**Supplemental Table 1. Shunt thrombosis patient characteristics**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Patient** | **Anatomy** | **Procedure** | **Age at shunt (days)** | **Time to shunt thrombosis (days)** | **Management of shunt thrombosis** | **Complications** |
| 1 | SV | Shunt as part of multicomponent procedure | 942 | 1 | Shunt unclipping | ECMO, stroke, re-exploration for bleeding, unplanned shunt re-operation |
| 2 | SV | Primary shunt | 173 | 0 | Shunt revision | Unplanned shunt re-operation |
| 3 | SV | Shunt as part of multicomponent procedure | 165 | 2 | Shunt revision | Unplanned cardiac catheterization, unplanned shunt re-operation, ECMO, death in hospital |
| 4 | BiV recruit | Shunt as part of multicomponent procedure | 1,008 | 0 | Shunt takedown | None |
| 5 | BiV recruit | Shunt as part of multicomponent procedure | 538 | 0 | Shunt clipping | None |
| 6 | BiV staging | Shunt as part of multicomponent procedure | 0 | 9 | Shunt clipping | Unplanned shunt re-operation, ECMO, death in hospital |
| 7 | SV | Primary shunt | 3 | 6 | Shunt thrombectomy, takedown of umbilical vein shunt, placement of BTS, balloon dilation and size adjustment of BTS | Cardiac arrest, ECMO, unplanned shunt re-operation, re-exploration for bleeding |
| 8 | SV | Primary shunt | 5 | 1 | Shunt takedown | None |
| 9 | SV | Primary shunt | 25 | 2 | Shunt revision, thrombectomy | Acute renal failure, unplanned shunt re-operation, death in hospital |
| 10 | SV | Primary shunt | 234 | 0 | Shunt milking | Unplanned shunt re-operation |
| *BiV: biventricular, SV; single ventricle.* |

**Supplemental Table 2. Univariate Logistic regression analysis for major complications and acute shunt thrombosis (N=71)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Odds Ratio** | **95% confidence interval** | ***P* value** |
| Major Complications  | 3.855 | (0.906, 16.404) | 0.06 b |
| Number of Complications | 1.723 | (1.139, 2.606) | 0.01 a |
| Renal Failure requiring dialysis | 6.667 | (0.382,116.292) | 0.19 |
| Cardiac Arrest | 1.583 | (0.159, 15.813) | 0.70 |
| ECMO/VAD | 4.417 | (1.018,19.160) | 0.04 a |
| Re-exploration for bleeding | 25.714 | (2.345, 281.964) | 0.008 a  |
| Unplanned cardiac catheterization | 0.736 | (0.082, 6.615) | 0.78 |
| Death | 8.143 | (1.370, 48.405) | 0.02 a |
| Unplanned shunt re-intervention | 4.600 | (1.142, 18.523) | 0.03 a |
| *a Statistically significant.**b Trend towards statistical significance.* *Death was defined as surgical death in hospital or within 30 days of discharge.**ECMO: extracorporeal membrane oxygenation; VAD: ventricular assist device.*  |

