

주최·주관 대한심장혈관흉부외과학회

2024 대한심장혈관흉부외과학회

제56차 추계학술대회

2024. 10. 31 (Thu) - 11. 01 (Fri) 여수 엑스포 컨벤션센터

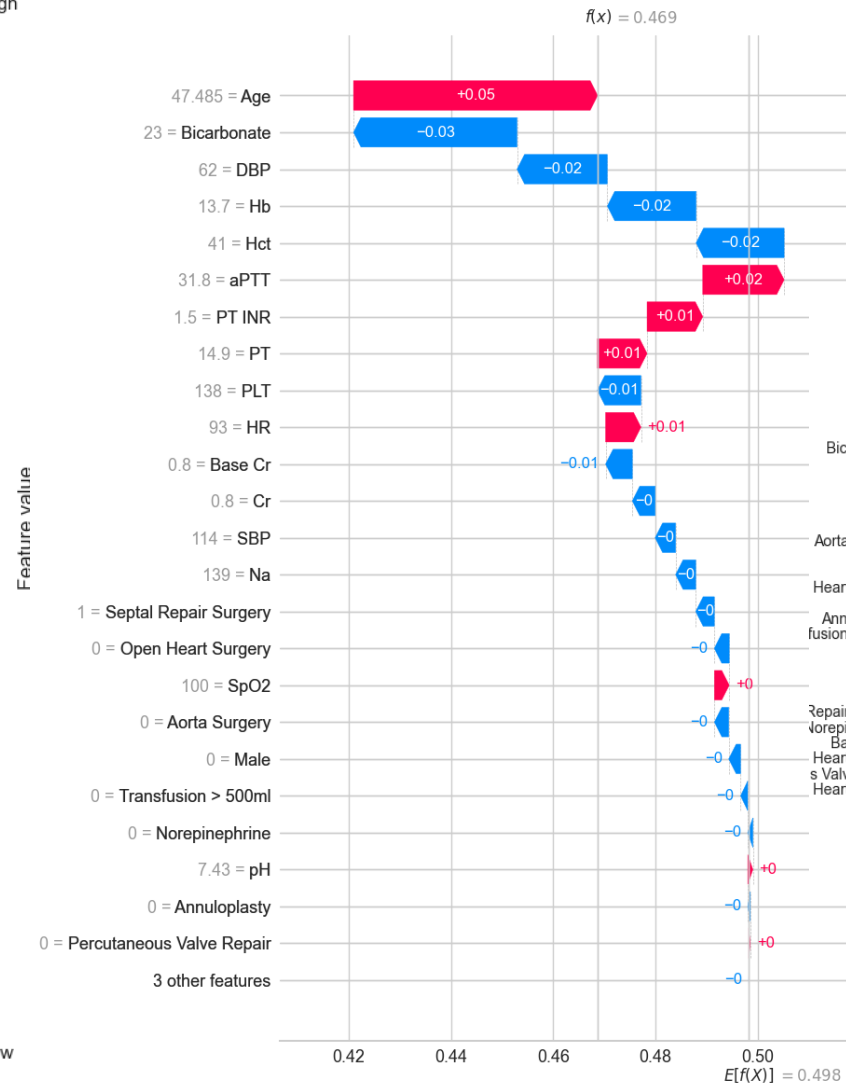
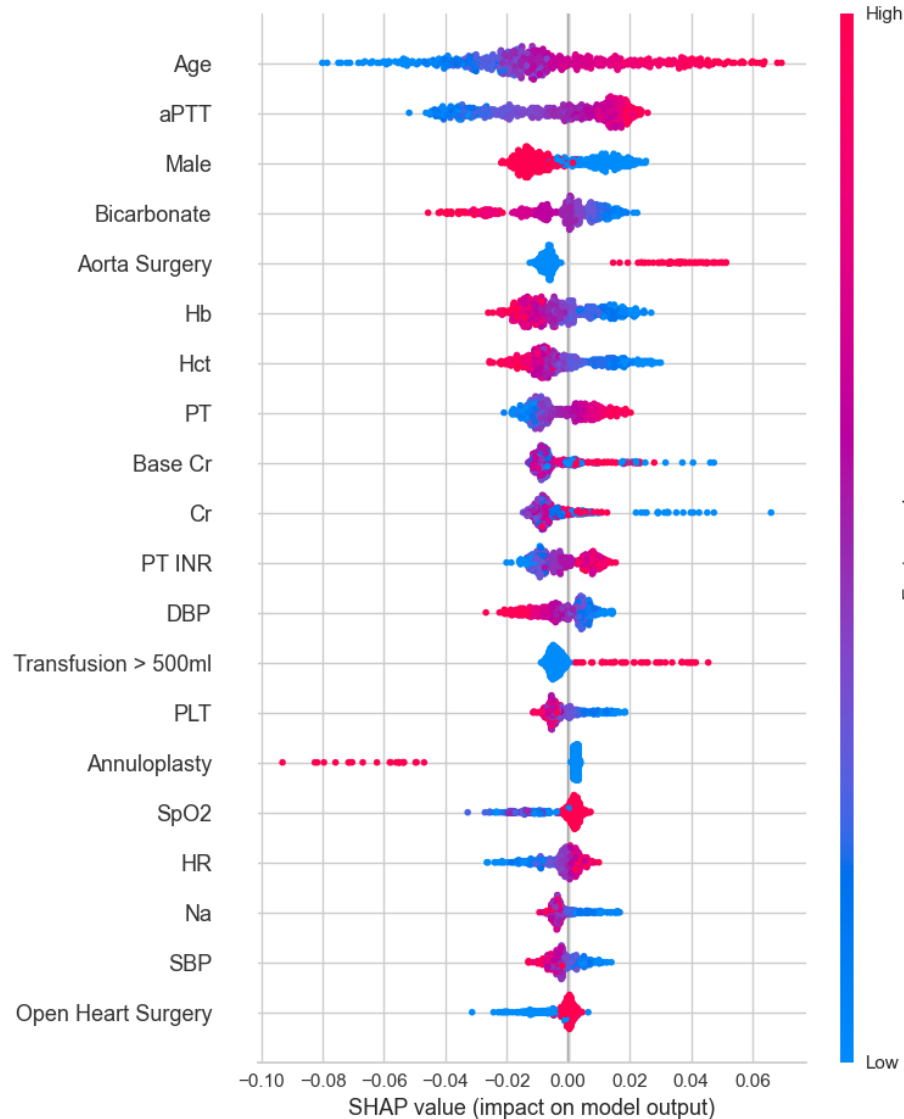


