$$T_{VE}(s) = P_{VE}(s)/P_I(s) = (s^4 + 0.1638585\,s^3 + 2.106502\cdot10^{-2}\,s^2 + 7.246142\cdot10^{-6}\,s + 2.002223\cdot10^{-9})/(7.531786\,s^6 + 21.400600\,s^5 + 5.085951\,s^4 + 0.3151307\,s^3 + 3.065295\cdot10^{-2}\,s^2 + 8.432361\cdot10^{-6}\,s + 2.002223\cdot10^{-9}) \quad (5)$$

We seek an expression for P_I that will give rise to a step function for P_{VE}. Therefore, let

$$P_{VE}(t) = 0.75\,u(t) \quad (6)$$

where $u(t)$ is the unit step function. The unit step, $u(t)$, is defined:

$$u(t) = 0.0 \quad (t < 0)$$
$$= 1.0 \quad (t \geq 0) \quad (7)$$

Taking the Laplace transform of Equation 6, we obtain

$$P_{VE}(s) = 0.75/s \quad (8)$$

We solve for P_I as follows:

$$P_I(s) = P_{VE}(s)/T_{VE}(s) \quad (9)$$

We substitute Equation 5 and Equation 8 into Equation 9 and separate by the method of partial fractions to obtain

$$P_I(s) = 5.649s + 15.125 + 0.750/s + 0.064/(s + 0.150) + 0.367/(s + 0.007605) + 0.031/(s + 0.005850) + 0.113/(s + 0.000302) \quad (10)$$

Inverse Laplace transformation yields the following expression for an inspiratory waveform which, if applied to a *linear* model having a cardiac output fixed at 4.875 l/min, would instantaneously achieve and maintain a partial pressure in the viscera of 0.75 per cent atm:

$$P_I(t) = 5.649\,\dot{\delta}(t) + 15.125\,\delta(t) + 0.750\,u(t) + 0.064\,e^{-0.150t} + 0.367\,e^{-0.007605t} + 0.031\,e^{-0.005850t} + 0.113\,e^{-0.000302t} \quad (11)$$

where $\delta(t)$ is the unit impulse and $\dot{\delta}(t)$ is the unit doublet. The unit impulse is the derivative of the unit step, and the unit doublet is the derivative of the unit impulse.[28, 29] If the transient terms (the doublet and the impulse) are excluded, this equation may be applied to the nonlinear model after the induction pulse produces a value of 0.75 for P_{VE}.

Anesthesia

ANALGESIA FOR CARDIOVERSION Conscious analgesia (stage 1, plane 3) produced by the inhalation of methoxyflurane was used in 20 consecutive patients who underwent 22 elective direct-current countershock procedures for supraventricular arrhythmias. After the drug had been administered in concentrations adequate to produce signs of perseveration, loss of memory, delayed response to verbal commands, and inability to focus the eyes, the direct-current countershock was delivered. Although the patients responded to verbal commands just prior to the procedure, postoperative interviews revealed complete amnesia. No significant changes in heart rate, blood pressure, or ventilation were noted. Following the procedure, emergence to an alert, oriented state occurred within two to five minutes. The technique provided both analgesia and amnesia—but without general anesthesia. *(Reier, C. E., and Hamelberg, W.: Conscious Analgesia and Amnesia for Cardioversion, J.A.M.A. 210: 2052 (Dec.) 1969.)*

HYPERTHERMIA The development of hyperthermia during general anesthesia is unpredictable. Continuous temperature monitoring is the safest means of early diagnosis. The primary cause is unknown but is probably a drug-induced disturbance of the thermal regulating centers. Pathologic findings are the same as those in heat stroke. It has been suggested that a subclinical genetic disorder of the neuromuscular system might be a cause. *(Thomford, N. R., and others: Sudden Hyperpyrexia during General Anesthesia, Surgery 66: 850 (Nov.) 1969.)*