Title: The Effect of High Flow, Humidified air via Air on Oxygen Content, Humidity and Temperature

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Introduction:

Supplemental oxygen is one of the most commonly prescribed treatments in medical care. At any given time, up to a quarter of patients in hospital receive additional oxygen. Data from the UK suggests that up to 34% of all ambulance transports involve the delivery of oxygen.

Nasal cannula is the most common method of oxygen delivery today. We have recently demonstrated that the fraction of inspired oxygen concentration with this delivery method varies depending on the rate of breathing or whether breathing with mouth open or closed. The oxygen delivered is also a dry gas. Humidified, heated, high flow air with supplemental oxygen via a specialist apparatus is an alternative way of providing oxygen therapy. A relatively newer device delivers oxygen via a heated, humidifier, high flow machine, the Airvo 2. It is portable, easy to use and comfortable to wear. It has been shown to be cost effective in the management of COPD (Chronic Obstructive Pulmonary Disease) and is widely used on the medical and respiratory wards. The increased humidity and inhaled temperature may increase patient comfort and compliance when compared to oxygen delivered via nasal cannula.

We are investigating, if we can deliver more precise levels of oxygen with a high flow system (i.e with the Airvo 2) than a low flow oxygen system (nasal cannula). With a low flow system the flow of oxygen only makes up a small portion of the gas that is inhaled, because the patient is still breathing room air as well. The ratio of air from the room and oxygen supplied is generally unknown as it is dependent on how the patient is breathing. The fraction of inhaled oxygen will be higher with a small breath and lower with a big breath, because as the patient breathes more the room air dilutes the oxygen. Hence, it is difficult to know how much oxygen is being delivered to the patient. In a high flow system such as the Airvo 2, the air flow (oxygen mix) is too great for the patient to breath in much extra air. Air and oxygen are premixed in this machine and the oxygen fraction of the mixture is measured before it is delivered to the patient. We believe the oxygen inhaled by the patient will be the same as the oxygen fraction displayed on the Airvo 2 screen. Thus, delivering a known amount of oxygen to the patient. To this leads us to the hypothesis that high flow systems are more predictable in the amount of oxygen they deliver to the trachea. This is why we are using an intratracheal (inside the windpipe) tube to sample the air when the machines are active, to measure the oxygen delivery.

Also we want to investigate if there is any difference in trachea air temperature when delivering unheated low flow oxygen therapy or heated humidified high flow therapy. If the temperature of the air breathed in changes the temperature inside the airways, this may be able to be used to ‘warm up’ the airways with warm air which may increase comfort

Aim:

My project’s aim was to compare the effectiveness of nasal cannula to that of the AIRVO 2 system. There’s been no previous research on how the oxygen delivery differs between the two

methods of oxygen delivery. We are exploring the effect of different settings on the oxygen concentration, carbon dioxide concentration and temperature inside the airways.

Method:

We tested out the actual out put of the Airvo 2 against the display on the machine. In order to do this, we used the Powerlab and the Center 301 thermometer- type K. We measured flow, oxygen and temperature. These variables were measured at three respective points along the air conducting mechanism of the Airvo.

Nasal delivery of Airvo 2 was measured using Powerlab during normal breathing. A volunteer was recruited to receive supplemental oxygen through the Airvo 2 via nasal delivery. The volunteer was asked to change her respiratory rate in time with the metronome, 10, 15 and 25 breaths per minute. Each treatment lasted five minutes. Oxygen and cacrbon dioxide were measured at the level of the nose using Powerlab.

Phase 2 of this study is to measure the intra tracheal concentration of oxygen, carbon dioxide and temperature, with results pending.

Results:

According to the results that we collected, Airvo 2 delivers oxygen and carbon dioxide at the levels to be expected. For each litre of oxygen we increased, the percentage of oxygen increased by 2.5% (2sf). As the flow of oxygen increased, Airvo had a tendency to underestimate the % of oxygen delivered by an average of 1.9 percentage point. Temperature stayed constant between treatments at 38 degrees Celsius (2sf).

The results obtained using real breathing rate showed the following: at a breathing rate of 10 breaths per minute, we found that the oxygen concentration was 21% and carbon dioxide 0.03%. At a breathing rate of 15, oxygen concentration was 19% and carbon dioxide 1.5%. The third treatment, with respiratory rate of 25, oxygen concentration was 16% and carbon dioxide 4.0%.

Conclusions:

The Airvo 2 is accurate in displaying the amount of oxygen it is delivering to within 2%. The results of real breathing showed a decrease in oxygen and increase in carbon dioxide with increase in respiratory rate at the level of the nose. This is consistent due to increase in respiratory rate. The more somebody breathes, the more entrapment of room air, leading to decreased oxygen in the nose. Carbon dioxide is breathed out more, therefore there is increased level of carbon dioxide detected in the nose.