LONGITUDINALLY AND CIRCULARLY MEASURED EMG ACTIVITY IN THE HUMAN UTERINE CERVIX DURING LABOUR*

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The role of the smooth cervical muscle has not yet be en sufficiently explored.
For that reason cervical EMG was measured during induced labour of several primiparas and multiparas. Three spiral electrodes were placed on the cervix in order to measure' the EMG in the longitudinal and circular direction referred to the cervical axis. A quantitative analysis of changes in the amplitude and frequency of the EMG signals was performed by means of the spectral method. It was found that the EMG measured from the two leads differed in unripe cervical in the latent phase of labour. The differences are illustrated by two cases. Some possible explanations for the different activity are discussed.

Key words: electromyography (EMG). cervix in labour

The role of the smooth cervical muscle in the human has not until now been sufficiently explored. It is unreasonable to presume it would not be found here if it were not to have some function [1]. Actual counts of smooth muscle fibers have not been made, hut examinations of many specimens suggest that, at most, the smooth muscle accounts for from 10 to 15% of the normal cervical substance [1]. Morphological studies using light and electron microscopy have revealed that the smooth muscle layer of the human cervix penetrates relatively deep into the connective tissue, and strips from the uterine cervix demonstrate spontaneous activity when mounted in organ baths [2].

In our investigations on cervical smooth muscle activity, the EMG of the cervix has been measured in more than 70 different labours [3]. This paper aims to present some differences of the cervical electrical activity measured from two different le"ads - a longitudinal and circular one, that were found by visual observation and by quantitative analyses.

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The cervical EMG activity was measured from the two leads in ten cases. The procedure is exemplified by the cases A. R. (Para II) and M. J. (Para 1). They were admitted to the delivery room to have induced labour with unripe cervix (Bishop 6 and 3 respectively) and cloudy amniotic fluid. After amniotomy, a catheter for measuring the intrauterine pressure was inserted, electrodes for measuring the electrical activities of the cervix were attached, and after 30 min oxytocin solution (Syntocinon) was administered in a drip in a dose of 6.75 mE/min.

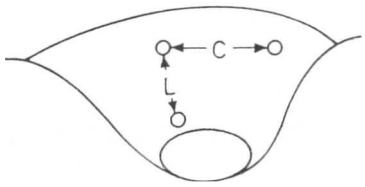

Fig. 1. Position of electrodes on the cervix C, circular lead; L, longitudinal lead

Intrauterine pressure measurements were performed by means of an open-end saline filled catheter and a pressure transducer. To obtain the EMG activity of the cervix, spiral electrodes which are otherwise usually used to pick up foetal ECG were adapted. These electrodes are standard accessories of the Hewlett Packard HP 8030A cardiotocographic measuring set. Three such electrodes were attached to the cervix approximately 2 cm apart from each other in the circular and longitudinal direction (Cf. Fig. 1).

A miniature two-channel differential EMG preamplifier was designed to preamplify low-amplitude EMG potentials (with a fixed gain of 5.000). EMG signals further amplified by a two-channel amplifier with an adjustable gain, an adjustable DC level and a built-in low pass filter (0.1 Hz to 10 Hz). EMG potentials were then recorded by a two- and three-channel paper chart recorder.

A quantitative analysis of changes in the amplitude and frequency parameters of the circularly and longitudinally measured EMG signals was done. A spectral analysis ",as computed by applying the fast Fourier transformation (FFT) algorithm to 4096 samples of EMG signal recordings.

Results

Among the 10 explored cases, two were selected to demonstrate here the specific EMG activity in the cervix in terms of the two lead measurements. The activity measured from the two leads changed, occurring as bursts in different phases of uterine contractions. In the early latent stage of labour, the two activities differed in their intensity and time distribution.

As an example of unsynchronised recording from the two leads the results in A. R. (Para II, unripe cervix) are given. In Fig. 2 a section of the EMG recordings half an hour after amniotomy and soon after Syntocinon infusion is presented. There was a characteristic difference in the onset of bursts in the two activities with respect to the uterine corpus contractions.

The activity of a very unripe cervix (Bishop 3) in a primipara at the beginning of induced lab our immediately after amniotomy is shown in Fig. 3. The circularly measured activity was stronger than the activity measured from the longitudinal lead. It manifested itself in bursts of shorter and longer duration arising independently of the uterine contractions.

