displayed during data logging and further analysis can be performed on stored data. Hard copy of displayed information and storage of measured or calculated parameters are also provided by the system.

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References


1 Introduction

It is known that, during intracellular recordings, contractions of the intact heart may interfere with the recording procedures. This may happen either through breakage or displacement of the glass microelectrode. Theoretically, there are two ways to overcome this problem:

(a) ensuring that the microelectrode follows the movement of the heart wall.

The movements of the heart wall may be followed passively by the commonly accepted method of floating microelectrodes (VAUGHAN WILLIAMS, 1959) or actively by a servoccontrol system (AKIVAMA and SERINO 1979).

In the latter case the movements of the surface of the heart are recorded in one direction and used to drive a stepping motor. Ideally, this should be executed for three dimensions but then the requirements for instrumentation would increase prohibitively. The passive method does not guarantee correct long-term impalements, while the active method is very complicated and laborious. This method has an additional handicap in that the heart wall in the direct vicinity of the site of the glass microelectrode impalement is not free for application of other electrodes, this precluding, for example, stimulation of the impaled cell.

(b) suppressing the movements of a small part of the heart wall.

The isometric method, used for investigating skeletal muscle, inspired us to develop a simple experimental set-up that can be used for small areas of the surface of the heart. The main purposes of this set-up are to allow long-term impalements as well as recording from and stimulation of the epicardium within one space constant of the impaled cell.
2 Experimental set-up

2.1 Fixation of the heart by suction (Fig. 1)

The heart rests in a depression 3 at the bottom 1 of a tank. In this pit we have constructed a circular slit 4, of which the walls are formed by the bottom of the tank and the top of the electrode support unit 5. Inside this slit the pressure is reduced to 0.9 atmosphere. This causes a part of the heart wall to be sucked into the slit, which causes radial pull on the tissue in the centre of the depression over the top of the electrode support unit, allowing only relatively minor movements of the exposed tissue at that centre. Through a hole in the centre of the electrode support unit a glass microelectrode 7 can be moved up and down. At the top of the electrode support unit two pairs of electrodes 6 are mounted for stimulation and bipolar recording.

2.2 Tank

An isolated intact heart, perfused according to the Langendorff principle, is submerged in a tank filled with Tyrode's solution, which is kept at the desired temperature by an Ag/AgCl heating coil 2, controlled by a thermostat. This coil also serves as a grounded reference electrode, which allows the Tyrode's solution to serve as a Faraday cage.

2.3 Electrolyte network

To eliminate offset potentials, which arise as a result of half-cell potentials, we chose a symmetrical network of half-cells in the following way: Ag/AgCl/Tyrode/3 M KCl/Tyrode/AgCl/Ag. The KCl solution within the glass microelectrode is in contact on one side with the intracellular fluid and on the other side with Tyrode's solution within an Ag/AgCl cup 9 mounted on the top of the preamplifier.

2.4 Preamplifier (Fig. 2).

The preamplifier possesses an adjustable frequency compensation 8 (2 kΩ/15 pF). The preamplifier's input impedance can be decreased by switching (Sₖ) a parallel resistor, which allows estimation of the impedance of the glass microelectrode to check for breakage during the experiment. The microelectrode-preamplifier system can be moved in a vertical direction by hand as well as by a stepping-motor.