VOLUME 4(1) March 1984

Below are short overviews of the articles that appeared in this issue of VOLUME:

The Wet Spirometer in 1984 (Judith Roget)

Judy Roget (now retired) was one of the key people responsible for the formation of our Society. She sat on many ASRT committees, the Board and served as President (see comments in my review of VOLUME 3(3) September 1983). This article provided an overview of the features, problems and role of the wet spirometer (or rolling seal) in her laboratory. She pointed out that this instrument, which records both inspiratory and expiratory volumes, is very useful for teaching "trainee technicians" whether the subject has performed the breathing manoeuvre correctly.

(When I first worked with wet spirometers, particularly the large ones, (eg 200 L Tissots), I was very impressed to learn their engineering subtleties that render them very accurate volume measuring devices, with the smaller models having similar accuracy specifications as a calibration syringe. For example, a potential problem with wet spirometers such as Tissot, which were used routinely during exercise testing, was that the weight of the bell (and back-pressure) varied with the degree to which the bell was immersed in the water jacket. The back-pressure would be very low at the start when the bell was fully immersed (Archimedes principle = it weighs less) and highest when the bell was fully extended (it weighs more). This may cause volume errors due to gas compression and may affect the subject's work of breathing. However, these spirometers were cleverly designed (engineered) to effectively eliminate this problem …. do you know how? It has something to do with the weight of the chain connecting the bell to the counterweight. ***DJ***

As the bell empties there is a greater length of chain between the pulley and the bell and this is added to the weight of the bell. As the bell rises and falls the weight of the chain effectively transfers between the counterweight and the bell in proportion to the height of the bell. Hence the term chain-compensation." ***KG****)*

Three Devices for the Administration of Oxygen (David P. Johns, Peter W. Trembath, Jonathan A. Streeton)

This article provided a basic overview of three commonly used oxygen delivery devices; nasal cannulae, simple masks, and entrainment (Venturi) masks.

(Since this article was written there have been significant developments in oxygen delivery technology, especially with respect to oxygen-conserving devices which effectively reduce oxygen wastage without compromising oxygen delivery to the lung. These devices significantly extended the 'life' of a cylinder and have proved to be of great benefit to patients dependent on portable compressed gas cylinders. Examples include mechanical devices that deliver oxygen to the airway only during the inspiration and electromechanical devices that deliver oxygen as a bolus at the start of inspiration.

Some may be interested to learn that the 'Venturi' mask operates as an entrainment device according to Bernoulli's principle, which effectively states: if a gas (primer) is forced through a narrow restriction at constant flow, it's velocity will increase causing a reduction in lateral gas pressure. If the lateral pressure becomes sub-atmospheric, room air will be entrained which mixes with the priming gas to produce the oxygen mixture. Although the mixture produced by a given 'Venturi' is sensitive to changes in the oxygen jet and obstruction of airflow through the entrainment ports, they are remarkably robust devices that faithfully produce a mixture of fixed composition, which is <u>not</u> particularly sensitive to variations in the priming flow. In fact, we have found that for a couple of dollars one can build a 'Venturi' *device that is capable of manufacturing gas mixtures of fixed composition on-site in the laboratory. The precision of the mixtures produced using a home-made 'Venturi' was such that one would be very hard-pressed indeed to detect any day-to-day, month-to-month, or even year-to-year variations in composition. In fact, I recently tested the ones I built in 1980 (hypodermic needle cemented into a brass housing which incorporated 1, 2 or 4 entrainment ports) and their performance has remained unchanged – 26 years latter. The capacity to produce precision gas mixtures at will and at very low cost can be extremely useful, eg establishing and monitoring the calibration of gas analysers and generating custom mixtures for a variety of clinical and research applications. Any pure gas (CO_2, O_2, He, N_2, etc) can be used as the priming gas, and depending on the entrainment ratio of the 'Venturi' (this depends on the total area of the entrainment ports and velocity of the gas emerging from the priming jet), they provide the potential to produce a very large range of precision gas mixtures – again at low cost. In addition one could use a <u>gas mixture</u> rather than a pure gas as the primer, in which case the number of distinct mixtures one can manufacture in the laboratory is almost endless. It is of interest to note that if a gas mixture containing 13% CO_2 and 8% O_2 is used as the primer then no matter what the entrainment ratio of the 'Venturi' the sum of CO_2 and O_2 concentrations produced **always equals 21%**! This could be very useful for calibrating gas analysers used to measure alveolar gas!*

History of the Hypodermic Syringe (no author)

This interesting review was reprinted with permission from Paratec, the journal of the Australian Society of Anaesthetic and Operating Theatre Technicians (Paratec, vol 1(3), 1980). In summary, the hypodermic syringe with a hollow needle was first described by Charles Gabriel Pravaz (Lyons, France) in the mid 19th century. However, intravenous injection on animals using quills was (surprisingly) carried out by Sir Christopher Wren (yes, the architect of St Paul's) in 1657. In the early 1820's it was realised that the absorption of morphine was more effective when applied to denuded skin (achieved by producing a blister, removing the raised epidermis and then applying the morphine) and therapeutic substances (eg inoculation for smallpox) were more effective, although disfiguring, when administered under the skin using a lancet. Very soon after the invention of the hypodermic syringe by Pravaz, its huge potential began to be realised and demand rapidly exceeded supply. To meet the demand redundant musket barrels (ie post the Franco-Prussian war) were purchased from the French Government by the instrument maker, Charriere, who drew the barrels into hypodermic needles! This was far easier than Pravaz's method of constructing hollow needles by soldering/brazing two longitudinal halves together.

Pulmonary Hypotension – diagnostic Aspects (J.D. Horowitz)

Dr John Horowitz, now a nationally respected senior academic cardiologist, provided this excellent review of pulmonary hypotension. Included was a review of the more common associated diseases: cor pulmonale secondary to chronic bronchitis and emphysema, primary pulmonary hypotension, sleep apnoea and Eisenmenger's syndrome. This article is well worth reading.

Mouth-Piece

Included in this issue was a new segment "Did You Know" and "Do You Know":

Did You Know Douglas bag measurements of oxygen uptake and carbon dioxide output may be performed without completely emptying the bag of room air prior to collecting expired gas!

(Note: The important point is that one does not need to know the volume of air present in the bag at the start! This may seem nonsense but when I did the maths all those years ago it worked out because although the final oxygen concentration in the bag will be increased due to the presence of air, this is exactly offset by the larger bag volume (expired gas + air). One down side is that too much air in the bag will push the oxygen concentration toward 21% (and CO_2 toward zero) and one would need to measure the concentration of these gases to several decimal places. I would be grateful if Jeff Pretto and/or Peter Rochford, or indeed anyone, could confirm that all this makes sense. My reasoning may very well be flawed – it was over 20 years ago. ***DJ****).*

Do You Know whether the oxygen uptake term in the Fick equation for the estimation of cardiac output should be expressed at BTPS or STPD?

What do you think? An answer to the above question was provided by Hennig Imberger in a letter to the Editor. I will provide a precis of his response in a coming review …. In the meantime have a think about it and let me or Kevin know your thoughts. ***DJ****)*

Please contact me if you are interested in a copy of this or any other issue of VOLUME.

David P. Johns PhD, CRFS, FANZSRS

david.johns@utas.edu.au

Tel: (03) 6226 4801