropriate time. As a note of explanation, the cardioplegia pump was set up for Del Nido delivery prior to bypass commencing. This involves setting the first Controlled pump to CPS [cardioplegia solution] and the second Controlled pump to Blood in order to achieve the 4:1 ratio required for Del Nido:Blood delivery. When Hot Shot is required, this involves changing the settings to having first Controlled pump back to Blood and the second Controlled pump to CPS to achieve standard 1:4 ratio required for Hot Shot:Blood. However, in this incident, when changing the cardioplegia settings from Del Nido to Hot Shot, ARTERIAL (1) was inadvertently selected as the Controlled pump without the arterial pump panel (ARTERIAL 1) being accessed, resulting in the main arterial pump being linked to the cardioplegia pump. As such, the main arterial pump would not run if the cardioplegia pump was off. Changing the settings in this way meant that the main arterial pump could stop without any alarm or notification from the S5 console mid bypass. It is very easy to 'accidentally' select ARTERIAL (1) pump in the cardioplegia settings without further prompt from the console, and thereby inadvertently stop the main arterial pump. When the back up perfusionist came to help, the notification on the console 'runaway pump' was a result of hand cranking, and not due to a 'fault' with the main pump. A detailed and thorough investigation was conducted to identify the root cause of the arterial pump stopping mid case. Eventually it was identified that the main arterial pump was inadvertently linked to the cardioplegia pump at the time of rewarming, which subsequently caused the main arterial pump to stop without alarm or notification. It was discovered that the arterial pump can be unintentionally stopped through the cardioplegia pump panel by reconfiguring the cardioplegia settings as above. Despite

	restarting the main pump, it was never going to start as it was linked to the cardioplegia pump. The only way to restart the main pump was to remove the arterial link from the cardioplegia setting.
GOOD CATCH - what went well	1.Primary perfusionist started immediately hand cranking and called for back up. 2. The Unit recently implemented n+1 model during normal hours so that a back up perfusionist is always available and onsite until 7pm. In this scenario, there were two perfusionists available as it was still in-hours. 3. Hospital investigation process understood the severity of the incident and allowed time for team and vendor to conduct a thorough investigation to find the root cause and thereby improve service.
What could we do better	1.Ensure perfusionists are aware of the small “controlled pump” icon on the pump display panels that may have helped diagnose this issue. 2. Use the servoregulation [global] override function instead of handcranking while troubleshooting (Using the servoregulation [global] override function (double hand icon above the pump flow control) in preference to handcranking was not considered at the time).3. Ensure that the team routinely evaluates their back up pump options and that it forms part of their routine checks. Continue to practice changeouts and troubleshooting techniques on a regular basis. 4. Ensure n+1 model is available out-of-hours as well. This incident happened at 5pm which meant that the backup perfusionists were readily available and the patient was adequately supported. If this incident happened at night, a backup perfusionist would not have been available and the patient outcome may have likely been unfavorable.
Preventive actions	1) Back up pump is attached to the HLM and can be used immediately 2) Updated instructions for Arterial Pump Stop to include checking cardioplegia settings. All team members are aware. 3) Community awareness: Engaging with LivaNova to ensure all existing S5 users are aware of the impact to main arterial pump when switching cardioplegia settings, as this can stop the main pump without alarm or notification.
Type of incident:	Management
Timing of incident:	CPBhypothermic
Hospital incident filed	Yes
Ext Authority Advised	No
Discussed with team:	Yes
Knowledge issue	Yes
Rule issue	Yes
Skill issue	No
Team Issue	No
Patient outcome variance	Nil
Commentary	Issues with servoregulation of cardioplegia pumps inadvertently stop-linked to the arterial pump have been previously reported to PIRS. As in this report, some have resulted in handcranking as a first response. While this reported issue was managed without patient harm, the use of the global servoregulation override function is arguably the safer initial action while evaluating servoregulation problems. Of note this incident was further complicated by a 'runaway pump failure' alarm that can occur during handcranking. The global override of servoregulation would have retained the visual and audible alarms associated with bubble, level pressure while permitting the arterial pumps to continue running. Perfusionists should practice activation and deactivation of that global servoregulation override function in a nonclinical situation. The Stop-link icons on the S5 pump control panel are quite subtle. A similar report in

2022, where the arterial pump stopped when inadvertently stop-linked to the cardioplegia pump, stated “No error message was displayed on the panel; however, the only indication was the orange icon on the main arterial pump” (see the photos from that report attached). Perfusionists should be alert to the absence of a warning message (like “Low Level”) on the main system control display in an unintended cardioplegia pump activated arterial pump stoppage. Pirs Ed

From 2022 report