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Title: Treatment of hypercapnic respiratory failure with a novel extracorporeal CO_2 removal system

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Body: Background: Extracorporeal CO_2 removal ($ECCO_2R$), a potentially valuable technique, has not been systematically evaluated in patients with hypercapnic respiratory failure. We describe the application of a novel single venous catheter, low blood flow, $ECCO_2R$ device (Hemolung® Respiratory Assist System, ALung Technologies, Inc.). Methods: Twenty three hypercapnic patients received $ECCO_2R$. Group 1 (n=7) consisted of patients with chronic obstructive lung disease on noninvasive ventilation with a high likelihood of requiring invasive ventilation, Group 2 (n=2) were patients who could not be weaned from noninvasive ventilation, Group 3 (n=11) were patients who could not be weaned from invasive ventilation, and Group 4

(n=3) were patients on invasive ventilation requiring lung protective ventilation techniques. Results: The device was well tolerated, with complications and rates similar to those seen with central venous catheterization. Blood flow through the system was 430.5±73.7 ml/min, and $ECCO_2R$ was 82.5±15.6 ml/min. Invasive ventilation was avoided in all patients in Group 1 and both patients in Group 2 were weaned; PaCO2 decreased significantly ($p<0.003$) with application of the device. In Group 3, three patients were weaned, in 3 patients ventilatory support was reduced, and one patient died due to a retroperitoneal bleed following catheterization. In Group 4, lung protective ventilation was enhanced by the ECCO2R device. Conclusions: This single catheter, low blood flow $ECCO_2R$ system provided clinically useful levels of CO_2 removal in these hypercapnic patients. The system appears to be a potentially valuable additional modality for the treatment of hypercapnic respiratory failure.