**Supplemental Table 3. Univariate Cox Regression of Covariates and Total Hospital Length of Stay with death as a competing risk**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Hazard Ratio** | **95% Confidence Interval** | ***P* value** |
| Shunt thrombosis | 3.647 | (1.258, 10.577) | 0.012 a |
| Age (<28 days vs. >=28 days) | 1.744 | (1.031, 2.950) | 0.04 a |
| STAT mortality category | 1.932 | (1.111, 3.360) | 0.02 a |
| Chromosomal abnormalities | 0.908  | (0.441, 1.869) | 0.79 |
| Overall preoperative anticoagulants | 0.659 | (0.379, 1.148) | 0.14 |
| Overall preoperative NOAC | 0.562 | (0.391, 0.806) | 0.002 a |
| Preoperative aspirin | 0.681 | (0.362, 1.283) | 0.23 |
| Preoperative clopidogrel | 0.915 | (0.277, 3.018) | 0.88 |
| Preoperative enoxaparin sodium | 0.274 | (0.152, 0.493) | <0.001 a |
| Preoperative IV heparin | 2.536  | (1.185, 5.425) | 0.02 a |
| Platelets in OR (Y/N) | 2.200 | (1.258, 3.848) | 0.006 a |
| Platelets in OR (ml/kg) | 0.972 | (0.951, 0.995) | 0.01 a |
| Cryoprecipitate in OR (Y/N) | 2.571 | (1.469, 4.499) | <0.001 a |
| Cryoprecipitate in OR (ml/kg) | 0.968 | (0.937, 0.999) | 0.04 a |
| RBCs in OR (Y/N) | 1.862 | (0.859, 4.035) | 0.12 |
| RBCs in OR (ml/kg) | 0.995 | (0.982, 1.008) | 0.45 |
| Cell Saver in OR (Y/N) | 0.433 | (0.159, 1.181) | 0.10 |
| Cell Saver in OR (ml/kg) | 0.989 | (0.979, 1.000) | 0.04 a |
| Factor VII in OR (Y/N) | 0.635 | (0.129, 3.132) | 0.58 |
| Factor VII in OR (ml/kg) | 4.952 | (0, 1175291) | 0.80 |
| Prior stroke | 2.249 | (0.672, 7.530) | 0.19 |
| Prior thrombosis  | 1.158 | (0.528, 2.538) | 0.72 |
| Prior sternotomies | 0.535 | (0.272, 1.054) | 0.07 |
| Number prior sternotomies (<=1 vs. >1) | 0.138 | (0.064, 0.299) | <0.001 a |
| Platelets in ICU (Y/N) | 3.112 | (1.071, 9.043) | 0.04 a |
| Cryoprecipitate in ICU (Y/N) | 3.638 | (0.957, 13.826) | 0.06 |
| RBC in ICU (Y/N) | 2.441 | (1.401, 4.253) | 0.002 a |
| Plasma in ICU (Y/N) | 2.727 | (0.965, 7.705) | 0.06 |
| *a Statistically significant.**b Trend towards statistical significance.* *ICU: intensive care unit; IV: intravenous; kg: kilogram; ml: milliliters; N: no; NOAC: Novel Oral Anticoagulants; OR: operating room; RBC: red blood cells; STAT: Society of Thoracic Surgeons- European Association of Cardio-Thoracic Surgery Congenital Heart Surgery Mortality Categories; Y: yes.* |

**Supplemental Table 4. Univariate Cox Regression of Covariates and ICU Length of Stay with death as a competing risk**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Hazard Ratio** | **95% Confidence Interval** | ***P* value** |
| Shunt thrombosis | 3.259 | (1.242, 8.548) | 0.02 a |
| Age (<28 days vs. >=28 days) | 1.893 | (1.111, 3.225) | 0.02 a |
| STAT mortality category | 2.071 | (1.191, 3.601) | <0.001 a |
| Chromosomal abnormalities | 0.801  | (0.409, 1.571) | 0.52 |
| Overall preoperative anticoagulants | 0.667 | (0.381, 1.166) | 0.16 |
| Overall preoperative NOAC | 0.061 | (0.023, 0.161) | <0.001 a |
| Preoperative aspirin | 0.673 | (0.356, 1.273) | 0.22 |
| Preoperative clopidogrel | 0.788 | (0.245, 2.537) | 0.70 |
| Preoperative enoxaparin sodium | 0.361 | (0.210, 0.620) | <0.001 a |
| Preoperative IV heparin | 2.813 | (1.153, 6.863) | 0.02 a |
| Platelets in OR (Y/N) | 2.122 | (1.212, 3.715) | <0.001 a |
| Platelets in OR (ml/kg) | 0.970 | (0.950, 0.991) |  0.005 a |
| Cryoprecipitate in OR (Y/N) | 2.657 | (1.521, 4.638) | <0.001 a |
| Cryoprecipitate in OR (ml/kg) | 0.966  | (0.935, 0.998) | 0.04 a |
| RBCs in OR (Y/N) | 1.820 | (0.841, 3.935) | 0.13 |
| RBCs in OR (ml/kg) | 0.995 | (0.980, 1.011) | 0.53 |
| Cell Saver in OR (Y/N) | 0.445 | (0.164, 1.203) | 0.11 |
| Cell Saver in OR (ml/kg) | 0.987 | (0.977, 0.998) | 0.02 a |
| Factor VII in OR (Y/N) | 1.575 | (0.319, 7.770) | 0.57 |
| Factor VII in OR (ml/kg) | 64660349 | (0.141, 2.96E16) | 0.08 b |
| Prior stroke | 2.101 | (0.640, 6.894) | 0.22 |
| Prior thrombosis  | 0.980 | (0.425, 2.263) | 0.96 |
| Prior sternotomies | 0.505 | (0.250, 1.022) | 0.06 6 |
| Number prior sternotomies (>1 vs. <=1) | 0.061 | (0.025, 0.147) | <0.001 a |
| Platelets in ICU (Y/N) | 4.088 | (1.211, 13.795) | 0.02 a |
| Cryoprecipitate ICU (Y/N) | 8.050 | (1.119, 57.936) | 0.04 a |
| RBCs in ICU (Y/N) | 2.819 | (1.581, 5.026) | <0.001 a |
| Plasma in ICU (Y/N) | 3.097 | (1.050, 9.137) | 0.04 a |
| *a Statistically significant.**b Trend towards statistical significance.* *ICU: intensive care unit; IV: intravenous; kg: kilogram; ml: milliliters; N: no; NOAC: Novel Oral Anticoagulants; OR: operating room; RBC: red blood cells; STAT: Society of Thoracic Surgeons- European Association of Cardio-Thoracic Surgery Congenital Heart Surgery Mortality Categories; Y: yes.* |

