TNF-alpha as a biomarker for neurological severity in acute Carbon Monoxide (CO) poisoning

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BACKGROUND

Carbon monoxide (CO) poisoning can result in mild-to-severe cardiac, neurologic, and other systemic complications. In severe CO intoxication, hyperbaric oxygen therapy (HBOT) may reduce neurologic sequelae (1). Traditionally, carboxyhemoglobin (COHb) serves as an index of exposure severity and duration, but post-treatment COHb does not correlate with patient outcomes. While early CO-induced cardiotoxicity can be identified with serum natriuretic peptides, neurologic injury cannot be similarly predicted.

METHODS

In this study, we evaluated biomarkers in 30 consecutive adult patients admitted with CO poisoning for HBOT at a single facility (Vaio Hospital; Parma, Italy) from 10/2013 - 12/2013. Intubated and comatose patients were excluded. HBOT was initiated within a few hours post-exposure and performed at 2.8 atmospheres absolute (ATA) O2 for 30 minutes followed by 2.5 ATA O2 for 60 minutes. As part of a standing research protocol approved by our regional safety committee, 10 mL venous blood samples were obtained at admission and immediately post-HBOT for standard venous blood gas data, COHb, interleukin (IL)-6, IL-8, IL-10, C-reactive protein (CRP), tumor necrosis factor-alpha (TNF-α), neuron-specific enolase, and S100B protein. Seven healthy adult volunteers served as controls from whom identical measures were obtained. Neurologic evaluations were performed at arrival and daily until discharge. Follow-up telephone interviews were completed at 10, 20, and 30 days after HBOT.

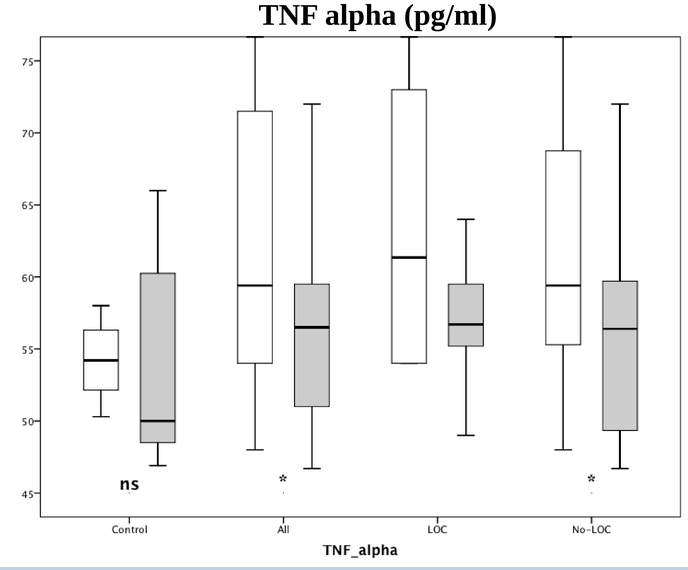
RESULTS

Neurologic symptoms were observed at HBOT initiation in 5 patients: 4 with confusion and malaise and 1 with headache. Although 10 patients had transient loss of consciousness, all patients were conscious at the start of HBOT. All neurologic symptoms resolved after 1 HBOT without long-term sequelae on follow-up. After HBOT, COHb levels were significantly decreased in all patients (3.8% vs 26.8%, p = 0.01). In controls, low COHb levels without significant changes were found.
Significant decreases were seen in IL-10 and TNF-α levels after HBOT for the pooled CO patients groups (Table 1 and Figure 1 for TNF-α; IL-10 data are similar but not shown). When further evaluating the 10 patients with transient loss of consciousness, TNF-α and IL-10 levels were significantly higher at admission. No significant differences were seen in the remaining markers.

Table 1. TNF-alpha Values in Controls and Carbon Monoxide Poisoning Patients Before and After Hyperbaric Oxygen Therapy

	Before	After
Controls (n=7)	55.2 pg/mL (13.1)	54.4 pg/mL (26)
HBO patients (n=30)	67.5 pg/mL (30.5)#	63.3 pg/mL (27.8)*

Data are depicted as mean (1 SD).
significantly different from Controls Before, p<0.01 by unpaired t-test;
* significantly different from Before treatment for HBO patients: p<0.03 by Wilcoxon two-tailed signed-rank test



CONCLUSION

Previous toxicology data from CO poisoning patients found that acute inflammatory modulation may mediate neurologic toxicity (2). Our data suggests that a rapid decrease in TNF-α and IL-10 levels after HBOT may predict resolution of neurologic symptoms. From our findings, we propose further study of TNF-α and IL-10 monitoring in CO poisoning patients as a marker of neurologic complications, especially if residual symptoms persist after HBOT.

REFERENCES

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