Transfusion and acute kidney injury following cardiac surgery: machine learning based analysis

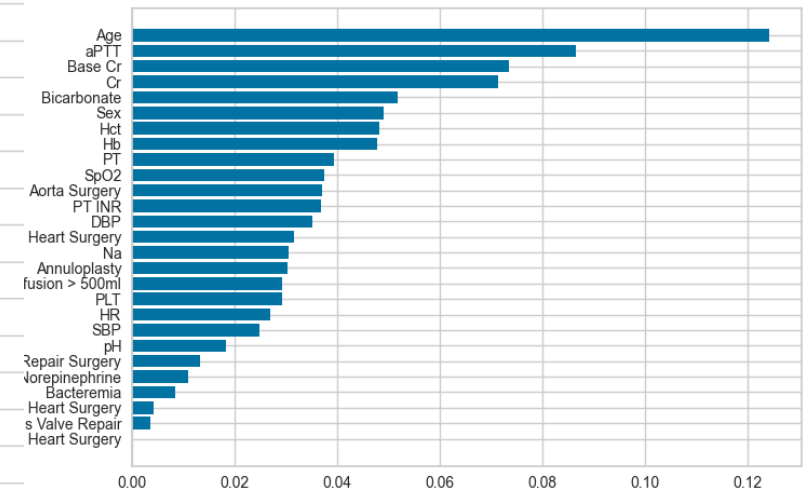
- The administration of blood products, though often necessary for managing anemia and significant intraoperative blood loss, has been associated with various adverse outcomes.
- The role of transfusion in the pathogenesis of acute kidney injury (AKI) following cardiac surgery highlights a need for stringent transfusion protocols and strategies to mitigate the risk.
- This study aims to elucidate the association between massive blood transfusion (500cc/48hr) and the incidence of AKI in patients undergoing cardiac surgery using machine learning techniques based on the data from the Medical Information Mart for Intensive Care (MIMIC-III) database.

