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NSTI Outcomes with and without Hyperbaric Oxygen Therapy

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BACKGROUND

- The role of hyperbaric oxygen therapy (HBOT) for necrotizing soft tissue infections (NSTI) remains controversial.
- HBOT is frequently used for NSTI at The Shock Trauma Center(STC) of the University of Maryland Medical Center; however, the early COVID-19 pandemic forced a significant decrease in its utilization.
- This resulted in an large number of patients who did not receive HBOT, which allowed us to compare outcomes amongst those who received HBOT and those who did not.

METHODS

- We conducted a retrospective cohort study of patients aged ≥ 18 years admitted with a diagnosis of NSTI between January 2018 and December 2020, (**Figure 1**).
- Data collected included patient demographics, comorbidities, wound characteristics, pathogens, APACHE II, whether HBOT was provided or not.
- Exclusion criteria included patients who either underwent amputation or died within 48 hours of admission.
- Outcomes included 90-day mortality, late amputations, inpatient antibiotic days, ventilator days, and hospital length of stay.
- Data then were used to create a logistic regression model for predicting risk of death at 90 days.

Figure 1. Proportion of NSTI patients admitted to R Adams Cowley Shock Trauma Center (STC) who received HBOT between January 2018 through December 2020.

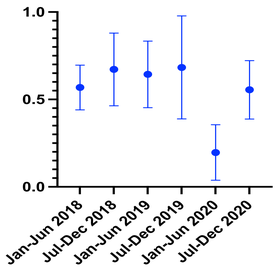

Table 1. Comparison of patient demographics in HBOT vs no HBOT groups.

Variable	HBOT no. (%)	No HBOT no. (%)	p-value
Patients	143 (56.3%)	110 (43.3%)	
Total			
Male	87 (62.6%)	49 (53.8%)	0.187*
Age, Mean±SD	53.5±13.9	52.2±15.5	0.494#
Transferred from OSH	129 (92.8%)	82 (90.1%)	0.468*
Number of Debridements at OSH			
0	80(66.1%)	45(66.2%)	
1	27(22.3%)	18(26.5%)	
>=2	14(11.6%)	5(7.4%)	0.581*
Comorbidities			
Diabetes	78(56.1%)	43(47.3%)	0.188*
Chronic Kidney Disease	17 (12.2%)	13 (14.3%)	0.651*
Peripheral Vascular Disease	8 (5.8%)	1 (1.1%)	0.091**
Substance Abuse	23 (16.5%)	17 (18.7%)	0.676*
Trauma	8 (5.8%)	3 (3.3%)	0.533**
Smoker	48 (34.5%)	25 (27.5%)	0.261*
BMI, Median (Q1,Q3)	32.0(25.8,40.1)	33.0(25.7,43.1)	0.344##
Immunosuppressed Chronic Steroids	9 (6.5%)	3 (3.3%)	0.372**
Immunosuppressed Uncontrolled HIV	1 (0.7%)	1(1.1%)	-
Immunosuppressed SOT	2 (1.4%)	1(1.1%)	-
Immunosuppressed HSCT	0 (0%)	0 (0%)	-
Immunosuppressed Chemotherapy	2 (1.4%)	3 (3.3%)	0.387**
Wound/Infection			
Non purulent	48(34.5%)	34(37.4%)	0.661*
Head and Neck	2 (1.4%)	1 (1.1%)	-
Perineal	83 (59.7%)	52 (57.1%)	0.699*
Abdominal	15(10.8%)	10 (11.0%)	0.962*
Truncal	8 (5.8%)	9(9.9%)	0.241*
Extremity	60 (43.2%)	25(27.5%)	0.016*
Inguinal	14 (10.1%)	9 (9.9%)	0.964*
Time to 1st Surgery, (hrs) Median (Q1,Q3)	5.0(3.0,9.0)	5.0(3.0,10.0)	0.843##
Total Surface Area, (Cm^2) Median (Q1,Q3)	525.0(255.0,828.0)	304.0(173.3,643.8)	0.005##
APACHE II, Median (Q1,Q3)	12.0(7.0,16.3)	14.0(7.3,21.0)	0.067##
Microbiology			
Beta Hemolytic Strep	45 (32.4%)	19 (20.9%)	0.057**
Clostridial Species	2 (1.4%)	4 (4.4%)	0.217*
MSSA	11(7.9%)	3(3.3%)	0.152*
MRSA	5 (3.6%)	7 (7.7%)	0.227**
Gram Negative Bacilli	47(33.8%)	31(34.1%)	0.968*
Polymicrobial	10 (7.2%)	6 (6.6%)	0.861*
Other	49 (35.3%)	43(47.3%)	0.069*

