Utilizing Hyperoxygenated Blood During Left Heart Bypass for Thoracoabdominal Aortic Aneurysm Repairs to Reduce Postoperative Renal Dysfunction

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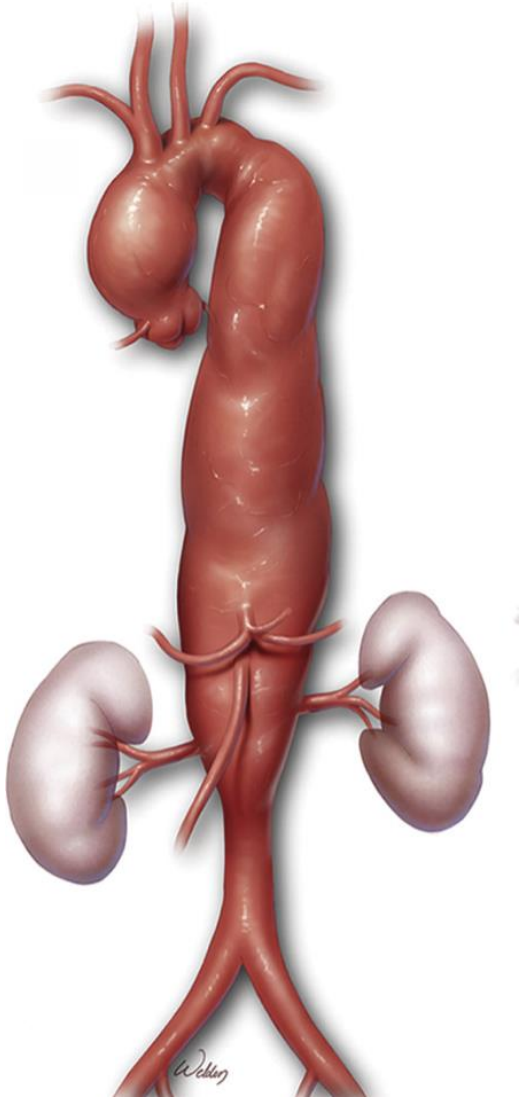
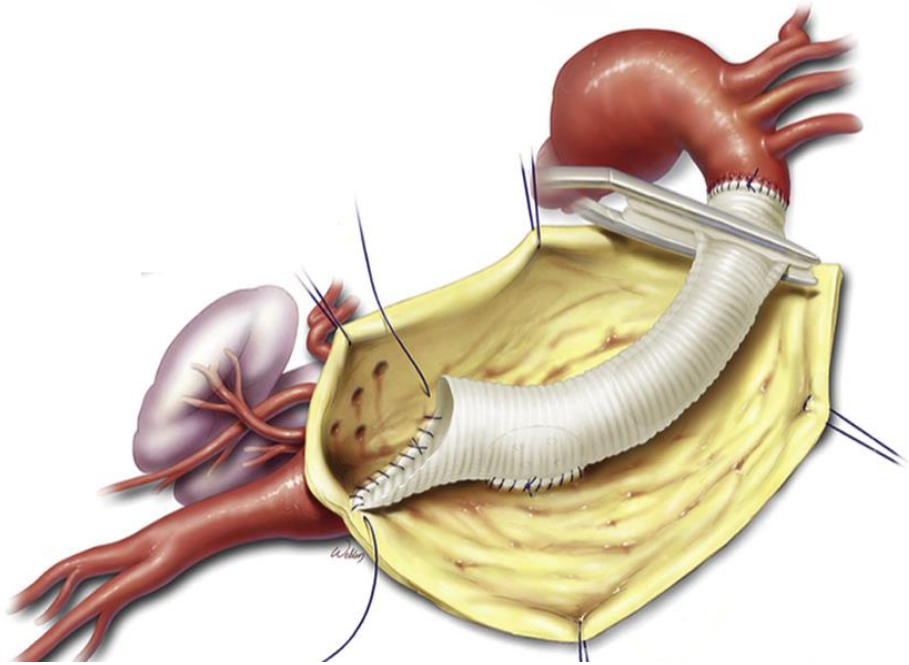
BACKGROUND

- Renal perfusion accounts for **20-25%** of the total cardiac output
- **Low oxygen delivery index** has been associated with an increase in the likelihood of renal dysfunction after cardiopulmonary bypass
- Renal dysfunction following thoracoabdominal aortic aneurysm (TAAA) repair remains a significant complication despite improvements in renal perfusion methods, surgical technique, and perioperative care
- Acute kidney injury (AKI) necessitating renal replacement therapy occurs in **4% to 17%** of TAAA repairs
- During TAAA repair using cold renal perfusion, there is typically a transient cessation of urine output with subsequent slow recovery of renal function



