Effect of carotid sinus nerve stimulation on coronary blood flow in myocardial ischaemia: Role of the collateral vessels

Einfluß der Karotissinusstimulation auf die regionale Myokarddurchblutung beim experimentellen Infarkt: Rolle der Kollateralgefäße

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With 4 figures and 1 table

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Summary

The carotid sinus nerves of dogs were electrically stimulated to reveal reflex effects exerted on the coronary blood flow both in normal and ischaemic states. Myocardia ischaemia was produced by occlusion of the left anterior descending (LAD) coronary artery. In 10 experiments the coronary sinus outflow was measured as an index of the overall coronary flow; in 30 cases the local myocardial blood flow was registered by means of the heat clearance technique.

In the overall coronary flow carotid sinus nerve stimulation (CSNS) elicited coronary dilatation. After acute LAD occlusion this effect was slightly potentiated. A similar but significantly greater potentiation was observed in the local reflex vascular dilatation recorded with the aid of the thermal probes immediately after LAD occlusion when the myocardial area explored was supplied exclusively by collateral channels.

24-48 hours and 5-64 days after the coronary ligation the effect of the CSNS on the local blood flow was tested in the developing and the regenerative phases of the myocardial infarction. In both phases an enhanced reflex dilatation was found in the collateral-dependent ischaemic areas as compared to the myocardial areas supplied by the normal vessels.

The results suggest that reflexly induced intrinsic redistribution of the myocardial blood flow is one of the mechanisms responsible for the therapeutical effects of the CSNS.

Electrical stimulation of the carotid sinus baroreceptor afferent fibres alleviates the anginal pain (1). The haemodynamic basis of the beneficial effect is not entirely clear. Stimulation of the carotid sinus afferents has been reported to elicit a reflex decrease of the coronary vascular resistance. However, the results arrived at in the former studies revealed only the reflex pattern characterizing the coronary bed as a whole. Considering the modified patterns of flow in the cardiac ischaemic foci, it was reasonable to assume that the reflex coronary response of these foci might
also be different from those of the normal myocardial areas. The purpose of our present study was to investigate this possibility.

**Methods**

Forty mongrel dogs of either sex, weighing between 9 and 17 kg, were used. The animals were anaesthetized with α-chloralose (0.09–0.11 g/kg). The chest was opened in the fourth intercostal space and artificial respiration was maintained using room air.

Blood pressure was measured in the carotid artery by a mercury manometer (12 experiments) or a Statham gauge (28 experiments). In some cases the left ventricular pressure was also measured with another Statham gauge. Pressure curves were registered on a direct writing recorder (Minograph, Elema) or an ink-writing drum, respectively.

Coronary flow was studied with the aid of two different methods. In 10 experiments the outflow of the coronary sinus was utilized as an index of the overall coronary flow, using a doublebore cannula inserted into the sinus. Flow was measured by means of a rotameter. Coagulation was hindered by i.v. administration of heparin (500–800 I.U. per kg body weight).

In 30 experiments the heat clearance technique was employed to measure the local tissue blood flow in a myocardial area supplied by the left anterior descending (LAD) coronary branch. In some cases flow was measured simultaneously in the territory of the left circumflex branch. Flexible, copper-constantan thermocouples were inserted into the myocardium remote from the larger subepicardial coronary branches. One of the thermal junctions of the probe was continuously heated through a separate constantan wire by a stabilized DC current. The heated and the reference junctions of the probe were 4–5 mm apart, each of them lying about 5 mm from the epicardial surface. The actual temperature difference between the two junctions (ΔT), which is inversely proportional to the local rate of flow was registered with the aid of a sensitive compensograph (Micrograph, Kipp and Zonen). Flow changes were expressed in per cent by establishing 0 flow value after having sacrificed the animal.

Local myocardial ischaemia was produced by occlusion of the LAD artery just proximal to its first major oblique branch. After coronary occlusion the area explored was supplied exclusively by the collateral channels.

Circulatory parameters were chosen for data analysis in the control (resting) state and after the stimulation of the carotid sinus afferents at steady state flow responses. Stimulation was performed with bipolar wire electrodes using rectangular pulses at parameters 50–70/sec, 0.5 msec and 3–8 V. Strength of the stimulus was set to such a degree as to attain a 30–35 per cent reflex fall of the mean blood pressure. Stimulation periods were 30–120 seconds.

The magnitude of all coronary responses were calculated as vascular conductance values (flow/mean arterial blood pressure). In cases of local tissue flow measurements the per cent values of these parameters were used, 100 % being the resting conductance level registered at the beginning of the experiment.