Lower activated clotting time values in patients undergoing cardiac surgery with retrograde autologous priming of the bypass machine and avoidance of hypothermia

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Introduction

Hypothermia and haemodilution increase the Activated Clotting Time (ACT) during hypothermic (<34°) cardiopulmonary bypass (CPB)¹. However, little data is available regarding ACT values when such conditions are avoided during CPB. Recently, a shift in surgical practice has occurred in our Institution towards non-hypothermic (>34°) CPB associated with retrograde autologous priming (RAP) of the CPB circuit. RAP consists in using the patient’s own blood as part of the priming volume, thus reducing the extent of haemodilution during CPB.

We therefore decided to test the hypothesis that minimizing the effect of hypothermia and haemodilution during CPB would be associated with lower average values of ACT after systemic heparinization.

Methods

- Retrospective audit of data from 312 patients undergoing cardiac surgery with CPB at Oxford University Hospitals during January to March 2013 (n=144) and January to March 2016 (n=168).
- Comparison of the 2016 cohort with a similar cohort of patients undergoing CPB before the introduction of RAP into clinical practice (2013).
- Data analysed: demographics, temperature, haemoglobin and ACT values during CPB, total amount of heparin administered, type of surgery, surgeons and anaesthetists, total bypass time.

2013 GROUP	Mean	SD	95% CI	P value (2013 v 2016)
Age	68.8	11.1	66.9 – 70.6	0.03
Weight	82.0	15.6	79.4 – 84.6	0.77
Bypass T°	34.7	1.9	34.4 – 35.1	0.38
ACT values	532	115	513 – 551	0.004
Heparin dose	26142	4444	24419 – 27866	0.34
Bypass time	85.2	34.9	79.4 – 90.9	0.1
Haemoglobin	8.58	1.34	8.4 – 8.8	< 0.001
2016 GROUP				
Age	65.8	12.8	63.8 – 67.7	
Weight	82.5	15.6	80.1 – 84.9	
Bypass T°	34.6	1.8	34.3 – 34.8	
ACT values	497	90	484 – 511	
Heparin dose	27103	5642	26107 – 28190	
Bypass time	92.6	43.9	85.9 – 99.2	
Haemoglobin	9.3	1.33	9.1 – 9.5	

Table 1 Baseline characteristics from the 2013 and 2016 datasets

Fig. 1 Difference in ACT between 2013 and 2016 datasets, P < 0.001 (t-test, after data transformation)

Results

- None of the 144 patients from the 2013 cohort had RAP (no-RAP). Of 168 patients from the 2016 cohort, 133 had RAP (RAP) and 35 did not (no-RAP).
- Out of the whole 312 patient group, 87 (27.9%) had hypothermic (<34°) CPB (COLD group) and 225 (72.1%) had non-hypothermic (>34°) CPB (WARM group).
- Patients in the WARM group were significantly heavier (83.7 vs 78.5 kg, P=0.008) and received more Heparin (27652 vs 25260 Units, P=0.02) but had significantly lower ACT values (499 vs 549 sec, P=0.01) than patients in the COLD group.
- ACT values were also significantly lower in RAP patients both within the COLD (RAP 495 sec vs no-RAP 586 sec, P=0.0005) and WARM (RAP 486 sec vs no-RAP 510 sec, P=0.01) groups.

Fig. 2 Breakdown of patients grouped by average bypass temperature (< 34° COLD, > 34° WARM) and retrograde autologous priming (RAP)

COLD group	Mean	SD	95 % CI	P value (COLD v WARM)
ACT	549	141	519 - 579	0.01
Heparin dose	25261	5830	23445 - 27078	0.02
Age	69	10.8	66 - 71	0.1
Weight	78.5	16.7	75 - 82	< 0.001
Bypass time	109	39.8	101 - 118	< 0.001
Haematocrit	27	4	26 - 28	0.05
WARM group				
ACT	499	81	489 - 510	
Heparin dose	27652	5069	26602 - 28702	
Age	66.5	12.5	65 - 68	
Weight	83.7	15.0	82 - 86	
Bypass time	81	37.6	76 - 86	
Haematocrit	28	4.1	27.4 – 28.5	

Table 2 Summary of main findings when patients are divided into COLD and WARM groups according to average CPB temperature, <34° = COLD, >34° = WARM

Fig. 3 Difference in ACT between patients in COLD and WARM groups, P = 0.01 (t-test, after data transformation)

Fig. 4 Effect of RAP in ACT values of patients in COLD and WARM groups. The effect is statistically significant in both groups, but it is more clinically relevant in COLD group

Conclusion

Avoidance of hypothermia coupled with retrograde autologous priming of the CPB pump is associated with significantly lower ACT levels during cardiopulmonary bypass. **When the biasing effect of hypothermia and haemodilution is minimized, ACT more accurately reflects the degree of anticoagulation produced by heparin during cardiopulmonary bypass.**

Reference

¹ Cohen E, Camerlengo L, Dearing J. Activated clotting times and cardiopulmonary bypass I: The effect of haemodilution and hypothermia upon activated clotting time. J Extra-Corpor Technol. 1980; 12: 139-141.