Association Between Intradialytic Central Venous Oxygen Saturation and Mortality

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Background

- Patients with end stage renal disease on hemodialysis (HD) have an elevated mortality compared to the general population.
- The major cause of death is due to cardiovascular disease.
- Central venous oxygen saturation ($ScvO_2$) is a marker of cardiac output, oxygen delivery, and oxygen consumption.
- In sepsis and post-surgical patients, $ScvO_2$ levels outside the normal range (60% - 80%) have been associated with morbidity and mortality.
- Review of literature did not reveal any studies examining the association between $ScvO_2$ and mortality in HD patients.

METHODS

- Crit-Line Monitor ™ is approved for the measurement of hematocrit, relative blood volume, and oxygen saturation in the extracorporeal dialysis circuit.
- It measures oxygen saturation 9,000 times per minute and reports a mean measurement every minute.
- When connected to a central venous catheter (CVC), the oxygen saturation reported will be the $ScvO_2$.
- This device was routinely used in 17 Renal Research Institute outpatient HD units.
- Patients with CVC as access were identified between January 2012 to September 2015. Each patient had intradialytic $ScvO_2$ assessed during a 6 month baseline period, and mortality was assessed for up to 36 months after this baseline period.
- Only patients with at least 10 HD treatments with $ScvO_2$ measurements during baseline were included in final analysis.
- We excluded treatments with values of <25% as this was incompatible with life and >85% as these were unlikely to be venous.

RESULTS

579 patients with central venous catheters between 1/1/2012 and 8/31/2015

→ 347 patients were excluded due to having <10 HD treatments with intradialytic $ScvO_2$ recordings during study period

232 patients in the final analytical cohort

Figure 1. Flow Diagram

Variables	Mean±SD
Number of eligible treatments during baseline (per patient)	26±13.3
Demographics	
Age [years]	62.7±15.7
Race [% white]	56
Gender [% male]	48.3
Vintage [years]	2.9±4.6
BMI [kg/m²]	28.1±6.9
Comorbidities [%]	
Diabetes	59
CHF	22.0
COPD	10.3

Table 1: Patient Characteristics

Variables	Mean±SD
Central Venous Oxygen Saturation [%]	
Mean $ScvO_2$	58.7±7.3
Median $ScvO_2$	59.1±7.3
Minimum $ScvO_2$	48.4±9.7
Maximum $ScvO_2$	65.2±6.2
SD $ScvO_2$	3.4±1.1
Start $ScvO_2$	59.1±7.4
End $ScvO_2$	57.3±7.8

Table 2: Central Venous Oxygen Saturation Parameters: Values were calculated per treatment then averaged per patient

		Crude[a]		Fully Adjusted[b]	
Outcome	Events	HR (95% CI)	P Value	HR (95% CI)	P Value
All-cause mortality	54	1.06 (1.03 to 1.1)	<0.001	1.04 (1.01 to 1.08)	0.0437

Table 3: Crude and adjusted hazard ratios for all-cause mortality per 1% decrease in $ScvO_2$
[a]Unadjusted model
[b]Adjusted for age, gender, chronic obstructive pulmonary disease, congestive heart failure, albumin, hemoglobin, erythropoietin dose, neutrophil to lymphocyte ratio and log vintage

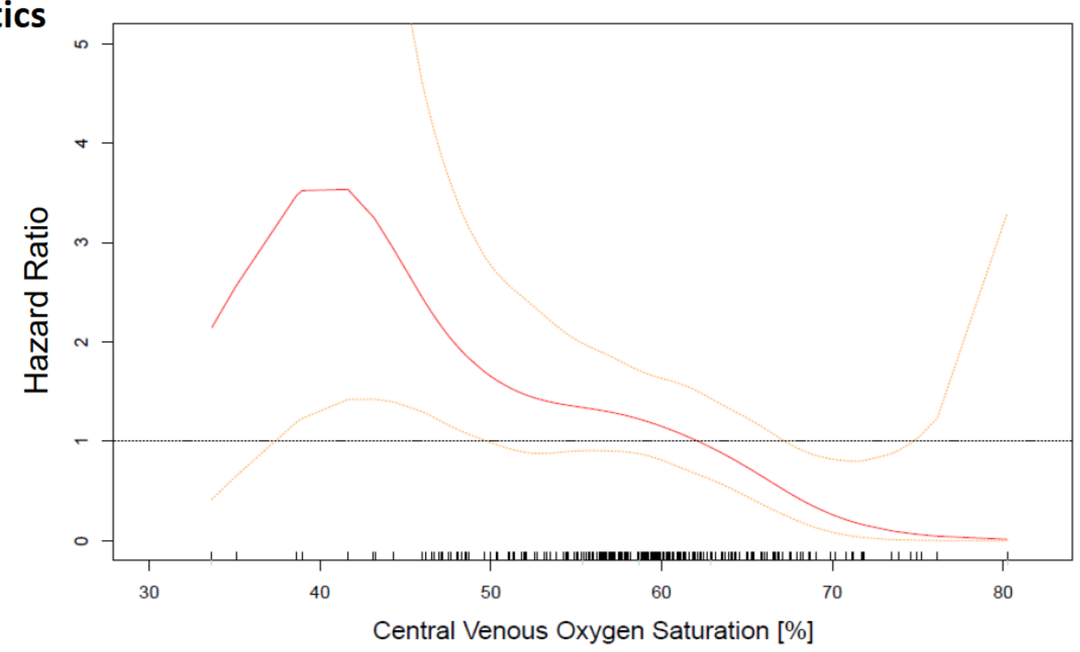

Figure 2: Spline analysis of hazard ratio for mortality as a function of mean $ScvO_2$. Solid line represents HR, the dotted lines the 95% confidence limits.

CONCLUSIONS

- Over 50% of our study population had mean $ScvO_2$ level below what is considered as normal (70%).
- $ScvO_2$ < 70% has been associated with increased morbidity and mortality in multiple populations including sepsis patients, post-surgical patients and patients with pulmonary hypertension.
- In a fully adjusted model, a 1% decrease in $ScvO_2$ was associated with a 4% increase in mortality.
- On spline analysis, $ScvO_2$ <63% was associated with increased mortality, with statistical significance reached at levels <50%.

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