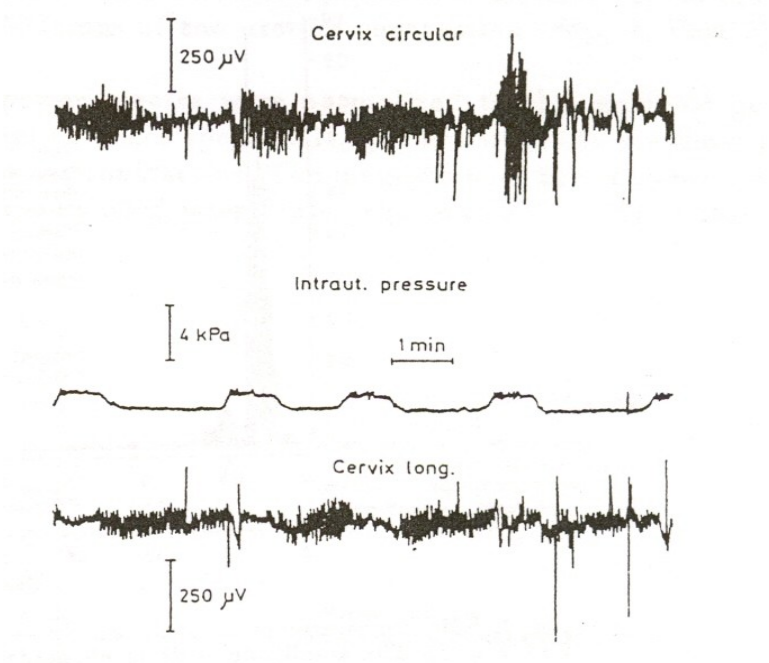

Fig. 2, EMG and intrauterine pressure recording. during induced labour in secundipara A.R. with unripe cervix (Bishop 6), one hour after amniotomy

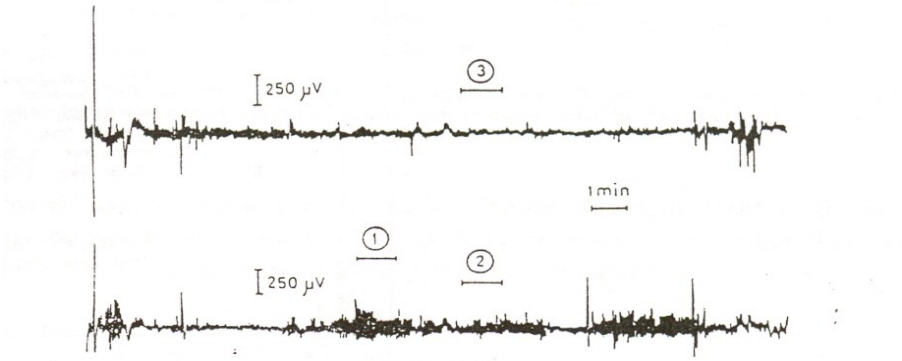

Fig. 3. EMG recordings during induced labour in primipara M.J. with unripe cervix (Bishop 3), immediately after amniotomy. Upper trace, EMG measured longitudinally; Lower trace, EMG measured circularly; Parts 1, 2, 3, time intervals sampled and analyzed by FFT

In Fig. 3 sections of the EMG recordings that were quantitatively analyzed by FFT spectral analysis are demonstrated: a circular EMG recording before a contraction - Part 1, a circular EMG recording at a contraction Part 2, and a longitudinal EMG recording at a contraction - Part 3.

In Figs. 4, 5 and 6 the power spectra for the above mentioned samples of EMG recordings are presented.

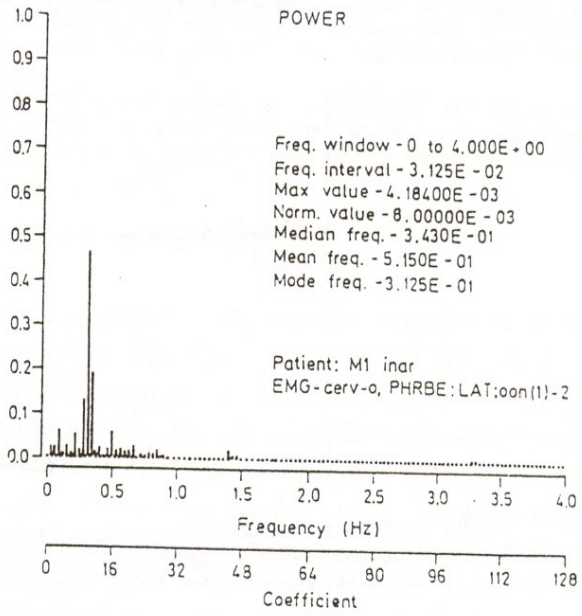

Fig. -4-. EMG Power spectrum of the cervix - circular lead before a uterine contraction (Part 1 in Fig. 3). The amplitude scale is normalized on the maximal power spectral component