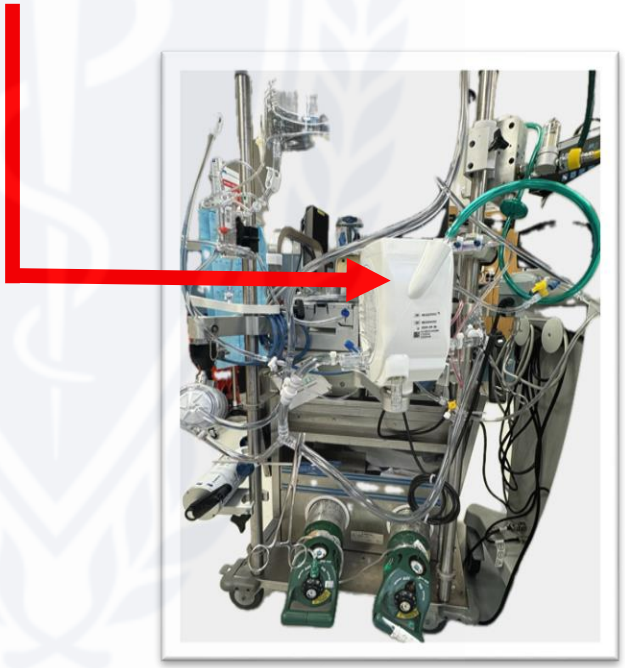
OBJECTIVE

- An oxygenator was added to our left heart bypass circuit to return hyperoxygenated blood to the patient
- We explored the use of hyperoxygenated blood to perfuse renal and visceral arteries during TAAA repair and present our experience with this novel technique