- A total of 60,217 ICU admission records were available, with **2,715 cases** involving patients who underwent cardiac surgery upon admission.
- The entire dataset was divided into 1900 training & 815 test data (7:3)
- A total of 27 variables (e.g. demographic & lab data) were used to create a classification model for predicting vasoplegia, employing algorithms such as **Extra Trees (ET), Random Forest (RF), Light Gradient Boost (LGBM), Extreme Gradient Boost (XGB), and CatBoost (CTB)** from classic machine learning, as well as **TabTransformer (TT)** from deep learning.
- **Causal inference model to find the groups benefit from massive transfusion : GANITE analysis**

SHAP beeswarm and waterfall plot of Extra Trees model



Variable importance of Extra Trees model



Results

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	Total
Accuracy	0.836
AUROC	0.753
ATE	0.151 (0.147-0.155)
CATE for transfusion	0.132 (0.117-0.146)

Massive Tf -> 13.2% increase of AKI

Group with a **decreased AKI risk** after massive Transfusion
: Female, higher HR, lower BP, higher age, low bicarb, lower Hb, higher PT INR

	Total Treatment Effect < 0	Total Treatment Effect ≥ 0	P-value
Male	105 (44.304)	1490 (60.129)	<0.001
Aorta Surgery	34 (14.346)	272 (10.977)	0.144
Bacteremia	3 (1.266)	16 (0.646)	0.493
HR	86.629 (85.026-88.231)	83.831 (83.292-84.369)	0.001
SBP	109.692 (106.889-112.495)	114.703 (113.971-115.434)	0.001
DBP	54.173 (52.819-55.527)	59.586 (59.111-60.061)	<0.001
SpO2	99.203 (98.938-99.467)	98.805 (98.653-98.956)	0.011
Age	77.463 (76.34-78.586)	66.543 (66.004-67.082)	<0.001
Bicarbonate	21.008 (20.673-21.344)	23.855 (23.741-23.969)	<0.001
Base Cr	0.959 (0.882-1.036)	0.96 (0.929-0.992)	0.976
Hb	8.679 (8.445-8.913)	9.73 (9.65-9.81)	<0.001
PLT	174.679 (163.437-185.922)	162.439 (159.564-165.313)	0.039
Hct	25.898 (25.222-26.575)	29.057 (28.82-29.294)	<0.001
aPTT	48.629 (45.85-51.408)	42.522 (41.657-43.387)	<0.001
PT INR	1.695 (1.629-1.761)	1.507 (1.491-1.524)	<0.001
pH	7.389 (7.377-7.401)	7.387 (7.384-7.39)	0.775
Norepinephrine dose	0.049 (0.014-0.084)	0.037 (0.02-0.053)	0.534



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- Machine learning and deep learning model found that massive transfusion was associated with **13.2% increase of postoperative AKI**.
- **The causal inference model** found that the group with a increased AKI risk after massive transfusion had significantly **higher Hb and blood pressure and low PT INR and heart rate** compared to the group with an decreased risk.
 - Conversely, the group with a decreased AKI risk after massive transfusion had significantly lower Hb and blood pressure and higher PT INR and heart rate.
- Under specific circumstances such as anemia, postoperative transfusion can be beneficial in terms of AKI. Stringent transfusion protocols and strategies to mitigate the risk is required.