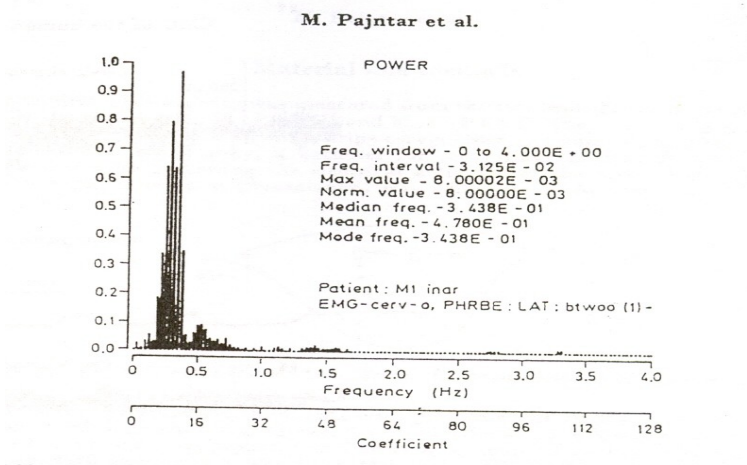

Fig. 5. EMG Power spectrum of the cervix - circular lead at the maximllID of the uterine contraction (Part 2 in figo 3). The amplitude scale is normalized on the maximal power spectral component in Fig. 4

The value of frequency with the maximal power spectral component obviously changed. In circular measurement before a contraction (Fig. 3, Part 1) it lies at O.34Hz. Later, at the maximum of the uterine contractions (Fig.3, Part 2) its value is 0.31 Hz. This frequency is much lower for the longitudinal lead at the maximum of the uterine contraction (Fig. 3, Part 3) and equals 0.083 Hz.

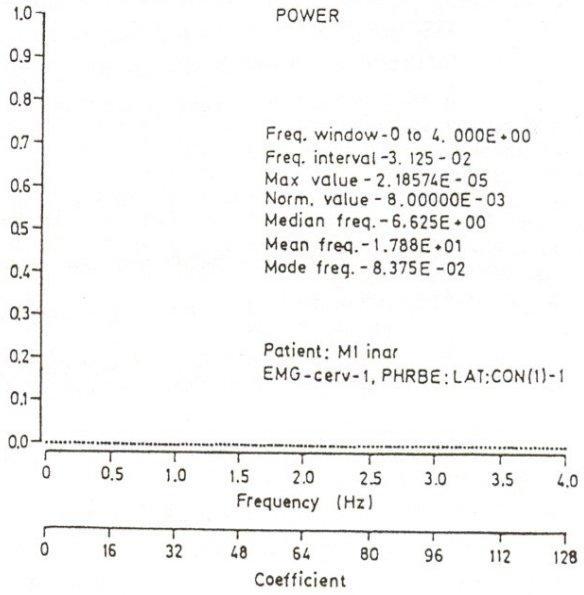

Fig. 6. EMG Power spectrum of the cervix - longitudinallcad at the maxi murn of the uterine contraction (Part 3 in Fig. 3). The amplitude seale is normalized on the maximal power spectral component in Fig. 4

All the power spectra were normalized to the maximal power spectral component from all three spectra. It appears with the maximal power in the circular lead before contraction. The magnitude of the maximal power spectral component drops by 50% later during the contraction. The value of the maximal power spectral component in the longitudinal measurement at the maximal contraction is so small that in Fig. 6 no component is visible. The other parameters of the power spectra are shown in the figures.

Discussion

It has long been suggested that smooth muscle fibers in the human cervix do not play an important role during labour. They have been considered nothing but prolonged muscle fibers from the uterine corpus, their contractions following the pattern of the uterine corpus contractions. Our investigations have revealed a considerably autonomous EMG activity in the cervical smooth musculature (3). The results presented here lead to the conclusion that this EMG differs if measured by two e1ectroc1e pairs attached to the cervix orthogonally. It may be assumed that bundles of fibers in the cervix probably lay in different directions - longitudinally and circularly, similarly as in the human uterine corpus or in some animal cervices.

Particularly interesting is the circular electric al activity in the cervix measured from a circular lead. This activity is sometimes entirely different from that recorded from a longitudinal lead. It mostly occurs in unripe cervices at the beginning of lab our and probably represents the circular muscle fibers activity. For the time being it can only be said that this activity probably influences the cervical tone at the beginning of labour. In some women it can hinder effective dilatation of the cervical canal.

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