

# Rapid cooling is a safe technique in patients undergoing circulatory arrest for aortic repair

**Objective:** The objective of this study was to evaluate our institutional experience with rapid cooling for hypothermic circulatory arrest in the context of proximal aortic and arch repair.

**Methods:** We retrospectively reviewed data from 2398 patients who underwent proximal aortic surgery (ascending aorta, aortic arch) requiring hypothermic circulatory arrest between 1991 and 2020. Cooling times were divided into quartiles and clinical outcome event rates were compared across quartiles using contingency table methods. Incremental effect of cooling time was assessed in the context of other perfusion time variables using multiple logistic regression analysis. All computations were performed using SAS 9.4

**Results:** Median age was 61 years (IQR 49-70) and 33.9% of patients were female. The procedure performed was classified as emergent in 32.3% of patients. The mean cooling time was 18.9 minutes (range 5-81). The mean warming time was 74.8 minutes (range 30-145). The mean circulatory arrest time was 24.5 minutes. The institutional technique for circulatory arrest included during this time period involved rapid cooling to a median nasopharyngeal temperature of 17.8 degrees Celsius. Retrograde cerebral perfusion (RCP) was used in the majority of cases (97.9%) with snaring of the superior vena cava and pressure monitoring. The lowest RCP pressure was a median of 29mmHg and highest RCP pressure was a median of 30mmHg. Mean cardiopulmonary bypass time was 157.3 minutes with an aortic cross clamp time of 94.9 minutes. Overall thirty-day mortality was 10.1% and was not significantly different across groups (Table). Patients with the shortest cooling time had significantly lower rates of intraoperative coagulopathy. There was a statistically significant trend toward lower rates of postoperative encephalopathy and respiratory failure with shorter cooling times. There was no significant difference in rates of postoperative stroke or dialysis requirement. Lowest nasopharyngeal temperature was significantly lower in quartiles 1 and 2. Despite this, temperature did not influence any postoperative outcomes once operative times were accounted for.

**Conclusions:** Rapid cooling can be performed safely in patients undergoing ascending aortic and arch surgery requiring circulatory arrest. There were significantly lower rates of intraoperative coagulopathy, respiratory failure, and postoperative encephalopathy associated with shorter cooling times with no significant difference in major adverse outcomes including mortality and stroke.

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Table. Postoperative outcomes by cooling time

	First quartile N=789	Second quartile N=610	Third quartile N=479	Fourth quartile N=520	
Cooling time, min (range)	5-13	14-18	19-23	24-81	
Lowest temperature, °C	21.2	18.1	17.5	17.2	
30 day mortality, n (%)	76 (9.6)	60 (9.8)	50 (10.4)	55 (10.6)	P=0.94
Postoperative stroke, n (%)	47 (6.0)	44 (7.2)	38 (7.9)	30 (5.8)	P=0.42
Postoperative encephalopathy, n (%)	109 (13.8)	95 (15.6)	83 (17.3)	119 (22.9)	P=0.0002
Intraoperative coagulopathy, n (%)	107 (13.6)	119 (19.5)	94 (19.6)	102 (19.6)	P=0.0042
Respiratory failure, n (%)	145 (18.4)	142 (23.3)	135 (28.2)	152 (29.2)	P<0.0001
New dialysis, n (%)	60 (7.6)	44 (7.2)	36 (7.5)	33 (6.4)	P=0.84