episodes, all characterized by bradycardia, hypotension, and normal levels of glucose and electrolytes. A bottle of propranolol was found in the patient's room on the fourth day of hospitalization. The serum level of propranolol was found to be 321 ng/ml (Bioscience Laboratories). The patient was seen in consultation by a psychiatrist, who recommended telling the patient of the elevated concentrations of propranolol in her blood. She continued to deny abuse of the agent and left the hospital against medical advice. She stood to gain considerable financial benefit if a diagnosis of organic heart disease were established.

**DISCUSSION**

Surreptitious drug abuse producing syndromes mimicking diseases is a well-known phenomenon. Commonly reported agents include insulin and diuretic drugs. To our knowledge, this represents the first report of abuse of propranolol to cause bradycardia and hypotension. Patients who surreptitiously ingest drugs are frequently, like our patient, in medically related fields. No definite patterns of age or sex are apparent, although many patients have been in their third to fifth decades of life. No single psychiatric disorder appears to apply to most reported cases. In conclusion, unsuspected usage of propranolol should be considered in the diagnosis of unexplained syncope, bradycardia, and hypotension.

**Guynne K. Neufeld, M.D., and Scott P. Smith, M.D.**

Department of Medicine
Veterans Administration Hospital and the University of Colorado Medical Center, Denver

*Reprint requests: Dr. Neufeld, Division of Cardiology B-130, University of Colorado Medical Center, 4200 E. Ninth Ave, Denver 80262*

**REFERENCES**


**The Abbreviated Alveolar Air Equation**

*To the Editor:*

The report by Raymond was a breath of fresh air (inspired). It is good to see that someone believes in the correct "alveolar air equation." An arithmetically easier equation is welcome. I hope that it will stimulate workers to analyze expired air for oxygen, as well as carbon dioxide, with their electrodes.

I offer a different derivation in the hope that it will explain the final equation a little better and emphasize the validity of Raymond's presentation. Since expired gas is made up of alveolar gas and dead-space gas, the "mixing equation" can be used with electrode values for expired gas partial pressures as follows (all conditions are body temperature and pressure, saturated):

\[
\frac{\dot{V}_A \times P_{A_o_2}}{\dot{V}_D \times P_{O_2}} = \dot{V}_E \times P_{E_o_2}
\]

where \(\dot{V}_A\) is alveolar ventilation, \(\dot{V}_D\) is dead-space ventilation, \(\dot{V}_E\) is total (ie, expired) ventilation, \(P_{A_o_2}\) is the partial pressure of oxygen in alveolar gas, \(P_{O_2}\) is the partial pressure of oxygen in the inspired gas, and \(P_{E_o_2}\) is the partial pressure of oxygen in the expired gas.

The assumption originally made by Lilienthal and Riley that the partial pressure of carbon dioxide in alveolar gas \((P_{A CO_2})\) equals the tension of carbon dioxide in arterial blood \((P_{A CO_2})\) can be used when there is little shunt. Bohr's equation then can be modified, assuming the inspired gas is free of carbon dioxide, as follows:

\[
\dot{V}_D/\dot{V}_T = \frac{\dot{V}_D}{\dot{V}_E} = \frac{(P_{A CO_2} - P_{E CO_2})/P_{A CO_2}}
\]

where \(\dot{V}_D\) equals dead-space volume, \(\dot{V}_T\) equals tidal volume, and \(P_{E CO_2}\) equals the partial pressure of carbon dioxide in the expired gas. Remembering that

\[
\dot{V}_A = \dot{V}_E - \dot{V}_D
\]

and

\[
\dot{V}_D = \dot{V}_E \left(\frac{P_{A CO_2} - P_{E CO_2}}{P_{A CO_2}}\right) = \dot{V}_E \times \dot{V}_D/\dot{V}_T,
\]

substitution then provides the following equation:

\[
P_{A O_2} (\dot{V}_E - \dot{V}_E \times \dot{V}_D/\dot{V}_T) + (P_{O_2} \times \dot{V}_E \times \dot{V}_D/\dot{V}_T) = P_{E O_2} \times \dot{V}_E
\]

Rearranging and factoring, this becomes

\[
P_{A O_2} = \frac{\dot{V}_E (P_{E O_2} - P_{O_2} \times \dot{V}_D/\dot{V}_T)}{\dot{V}_E (1 - \dot{V}_D/\dot{V}_T)}
\]

Cancelling gives the following equation:

\[
P_{A O_2} = \frac{P_{E O_2} - P_{O_2} \times \dot{V}_D/\dot{V}_T}{1 - \dot{V}_D/\dot{V}_T}
\]

which is what Raymond presented. It allows calculation of \(P_{A O_2}\), regardless of the state of the patient and regardless of the oxygen concentration of the inspired gas, as long as the expired air is collected while the arterial sample is taken and is analyzed for oxygen pressure, as well as carbon dioxide pressure. Of course, it is a good idea to run a sample of inspired gas through the electrodes, too.

**H. Frederic Helmhola, Jr., M.D., F.C.C.P.**

Mayo Clinic, Rochester, Minn

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CHEST, 75: 6, JUNE, 1979