Legend: OSH - Outside Hospital, BMI - Body Mass Index; HIV - Human Immunodeficiency Virus,* p value using Chi square test,** p value using Fisher's exact test,# p value using Independent t test, ## p value using Mann-Whitney u test.

Table 2: Comparison of outcomes between patients who received HBOT and those who did not. Mortality further stratified by APACHE II Score.

Outcome	HBOT no. (%)	No HBOT no. (%)	p-value
Number of Surgeries, Median (Q1,Q3)	3.0(2.0,4.0)	3.0(2.0,4.0)	0.037
Inpatient Antibiotics Days, Median (Q1,Q3)	13.0(9.0,16.0)	11.0(7.0,15.0)	0.002
Ventilator Days, Median (Q1,Q3)	1.0(0.0,4.0)	0.0(0.0,4.0)	0.65
Length of Stay, Median (Q1,Q3)	15.1(9.8,22.2)	11.7(7.0,21.2)	0.015
Amputation Performed	7 (5.0%)	2 (2.2%)	0.489
Died within 90 days of admission	8 (5.8%)	14 (15.4%)	0.015

Table 3: Logistic Regression of Effect of HBOT on Death within 90 days, comparing interactions of HBOT with APACHE II score and Wound size.

Contrasts for Outcome of Death Within 90 Days	Odds Ratio	95% Confidence Limits		p-value
Effect of HBO Among Apache < 18	0.88	0.20	3.83	0.87
Effect of HBO Among Apache >= 18	0.23	0.06	0.95	0.04
Effect of HBO Among Wound Size < 450	0.88	0.12	6.51	0.90
Effect of HBO Among Wound Size >= 450	0.22	0.07	0.70	0.01
Effect of HBO Among Apache < 18 and Wound Size < 450	5.37	0.18	159.40	0.33
Effect of HBO Among Apache < 18 and Wound Size >=450	1.36	0.14	13.34	0.79
Effect of HBO Among Apache >= 18 and Wound Size <450	1.20	0.06	22.30	0.90
Effect of HBO Among Apache >= 18 and Wound Size >=450	0.12	0.02	0.72	0.02

RESULTS

- 253 patients were included of whom 143 (56.3%) received HBOT and 110 (43.3%) did not.
- Baseline characteristics were similar except for Wound Surface Area (WSA) and distribution on the extremities (**Table 2**).
- More patients in the non-HBOT group died within 90 days of admission than the treated group (5.8% vs 15.4%, p=0.015, **Table 2**).

RESULTS

- Length of stay and inpatient antibiotic days were longer in HBOT patients (15.1 vs 11.7 days, p=0.015, 13.0 vs 11.0, p=0.002, **Table 2**).
- Logistic regression model for risk of death revealed (**Table 3**):
  - HBOT patients with APACHE II scores ≥18 had significantly lower risk of death than non-HBOT patients (OR 0.23, 95% CI 0.06-0.95)
  - HBOT patients with wounds ≥ 450 cm^2 had significantly lower risk of death than non-HBOT patients (OR 0.22, 95% CI 0.07-0.70)
  - HBOT patients with APACHE II scores ≥ 18 and wounds ≥ 450 cm^2 had significantly lower risk of death than non HBOT patients (OR 0.12, 95% CI 0.02-0.72)

CONCLUSIONS

- In this population of NSTI patients who underwent surgical debridement, HBOT was associated with lower 90-day mortality.
- The difference in mortality appears most profound in patients who had large wounds (≥ 450 cm^2) and severe illness (APACHE II score ≥ 18.
- A prospective study should further evaluate the impact of HBOT on mortality.