

The effect of pethidine hydrochloride on the cervical muscles in the active phase of labour

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Summary: The effect of pethidine hydrochloride (PHC) on the smooth muscles of the cervix was studied in the active phase of induced labour in 27 primiparous women. The Electromyographic (EMG) root mean square (RMS) which provides information about the amplitude (intensity) of muscular cervical activity, and the median frequency (MF) which represents the EMG frequency spectrum were analyzed in connection with the intensity of intra-uterine pressure (IUP). The RMS significantly decreases after the application of PHC, while the IUP significantly increases. The effect of the applied drug disappears in one hour's time. The MF values increase insignificantly after the application and change in the opposite direction to the change of MSR. The changed RMS, MF and IUP values do not correlate with the duration of the active phase of labour.

Key words: Electromyography; Smooth cervical muscles; Spasmoanalgetics; Labour.

INTRODUCTION

In our previous study ⁽¹⁾ the effect of pethidine hydrochloride (PHC), given to parturient women during the latent phase, was studied taking only the highest EMG amplitude into account. We found EMG activity in the cervix to be diminished at the time of a uterine contraction and even more so in the period between two consequent contractions. With new technology ⁽²⁾ enabling us to study continuously different components of EMG activity and intra-uterine pressure (IUP), we intended to discover and analyze the spasmolytic

effects (PHC) on root mean square (RMS) and median frequency (MF) of circularly registered ⁽³⁾ activity of the smooth cervical muscles.

Root mean square (RMS) is the expression for certain property of some varying quantity. The expression itself comes directly from its mathematical definition, i.e.: (square) Root of Mean of Squares of variable of interest (see equation on page 2 of the article). As such it has to be written RMS, which is a well known acronym in many technical fields.

MATERIALS AND METHODS

The study involved 27 primiparous parturient women in induced labour (amniotomy + oxytocin drip 6.75 - 13.5 mEq/min). The mean Bishop score before amniotomy was 4.51 (SD = 2.29). A catheter for measuring IUP was inserted and an ECG electrode was attached to the infant's head to monitor the fetal heart rate.

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Besides this routine procedure, EMG activity of the cervix was recorded simultaneously with IUP. Two spiral needle EMG electrodes were attached to the cervix for bipolar, differential registration of signals of EMG activity in the circular direction, with a reference electrode placed on the woman's thigh. Circular registration was used in order to monitor the activity of the circular muscular layer to the highest possible extent. The procedure is described in greater detail in our earlier reports (3). At approximately 5 cm ($M=5.07$, $SD=.05$) dilated cervix each woman was given an intravenous dose of 25 mg PHC.

Cervical myoelectrical activity was amplified and recorded simultaneously with IUP on a paper recorder and on a PC equipped with a data acquisition board. We found the RMS and the MF of EMG to be particularly relevant parameters. The RMS values provide information about the amplitude (intensity) of muscular cervical activity, while the MF represents a frequency spectrum of EMG. Each recorded EMG signal was divided into 10-second intervals. For every interval the RMS was calculated according

to the equation $V_{rms} = \sqrt{\frac{1}{N} \cdot \sum_{i=1}^N u_i^2}$, and the

MF was obtained from the Fourier transform for 10-second intervals. These data were used for subsequent grouping (5- and 30-minute intervals) and for the statistical analysis.

The IIUP, the RMS and the MF were observed immediately before (A) PHC application and (B) 30 and (C) 60 minutes after it.

RESULTS

The representative EMG paper recordings for the patient K.B. show myoelectrical activity of the cervix and IUP (Fig. 1). The first part refers to the time before PHC application, the second to the time of its application and immediately after it, and the third for 30 min and more after application. There are regular uterine contractions at one and a half to three and a half minutes, with the signs of intra-abdominal pressure before the application. After the application contractions are of almost the same quality, but without signs of intra-abdominal pressure. Bursts of electrical activity which are at the time of a uterine contraction demonstrated by great amplitudes before the ap-

plication, achieve lower amplitudes after the application, and again greater amplitudes in the last period observed.