**Supplemental Table 5. Univariate Cox Regression of Covariates and Ventilation Time with death as a competing risk**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Hazard Ratio** | **95% confidence interval** | ***P* value** |
| Shunt thrombosis | 2.162 | (0.939, 4.978) | 0.07 b |
| Age (>28 days vs <=28 days) | 2.175 | (1.262, 3.748) | 0.005 a |
| STAT mortality category | 2.204 | (1.219, 3.985) | <0.001 a |
| Chromosomal abnormalities | 0.758 | (0.361, 1.591) | 0.46 |
| Overall preoperative anticoagulants | 0.643 | (0.369, 1.122) | 0.12 |
| Overall preoperative NOAC | 0.264 | (0.162, 0.430) | <0.001 a |
| Preoperative aspirin | 0.552 | (0.306, 0.994) | 0.04 a |
| Preoperative clopidogrel | 0.449 | (0.212, 0.950) | 0.04 a |
| Preoperative enoxaparin sodium | 0.432 | (0.239, 0.780) | 0.005 a |
| Preoperative IV heparin | 4.346 | (1.142, 16.537) | 0.03 a |
| Platelets in OR (Y/N) | 1.494 | (0.847, 2.635) | 0.17 |
| Platelets in OR (ml/kg) | 0.962 | (0.938, 0.986) | 0.002 a |
| Cryoprecipitate in OR (Y/N) | 2.149 | (1.244, 3.712) | 0.006 a |
| Cryoprecipitate in OR (ml/kg) | 0.950 | (0.903, 0.999) | 0.04 a |
| RBCs in OR (Y/N) | 1.407 | (0.700, 2.830) | 0.34 |
| RBCs in OR (ml/kg) | 0.993 | (0.979, 1.008) | 0.38 |
| Cell Saver in OR (Y/N) | 0.693 | (0.299, 1.608) | 0.39 |
| Cell Saver in OR (ml/kg) | 0.985 | (0.971, 1.000) | 0.05 |
| Factor VII in OR (Y/N) | 0.782 | (0.146, 4.196) | 0.77 |
| Factor VII in OR (ml/kg) | 64660349 | (0.141, 2.96E16) | 0.07 b |
| Prior stroke | 1.198 | (0.547, 2.625) | 0.65 |
| Prior thrombosis  | 0.934 | (0.449, 1.943) | 0.86 |
| Prior sternotomies | 0.378 | (0.200, 0.718) | 0.003 a |
| Number prior sternotomies (>1 vs. <=1) | 0.090 | (0.041, 0.196) | <0.001 a |
| Platelets in ICU (Y/N) | 2.036 | (0.828, 5.002) | 0.12 |
| Cryoprecipitate in ICU (Y/N) | 4.183 | (1.012, 17.296) | 0.04 a |
| Plasma in ICU (Y/N) | 3.463 | (1.217, 9.856) | 0.02 a |
| RBC in ICU (Y/N) | 2.301 | (1.332, 3.975) | 0.003 a |
| *a Statistically significant.**b Trend towards statistical significance.* *ICU: intensive care unit; IV: intravenous; kg: kilogram; ml: milliliters; N: no; NOAC: Novel Oral Anticoagulants; OR: operating room; RBC: red blood cells; STAT: Society of Thoracic Surgeons- European Association of Cardio-Thoracic Surgery Congenital Heart Surgery Mortality Categories; Y: yes.* |

