LETTER TO THE EDITOR

Patients with Hemoglobinopathies Require Continuous Flow Supplemental Oxygen During Commercial Airline Flights

Sota Omoigui*, and Helen Omoigui

Division of Inflammation and Pain, L.A. Pain Clinic - Medicinehouse.com, 4019 W Rosecrans Ave, Hawthorne, CA 90250, USA

TO THE EDITOR

Patients with hemoglobinopathies are known to experience complications e.g. bone pain [1], splenic infarction [2] and osteonecrosis (avascular necrosis) of the hip (anecdotal report) subsequent to commercial airline flights. These complications are due to prolonged decrease in oxygen delivery at high altitudes. There is no study in the literature that has measured the oxygen saturation in these patients on commercial airline flights where planes ascend to altitudes of 30,000 feet or greater. At these altitudes, there is a low partial pressure of oxygen which is about a quarter of that at sea level. Humans would not be able to breathe without a pressurized environment and modern commercial jets are pressurized to an altitude of 5000-8000 feet. Ideally an airplane would be pressurized to ground level pressure (760 Torr). However this is not practical as the fuselage of a plane would have to be incredibly strong (and hence very heavy and expensive to fly) to withstand the outward force caused by 760 Torr while cruising at altitudes of 30,000 feet or greater [3]. At ground level, the partial pressure of oxygen is about 150 Torr or mm of mercury (20% of atmospheric pressure at 760 Torr). Inside a plane at cruising altitude oxygen partial pressure is reduced to about 125 Torr, In most people, this is a negligible change and their blood will remain fully saturated with oxygen at this pressure. This is not the case in patients with hemoglobinopathies in which tissue oxygen delivery is already compromised. We set out to determine the changes in oxygen saturation in seven patients with and without supplemental oxygen (continuous flow and pulse dose) provided during commercial airline travel. These patients with a mix of Hgb SS and SC were stable and without any underlying conditions. We provided them with a Sequal SmartPulse™ fingertip pulse oximeter to monitor oxygen saturation as well as with a Sequal™ Eclipse 3 oxygen concentrator (Sequal Technologies, San Diego, California. Phone 858 202-3100). This oxygen concentrator is one of a few that are approved by the Federal Aviation Administration (FAA) for supplemental oxygen delivery on commercial airline flights. The Sequal™ Eclipse 3 has capabilities of pulse dose oxygen delivery (96 to 192 mls) triggered by inspiratory effort as well as ability to deliver continuous flow oxygen of 0.5 to 3 liters /min.

Starting after 10 mins of ascent with an altitude greater than 10000 feet, oxygen saturation dropped from an average of 93 to 95% at sea level to 77% to 83%. The drop in saturation was associated with an increase in heart rate of 10 to 15 beats per min (bpm). After administering the pulse dose mode of oxygen delivery, at 2 liters/min by nasal cannula triggered by inspiratory effort, oxygen saturation improved to 89% to 91%. When the delivery mode was changed to continuous flow oxygen at 2 liters/min by nasal cannula, oxygen saturation improved rapidly within a couple of minutes to 93% to 98% and the heart rate decreased back to the baseline. Discontinuation of use of the concentrator resulted in a rapid desaturation back to 77% to 83%. When continuous flow oxygen was administered at only 1 liter/min, oxygen saturation did not improve beyond 83%. At a continuous flow of 1.5 liter/min, oxygen saturation improved to 88%. At 2.5 liter/min, oxygen saturation was similar to but not better than that obtained with the flow rate of 2 liter/min at 93% to 98%. Within 10 mins of descent, and with discontinuation of use of the concentrator, oxygen saturation was 93% to 95% and similar to that obtained when the plane was back on the ground. The oxygen saturation for another passenger on the same flight who did not have a hemoglobinopathy and thus served as a control was 97 to 100% at sea level with the same saturation and heart rate maintained throughout the flight.

This study demonstrates that patients with hemoglobinopathies desaturate during commercial airline flights and should receive supplemental continuous flow oxygen at 2 liters per min during all flights that exceed one hour in duration. Flights of less than one hour in duration do not attain very high altitudes after ascent and cruise for only a short time before they begin their descent. Therefore the physiological compromise should be of minimal duration. Physicians should be made aware of the need to not only advise their patients to be well hydrated but to prescribe supplemental oxygen for airline travel and should educate patients and their families accordingly. As a matter of public policy, commercial airlines should be mandated to make supplemental oxygen available to passengers who request it. Supple-

*Address Correspondence to this author at the Division of Inflammation and Pain, L.A. Pain Clinic - Medicinehouse.com, 4019 W Rosecrans Ave, Hawthorne, CA 90250, USA; Tel: 310 345-0899; Fax: 310 494-3462;
E-mail: Medicinechief@aol.com

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mental oxygen should be provided as continuous flow oxygen from an FAA approved oxygen tank or concentrator. Concentrators that can only provide pulse dose oxygen delivery triggered by inspiratory effort do not provide adequate oxygen delivery for commercial airline travel and should not be used. Continuous flow oxygen delivery will prevent hypoxic organ damage in patients with hemoglobinopathies during commercial airline travel.

In conclusion our observations can be summarized by our rule of 10. In the absence of supplemental continuous flow oxygen on commercial airline flights, patients with hemoglobinopathy experience physiological decompensation after 10 mins of flight with ascent above 10000 feet manifested by a decrease in oxygen saturation of more than 10% and an increase in heart rate of greater than 10 bpm.

Sota Omoigui M.D., Helen Omoigui RN, BSN

Division of Inflammation and Pain Research

L.A. Pain Clinic, Los Angeles, California

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