

Ultrafiltration Rate >13 ml/kg/hr is Associated with Decrease in Central Venous Oxygen Saturation Levels in Pediatric Hemodialysis Patients


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Disclosures

- Sarah Swartz participated on Fluid Management Medical Advisory Board for Fresenius Renal Therapies Group
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Background

- Inter-dialytic fluid overload / subsequent intra-dialytic cardiac stress associated with removal of this fluid contributes to cardiovascular (CV) morbidity
- Relying on symptomatology to guide safe rate of fluid removal might lead to missed subtle changes
- We have previously shown that in children and young adults receiving maintenance hemodialysis, cardiac index falls in more than half the patients during dialysis. This is associated with rate of fluid removal

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Background

- CMS recommends removing no more than 13 ml/kg/hr
- It is not yet known if this is true for children
- Traditional monitoring tools in current practice might not be sensitive enough to assess adequately

Background

- Adequate cardiac output and levels of hemoglobin are required for optimal tissue oxygen delivery under normal conditions
- Mixed venous oxygen saturation ($S_{mv}O_2$) is a surrogate measure of adequate tissue oxygen delivery as it correlates with the tissue oxygen uptake
- $S_{mv}O_2$ is traditionally measured from pulmonary artery and requires placement of a pulmonary artery catheter

Background

- Central venous oxygen saturation ($ScvO_2$) is easily measurable from upper extremity central veins and correlates with mixed venous levels
- Non-invasive blood volume monitor also displays oxygen saturation and can be used to trend $ScvO_2$ if used with a dialysis catheter

Background



Hypothesis

- Rate of fluid removal $>13\text{ml/kg/hr}$ is associated with ScvO₂ decrease and dialysis associated morbidity symptoms
 - Hypotension, cramping, abdominal pain, vomiting, lightheadedness

Criteria

- Inclusion:
 - End Stage Renal Disease (ESRD) patients on hemodialysis
 - Patients with internal jugular and subclavian central venous catheters
- Exclusion:
 - Patients with femoral catheters, AV fistulas, and AV grafts
 - Treatments with incomplete data
 - Treatments for pure ultrafiltration

Methods

- Retrospective chart review
 - Data collected from April – June 2017
 - 828 dialysis treatment runs
- 4 hour HD performed with linear fluid removal
- Noninvasive blood volume monitor used to record ScvO₂ and blood volume change (ΔBV) at initiation of HD, 2 hours into HD, and at completion of HD

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Demographics

- 22 patients; 12 males
- Mean age: 9.8 years (range 1-21)
- Etiology:
 - Nephrotic Syndrome: 10/22 = 45%
 - Obstructive Uropathy/Dysplasia: 6/22 = 27%
 - Chronic GN: 1/22 = 4.5%
 - Other: 5/22 = 22.7%

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Outcome Data

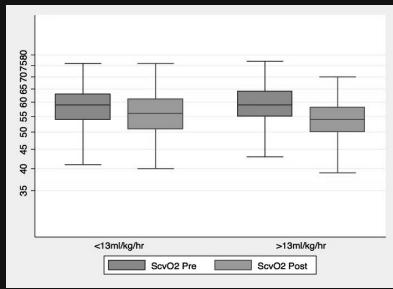
	Hgb (g/dl)	Dry Weight (kg)	ScvO ₂ Pre	ScvO ₂ Post
< 13 mL/kg/hr	11.18 ± 1.45	29.53 ± 21.18 [†]	58.39 ± 8.18	56.07 ± 7.66 [*]
> 13 mL/kg/hr	11.25 ± 1.66	25.84 ± 14.68 [†]	59.23 ± 6.59 [†]	54.29 ± 8.73 ^{**†}

* = p < 0.05
† = p < 0.05

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ScvO₂ Saturation Pre and Post HD



* = p < 0.05

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Outcome Data

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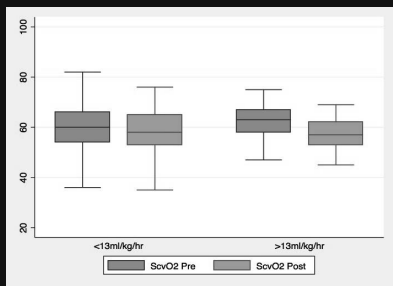
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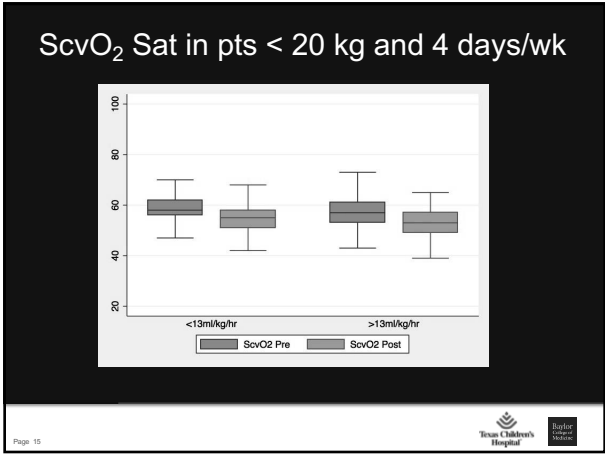
ScvO₂ Sat in pts > 20 kg and 3 days/wk



P < 0.05

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Pts < 20 kg on 4 days/wk

	Number of treatments	Mean rate of fluid removal
No drop in ScvO ₂ Sat	104	12.4 ± 5.1 ml/kg/hr
Drop in ScvO ₂ Sat	231	13.0 ± 4.7 ml/kg/hr

P=0.302

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Outcome Data

	< 13 mL/kg/hr	> 13 mL/kg/hr
Symptoms Absent	437 (84.20%)	270 (85.38%)
Symptoms Present	82 (15.79%)	39 (14.61%)
Total	519	309

P= 0.2

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Conclusion

- ScvO₂ decreased significantly in patients > 20 kg when UFR > 13 mL/kg/hr signifying possible morbidity in pediatric patients
- Patient symptoms are inadequate and late measures for assessing morbidity
- A different UFR standard may be required in smaller children
 - Achieving UFR < 13 mL/kg/hr was difficult even in those receiving 4 days/wk HD
 - There was no difference in ScVO₂ between the higher and lower UFR groups

Thank you



Questions?

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Outcome Data

	% BV 2hr	% BV 4hr	Total Fluid Removed
< 13 mL/kg/hr	-6.459 ± 7.648*	-8.8472 ± 7.392*	1118.12 ± 934.10*
> 13 mL/kg/hr	-8.856 ± 4.946*	-13.043 ± 8.193*	1644.62 ± 925.38*

* = p<0.05