**Supplemental Table 6. Multivariable cox regression of parameters associated with greater hospital length of stay with death as competing risk (Harrell’s c-index=0.75)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Hazard Ratio** | **95% Confidence Interval** | ***P* value** |
| Shunt thrombosis | 4.55 | (1.34, 15.39) | 0.006 a |
| Cryoprecipitate in OR (Y/N) | 2.66 | (1.47, 4.81) | 0.001 a |
| STAT mortality category | 2.52 | (1.27, 4.99) | 0.04 b |
| RBC in ICU (Y/N) | 2.18 | (1.16, 4.10) | 0.01  a |
| Number of Sternotomies (>1 vs. <=1) | 7.519 |  (3.021, 18.867) | <0.001 a |
| *a Statistically significant.* *b Trend towards statistical significance.**N: no; OR: operating room; RBC: red blood cells; STAT: Society of Thoracic Surgeons- European Association of Cardio-Thoracic Surgery Congenital Heart Surgery Mortality Categories; Y: yes.* |

**Supplemental Table 7. Multivariable cox regression for factors associated with greater intensive care unit length of stay with death as competing risk (Harrell’s c-index=0.78)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Hazard Ratio** | **95% Confidence Interval** | ***P* value** |
| Shunt thrombosis | 4.12 | (1.34, 12.68) | 0.009 a |
| STAT mortality category | 2.96 | (1.48, 592) | 0.004 a |
| Cryoprecipitate in OR (Y/N) | 2.48 | (1.34, 4.59) | 0.01 a |
| RBC in ICU (Y/N) | 2.87 | (1.49, 5.48) | 0.002 a |
| Number of sternotomies (>1 vs. <=1) | 3.33 | (1.02, 11.11) | 0.04 a |
| *a Statistically significant.* *ICU: intensive care unit; N: no; OR: operating room; RBC: red blood cells; STAT: Society of Thoracic Surgeons- European Association of Cardio-Thoracic Surgery Congenital Heart Surgery Mortality Categories; Y: yes.* |

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**Supplemental Table 8. Multivariable cox regression for factors associated with longer ventilation time with death as competing risk (Harrell’s c-index=0.77)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Hazard Ratio** | **95% Confidence Interval** | ***P* value** |
| Shunt thrombosis | 2.13 | (0.80, 5.66) | 0.13 |
| Neonate (Y/N) | 2.34 | (1.26, 4.37) | 0.01 a |
| Cryoprecipitate in OR (Y/N) | 2.24 | (1.25, 4.04) | 0.02 a |
| Number of Prior Sternotomies (>1 vs. <=1) | 1.25 | (0.22, 7.01) | <0.001 a |
| RBC ICU (Y/N) | 1.95 | (1.07, 3.57) | 0.03 a |
| *a Statistically significant.* *b Trend towards statistical significance.**N: no; OR: operating room; RBC: red blood cells; STAT: Society of Thoracic Surgeons- European Association of Cardio-Thoracic Surgery Congenital Heart Surgery Mortality Categories; Y: yes.* |

**Supplemental Table 9. Multivariable linear regression (log transformed) for hospital cost (Model R2= 0.83)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Estimate** | **95% Confidence Interval** | ***P* value** |
| Shunt thrombosis | 31.53 | (10.12, 98.21) | 0.05 a |
| Cryoprecipitate in OR (ml/kg) | 1.14 | (1.09, 1.19) | 0.05 a |
| *a Trend towards statistical significance.**kg: kilogram; ml: milliliters; OR: operating room.* |

**Supplemental Figure 1. Flowchart of Patients’ Inclusion and Exclusion**