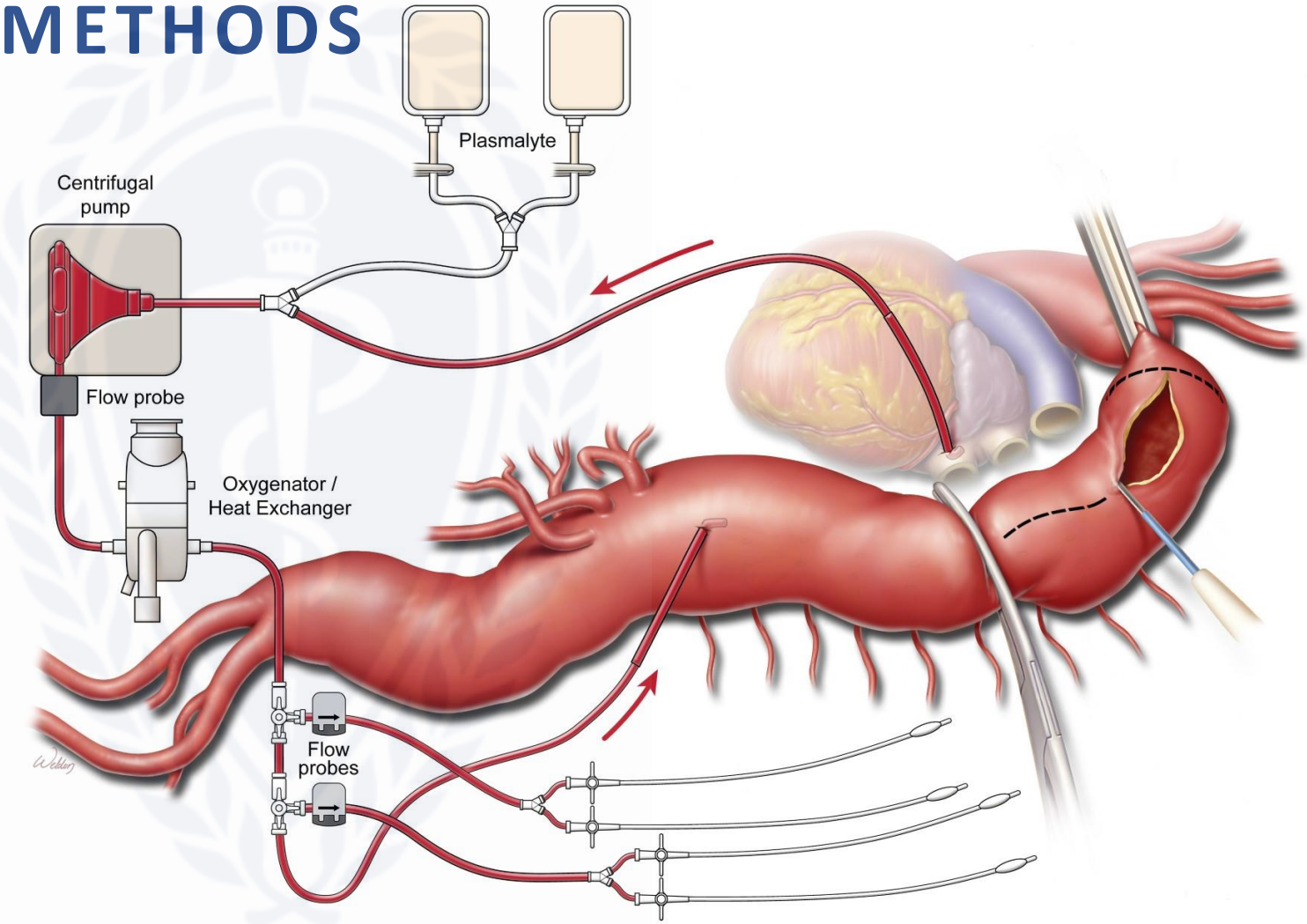
METHODS

- A standard left heart circuit was utilized for left heart bypass with the addition of an oxygenator to increase the PaO_2 of the blood as it is exposed to 100% FiO_2 via the **oxygenator** before returning to the patient



- Separate return lines and balloon perfusion catheters were prepared and branched from the main return line for selective visceral and renal **hyperoxygenated blood perfusion**
- Heparin is administered for **ACT ~250**
- **Heat exchanger** aims to maintain normothermia
- No additional cold blood or cold crystalloid visceral perfusion was administered

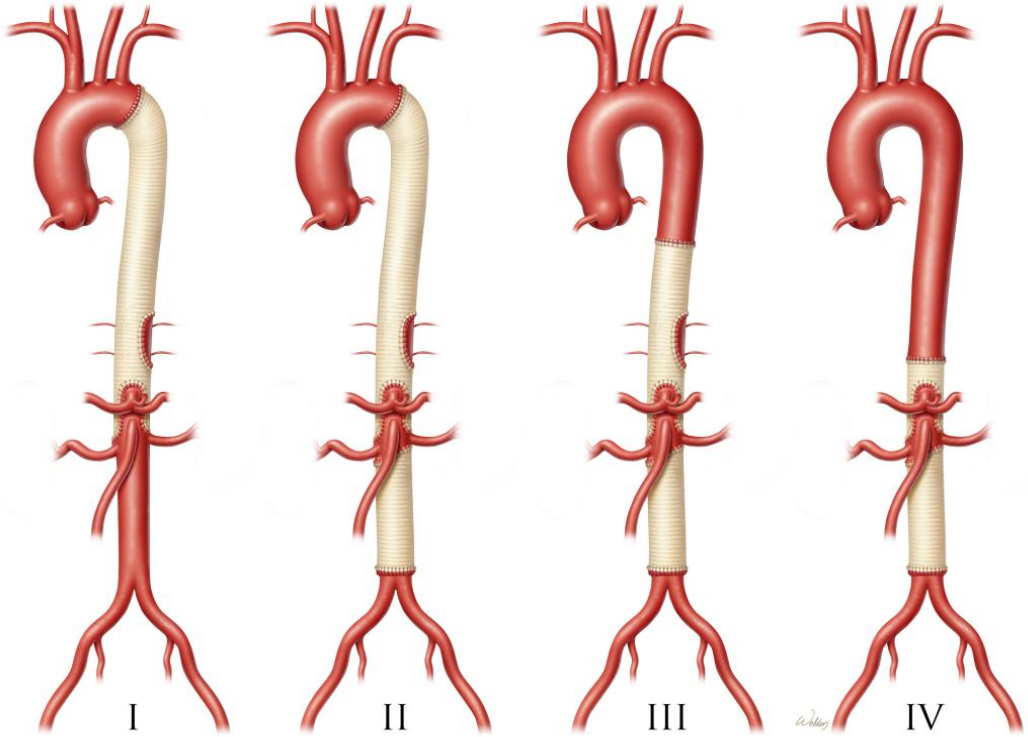
METHODS



Variable	All (n = 11)
Management of visceral/renal arteries	
Endarterectomy, stenting, or bypass	5 (46%)
Endarterectomy	1 (9%)
Stenting	0
Bypass graft	4 (36%)
Adjuncts	
Left heart bypass	10 (90%)
Modified distal perfusion circuit	1 (9%)
Selective perfusion of visceral arteries)	11 (100%)

For **Extent IV TAAA** repairs, a multistage femoral venous cannula is instead advanced to the level of the right atrium to drain into the circuit and oxygenator for perfusion into the visceral and renal arteries

- Since February 2023, we have provided intraoperative hyperoxygenated blood to 11 patients undergoing TAAA repair
- Data was obtained from a **prospectively** maintained database and supplemented with a review of additional medical records
- **Postoperative complications** including renal dysfunction and persistent paraplegia were retrospectively evaluated