All the above changes of IIUP, RMS and MF are graphically (Fig. 2) demonstrated for each period observed (A, B, C) for mean 5-minute intervals. There are no significant differences between the observed mean IIUP 30-minute values. We can however see that mean IIUP 30 minutes after the PHC application is more constant. The 30-minute RMS mean value is in significant decrease ($p<0.000$) in the first 30 minutes after its application, and then again in the increase in the last 30 minutes. The 30-minute mean MF value is in significant increase ($p<0.000$) after the application, and in significant decrease ($p<0.000$) in the last 30 minutes. Five-minute average show that the RMS and the MF are varying all the time with the exception of the first 30 minutes after the application. It is interesting that a low MF corresponds to a high RMS and vice versa.

Mean IIUP, RMS and MF values for the whole group (Fig. 3) show that the IIUP increases slightly but significantly in the first 30 min after PHC application and stays nearly at the same level in the second period after the application; the RMS decrease significantly in the first period after the application and increases significantly in the second; there is an MF increase in the first period after the application and a decrease to the initial level in the second period, but the changes are not significant.

Correlations between IIUP, RMS and MF in different time periods (A, B, C) and the duration of the active phase of labour only show the existence of significant ($p<0.05$) positive correlation between the duration of the active phase of labour and the RMS-A. That means that a high RMS before PHC application corresponds to a long active phase of labour and vice versa.

