ONLINE SUPPLEMENT:

EXCESS PRESSURE INTEGRAL PREDICTS CARDIOVASCULAR EVENTS INDEPENDENT OF OTHER RISK FACTORS IN THE CONDUIT ARTERY FUNCTIONAL EVALUATION (CAFE) SUB-STUDY OF ANGLO-SCANDINAVIAN CARDIAC OUTCOMES TRIAL (ASCOT)

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Supplemental methods

Calculation of excess and reservoir pressure from radial tonometry recordings.

Reservoir pressure was defined as

$$\frac{d\overline{P}}{dt} = a(P - \overline{P}) - b(\overline{P} - P_\infty)$$  \hspace{1cm} (1)

where $\overline{P}$ is a time varying reservoir pressure; $a = \lambda / C$ and $b = 1 / R \cdot C = 1 / \tau$ are the rate constants of the system with units s$^{-1}$ and $P_\infty$ is the pressure at which outflow from the reservoir ceases.

If $T_d$ is the start of diastole and $T$ is the end of the cardiac cycle and there is assumed to be no inflow into the reservoir during diastole ($T_d \leq t \leq T$) then for this period equation (1) becomes

$$\frac{d\overline{P}}{dt} = -b(\overline{P} - P_\infty)$$  \hspace{1cm} (2)

and

$$(\overline{P} - P_\infty) = [\overline{P}(T_d) - P_\infty]e^{-b(t - T_d)}, T_d \leq t \leq T$$  \hspace{1cm} (3)

During systole equation (1) can be solved explicitly using the integration factor $e^{(a+b)t}$ to give

$$\overline{P} = \frac{b}{a = b} P_\infty + e^{-(a+b)t} \times \left[ \int_0^t aP(t')e^{(a+b)t'} dt' + \overline{P}_0 - \frac{b}{a + b} P_\infty \right], 0 \leq t \leq T_d$$  \hspace{1cm} (4)

Where $\overline{P}_0$ is the start of the cardiac cycle. To determine a continuity of $\overline{P}$ is enforced at $t = T_d$, giving

$$\overline{P} = \frac{b}{a + b} P_\infty + e^{-(a+b)T_d} \times \left[ \int_0^{T_d} aP(t')e^{(a+b)t'} dt' + \overline{P}_0 - \frac{b}{a + b} P_\infty \right]$$  \hspace{1cm} (5)
$T_{\text{e}}$ was defined as the minimum first derivative of pressure(1). This time point was identified automatically using a 7 point Savitsky-Golay first derivative filter function. Exponential fits were performed using the method of moments and the fminsearch algorithm in Matlab.

References