RESULTS

- Patient age ranged from 37-77 years
- Extent I: 2; Extent II: 6; Extent III: 1; Extent IV: 2
- Baseline preoperative creatinine ranged from 0.86-3.34mg/dL with two patients having chronic kidney disease at baseline (eGFR<60mL/min/1.73m^2)
- Visceral artery intervention (bypass, endarterectomy, and/or stenting) was performed in 5 patients

Age	Sex	Extent TAAA	Baseline Creatinine (mg/dL)	eGFR	Visceral artery intervention
31	M	II	0.94	108	**Yes**
37	M	II	0.86	111	No
46	M	IV	3.34	**24**	**Yes**
47	M	I	1.03	100	No
48	M	II	0.88	102	No
55	M	II	1.1	75	No
58	M	IV	0.9	94	**Yes**
59	M	I	1.17	79	No
62	M	II	2.51	**26**	**Yes**
73	F	I	0.87	66	**Yes**
77	M	II	1.07	67	No

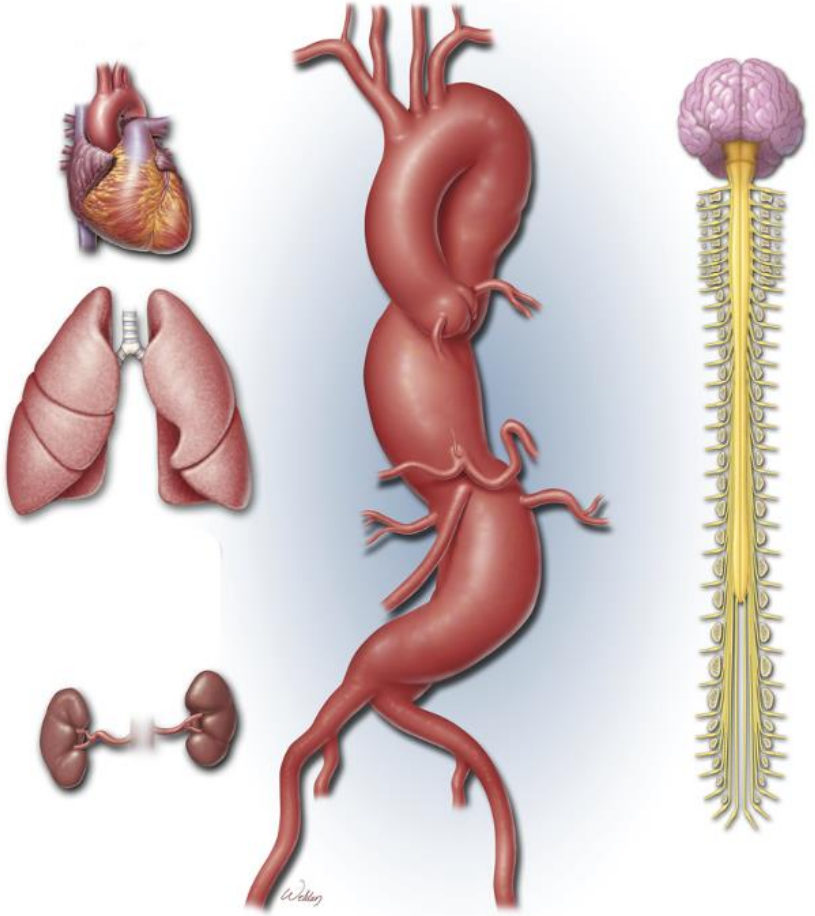
RESULTS

- 1 patient developed postoperative acute renal dysfunction (with creatinine elevation greater than 50% above baseline within 10 operative days) but did not need dialysis
- None of the patients had persistent renal failure on discharge
- There was no incidence of mesenteric ischemia, return to the operating room for bleeding, or persistent postoperative paraplegia
- One patient died of cerebral herniation due to subarachnoid hemorrhage from an undiagnosed intracranial aneurysm and another patient died suddenly on postoperative day 18 of unknown causes

Age	Persistent paraplegia	Persistent renal failure requiring dialysis	Persistent stroke	Operative death
31	No	No	No	No
37	No	No	Yes	Yes
46	No	No	No	No
47	No	No	No	No
48	No	No	No	No
55	No	No	No	No
58	No	No	No	No
59	No	No	No	No
62	No	No	No	No
73	No	No	No	No
77	No	No	No	Yes

CONCLUSIONS

- Early **observational results** from the addition of an oxygenator to a standard left heart bypass circuit for TAAA repairs have yielded **favorable results for postoperative renal dysfunction**, even for patients with baseline chronic renal dysfunction and elevated serum creatinine
- Future steps include conducting a formal clinical trial to further evaluate the utility and clinical significance of left heart bypass with hyperoxygenated blood in TAAA repairs
- Additional research is needed to evaluate the potential applicability and significance of the hyperoxygenated blood on **spinal cord deficits** and **pulmonary complications**



Thank you!

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