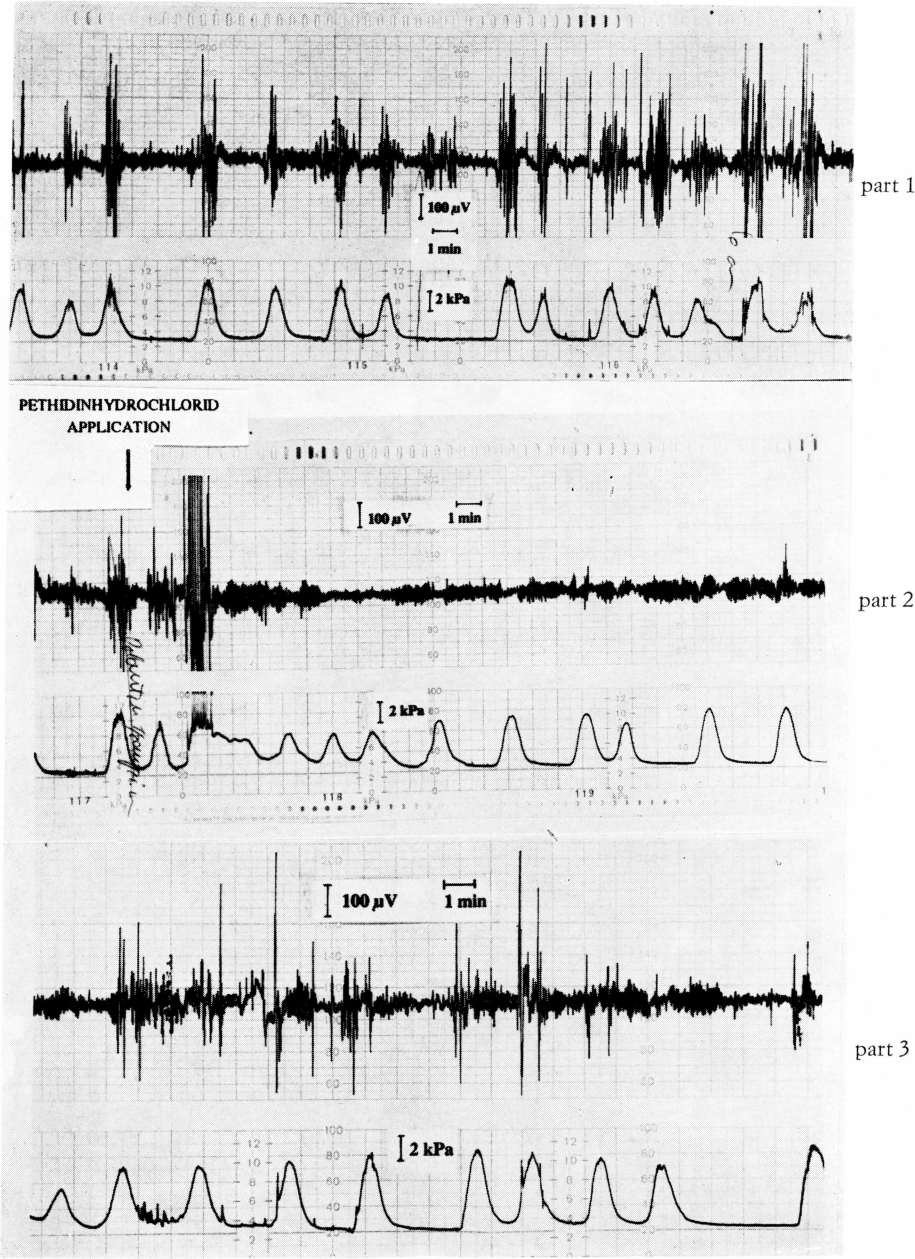


Fig. 1. — EMG (upper traces) of the cervix registered in circular direction and IUP (lower traces) paper recordings: part 1 - before pethidine hydrochloride application; part 2 - at the time of pethidine hydrochloride application and immediately after it; part 3 - 30 min and more after pethidine hydrochloride application (patient K.B.).

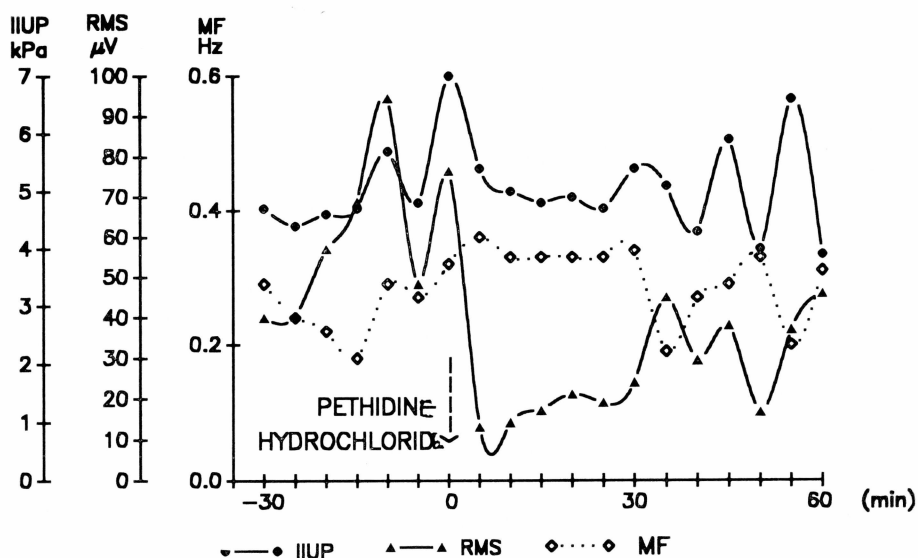


Fig. 2. — Five-minute averages for the intensity of intra-uterine pressure (IIUP), root mean square (RMS) and median frequency (MF) of the cervical EMG for the time before and after pethidine hydrochloride application (patient K.B.).

