The effect of mental arithmetic on blood pressure variability and baroreflex sensitivity in man

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Summary

1. Baroreflex sensitivity was tested in three normal, three borderline and one hypertensive subject before and during mental arithmetic, the prolongation of pulse interval caused by a provoked rise in blood pressure being used as a measure of baroreflex sensitivity.

2. Baroreflex sensitivity was significantly decreased during mental arithmetic.

3. During mental arithmetic the arterial pressure fluctuated markedly.

4. These findings suggest that in man, as well as animals, the defence of alerting reaction depresses baroreflex control and thus contributes to the rise in blood pressure seen at this time.

Key words: baroreflex sensitivity, blood pressure, mental arithmetic.

Introduction

Brod, Fencl, Hejl & Jirka (1959) described the circulatory changes which accompanied the rise in blood pressure provoked by the stress of mental arithmetic.

Hilton (1965) and his co-workers showed that stimulation of the defence area in the hypothalamus reduced the reflex bradycardia and peripheral vasodilatation which followed a rise in pressure in a carotid sinus pouch. There has been some dispute whether or not the reflex inhibition does involve the peripheral arterioles as well as the heart but Coote & Perez-Gonzalez (1972) showed that there was a sustained increase in sympathetic nerve activity on stimulation of the hypothalamus in the cat, and this increase could not be reduced by raising the pressure in an isolated carotid sinus.

We have investigated the effect of mental arithmetic on baroreflex sensitivity for heart-rate control in man.

Methods

Baroreflex sensitivity was assessed using the method of Smyth, Sleight & Pickering (1969). Phenylephrine (80–100 μg intravenously) was used to raise the arterial pressure briefly by 20–30 mmHg. During the rise in pressure the systolic pressures of successive pulses were correlated with the pulse interval which followed each beat. The slope of the line gives a measure of baroreflex sensitivity (see Fig. 1).

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Three normal subjects three borderline and one established hypertensive subject were studied, of which one normal subject was a woman and all the other subjects were men. The subjects lay supine and cannulae were inserted into an antecubital vein and the brachial artery under local anaesthesia. After 30 min five or more injections of phenylephrine were performed, at intervals of at least 3 min. The calculated regression lines were averaged to obtain control baroreflex sensitivity. The subjects were then asked to carry out mental arithmetic by subtracting successive sevens from a variable starting number. When this was well established (usually after 1–2 min) a further bolus injection of phenylephrine was made while mental arithmetic continued. The test was repeated on at least three occasions during the stress of mental arithmetic with intervals of 3–4 min between each.

Regression lines with low correlation coefficients \( r = < 0.5 \) were discarded.

**Results**

Baroreflex sensitivity was decreased during mental arithmetic in all seven subjects (Fig. 1). The correlation coefficient \( r \) was invariably less during mental arithmetic so that one in three tests had to be discarded because \( r = < 0.5 \). In the one hypertensive subject the control baroreflex sensitivity was low, in keeping with the previous study of Gribbin, Pickering & Sleight (1971); during mental arithmetic no significant slowing of the heart rate occurred in response to the phenylephrine injection so that no baroreflex sensitivity could be calculated.

The mean control baroreflex sensitivity from 19 regressions in the three normal subjects was \( 8.4 \pm 2.6 \) (sd) ms/mmHg and fell to \( 4.7 \pm 3.2 \) ms/mmHg during mental arithmetic \( (n = 8) \). The mean control baroreflex sensitivity in 14 regressions in the three borderline hypertensive subjects was \( 9.2 \pm 4.0 \) ms/mmHg and fell to \( 4.9 \pm 1.5 \) \( (n = 8) \).

In the majority of subjects, the arterial pressure during mental arithmetic was far more variable than during the control period.

**Discussion**

These results in man parallel the experiments performed on the anaesthetized animal and suggest that the baroreflex (at least for heart-rate control) is depressed during the defence reaction. It is possible that this partly or wholly accounts for the rise in pressure seen in some patients when they confront a doctor. We have observed some patients in whom this reaction may give quite erroneous impressions of the subject’s blood pressure. In these subjects the highest pressures are seen in hospital; away from hospital the pressure may be much lower or normal (Littler, Honour, Pugsley & Sleight, 1975).

**References**