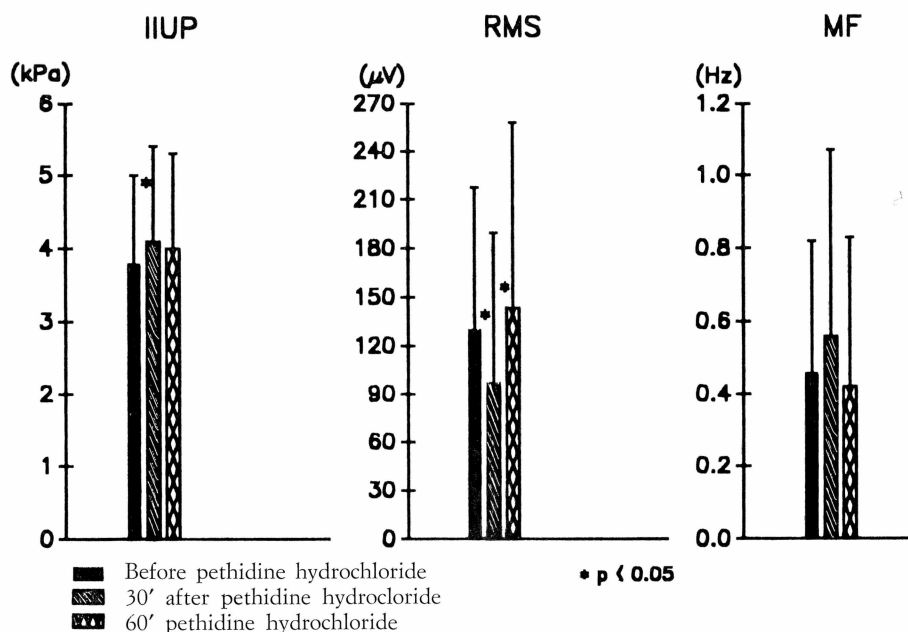


Fig. 3. — Effect of pethidine hydrochloride on the intensity of intra-uterine pressure (IIUP), root mean square (RMS) and median frequency (MF) of the cervical EMG for the whole group ($n = 27$).

Table 1. — *Regression weights and summary of stepwise regression between durations of active phase of labour and muscular activity in the cervix (RMS - root mean square, MF - median frequency) and uterine corpus (IIUP - intensity of intrauterine pressure) before (A) and after (B, C) pethidine hydrochloride application.*

	Multiple A	R ²	β	F	P _F
RMS-A	0.386	0.149	0.416	4.378	0.047
IIUP-A	0.435	0.189	-0.240	1.194	0.285
MF-A	0.476	0.226	-0.197	1.106	0.303

Multiple regression, step by step analysis of the observed parameters (IIUP, RMS, MF) and the duration of the active phase show how strongly the observed parameters are involved in the process of progression of the active phase of labour (Table 1). The factors significantly connected with the duration of the active phase of labour follow the hierarchy: RMS-A, IIUP-A and MF-A. A long active phase of labour is connected with a high RMS before PHC application, and with the low IIUP and MF before the application. The changed values after the application are not connected with the duration of the active phase of labour.

DISCUSSION

With the present study of myoelectrical cervical activity we intended to confirm on the one hand that the cervix is an active organ during labour and on the other to investigate the influence of a specific drug (pethidinehydrochlorid) on the cervical muscles in the active phase of labour.

Contrary to our previous research in this field⁽¹⁾ we now have at our disposal a system for data collection which enables computing of individual EMG parameters, and offers a better and continuous insight into the changes of myoelectrical activity.

The results (Figures 1-3) of the study show that the cervix is an active organ

and that the intensity of contractions in the smooth cervical muscles (circular layer) differs from those in the uterine corpus. While the intensity of uterine corpus contractions increases significantly after PHC application, the RMS as an indicator of EMG intensity in the cervix decreases in the majority of cases during the first 30 minutes after the application (Fig. 3). Some amplitudes of electrical bursts are greater between two contractions of the uterine corpus than at the time of contractions (Fig. 1). However, these differences are not as frequent or important as in the latent phase of labour^(3, 4). In circular registration of EMG of the cervix in the active phase of labour there appears, in our opinion, to be a prevalence of longitudinal myoelectrical activity, which to our hypothesis, comes from the longitudinal layer of the cervical muscles and which is more similar to contractions in the corpus.

As in our previous study on the influence of oxytocin on the cervical muscles⁽⁴⁾ we have also found in the present study that the MF changes take the opposite direction to the RMS changes. A high RMS is accompanied by a low MF and vice versa. This phenomenon may be attributed to the different activity of the cervical sympathetic and parasympathetic nerves. The activity of the cervical smooth muscles is undoubtedly greater at low frequencies.

Our present study shows that PHC given to parturient women in the active phase of labour with dilatation of the cervical canal 4-6 cm promotes the activity of the uterine corpus slightly and decreases the activity in the circular layer of the cervical muscles. But these changed activities of the cervical musculature disappear in one hour's time. Similarly to our earlier findings⁽¹⁾ we can conclude that PHC reduces the muscular activity in the circular layer of the cervix in the latent and active phases of labour.

Due to the brief effect of PHC on the circular muscle layer it presumably does not effect the duration of the active phase of labour. Multiple regression step by step analysis shows that the changed IIUP, RMS and MF following PHC application do not correlate with the duration of the active phase of labour, therefore PHC does not effect the shortening of labour. But the IIUP, RMS and MF prior to the application are significant for the duration of the active phase of labour. The more vigorous the uterine corpus contractions, and the less vigorous the contractions of the circular cervical muscles the shorter the active phase of labour.

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