■ *Research paper*

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Assessing Ripeness of the Cervix Through its Electromyographic Activity in Relation to the Bishop Score

Abstract. Our aim was to characterise selected parameters of the cervical smooth muscle EMG activity at the onset of labour as indicators of cervical ripeness in comparison to the Bishop score. We conducted a retrospective study of 46 healthy primiparous women with induced labour (rupture of membranes and oxytocin stimulation). Digitally assessed Bishop score values for the cervix at the onset of labour were compared with two parameters of EMG signal derived from the cervix: average amplitude (U_{RMSA}) and average median frequency (MF_A). Only the basal cervical EMG activity was considered, i.e., the periods of EMG activity when there was no uterine contraction and no bursts in EMG signal. U_{RMSA} and MF_A of the uterine smooth muscle EMG activity proved to be negatively correlated with cumulative Bishop score. The basal EMG activity reflects a stage in the cervical ripening process and thus a level of readiness of the cervix for labour, therefore the EMG parameters U_{RMSA} and MF_A are indicators of cervical ripeness.

Ocena zrelosti maternične vratu z vrednotenjem njegove EMG aktivnosti v odnosu do ocene po Bishopu

Povzetek. Želeli smo ovrednotiti parametre EMG aktivnosti gladkega mišičja maternične vratu, izmerjene na začetku poroda, kot indikator zrelosti maternične vratu in jih primerjati s kumulativno oceno po Bishopu. V retrospektivno študijo smo zajeli 46 prvorodk z induciranim porodom (predrtje jajčnih mehurjev in stimulacija poroda z oksitocinom). Oceno maternične vratu s prsti po Bishopu na začetku poroda smo primerjali z dvema parametroma EMG aktivnosti, izmerjenima na maternične vratu: povprečno amplitudo (U_{RMSA}) in mediano frekvence (MF_A). Ocenjena so bila le obdobja bazalne EMG aktivnosti maternične vratu, tj. tista, v katerih ni bilo kontrakcij maternice in ni bilo registriranih izbruhov EMG aktivnosti. Pokazalo se je, da sta U_{RMSA} in MF_A EMG aktivnosti gladkega mišičja maternične vratu negativno korelirani s kumulativno oceno po Bishopu. Bazalna EMG aktivnost odseva stanje v procesu zorenja maternične vratu in s tem stopnjo pripravljenosti maternične vratu za porod, torej lahko trdimo, da sta EMG parametra U_{RMSA} in MF_A pokazatelja zrelosti maternične vratu.

■ **Infor Med Slov** 2020; 25(1-2): 9-18

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Prispelo / Received: 4. 2. 2020. Sprejeto / Accepted: 4. 3. 2020.

Introduction

The cervix prepares itself for labour during the process of ripening.[1-3] Failure of the cervix to ripen at term may be followed by failure to progress in labour.[4] At labour, before a regimen of conducting the labour is selected, the obstetrician assesses cervical ripening or its preparedness for induction of labour. In the absence of a ripe (favourable) cervix, steps are to be taken for its preparation. Numerous non-pharmacological methods and pharmacological agents are available for that purpose.[5]

Systems of quantifying and scoring cervical ripeness have been sought for years to determine if a patient may successfully and safely undergo induction of labour. The prevalent Bishop scoring system[6] is a subjective method performed by an obstetrician involving also an assessment of physical properties of the cervix. The scoring system considers the effacement, dilation, consistency, and position of the cervix in addition to the station of the presenting part. Attributes that advocate for cervical ripeness are: an effaced, dilated, favourable cervix with its canal axis directed as much forward as possible. When assessing the Bishop score, each of the attributes is scored so that the cumulative score ranges from 0 to 13. Scores for unripe cervices range from 3 to 6, and for ripe cervices from 7 to 12. Repeated digital cervical examinations give poorly reproducible results and are uncomfortable for the patient.

As the cervix can be considered a mechanical system with physical characteristics that can be measured objectively, methods for objective evaluation of cervical ripeness have been sought. They have not been aiming at substituting the Bishop scoring system but to empower the obstetrician in decision-making by giving him/her objective information on the progress of cervical preparation for labour. Different non-invasive and invasive solutions have been proposed for periodic or continuous follow-up of changes of a single cervical physical characteristic, e.g. cervical dilatation,[7-9] consistency,[10] cervical resistance,[11] mechanical stretch characteristics[12] or cervical compliance.[13] Modern techniques of cervical ripeness assessment technique are based on collagen content assessment,[3,14,15] determination of cervical hydration state[16] or determination of quantity of fetal fibronectin in cervicovaginal secretion.[17] Nowadays, transvaginal sonography is a widely accepted and well-standardised method to measure cervical length.[18,19] One of potential methods for assessing cervical ripeness is also electromyography (EMG). Some researchers have combined different methods (EMG, dilatation, intrauterine pressure) in order to better assess cervical ripeness in humans[8] or animals.[20]

It has been proved in humans[21-29] and animals[20,30-34] that EMG signals derived from the cervix reflect electrical activity of smooth muscle cells in the cervix. The activity is different in women at different stages of the cervical ripeness at the onset of labour.[35] When a labour progresses and the cervix ripens, EMG activity changes in its pattern and the EMG content thus probably (at least partly) reflects changes in the status of cervical ripeness.[8,23,28,29,35]

EMG activity registered in the cervix at the onset of labour when there are no uterine contractions and no locally produced bursts in EMG activity can be considered the basal EMG activity of the smooth muscle tissue in the cervix. As such, it could reflect the level of cervical readiness for successful labour and thus the level of its ripeness.

Researchers and clinicians still argue about the value of some technical approaches in assessment of cervical ripeness. As the Bishop scoring system[6] seems to be the best and currently the most widely accepted method, any newly developed method should parallel its results to it.[36] Hence, our paper is aimed at relating Bishop score values to parameters calculated from EMG signal derived from the cervix at the onset of labour. More specifically, our hypothesis was that the average EMG signal amplitude (U_{RMSA}) and the average median frequency (MF_A) calculated from the EMG that is derived from the cervix at the onset of labour in primiparous women correlate with the cumulative Bishop score and could therefore serve as a measure of cervical ripeness.

Methods

Sample

Forty-six healthy women at term undergoing induction of labour with amniotomy and subsequent oxytocin infusion were included in the study. Cervical electromyographic activity (EMG) and intrauterine pressure (IUP) were registered electronically throughout the latent and active phase of labour without major artefacts. Women were classified into three groups according to their cumulative Bishop score (CBS) value assessed by an obstetrician at the onset of the labour: group CBS 1-4 with 12 labours having CBS values from 1 to 4, group CBS 5-6 with 21 labours and CBS values 5 and 6, and group CBS 7-9 with 13 labours having CBS values 7 and above.

The National Medical Ethics Committee of the Republic of Slovenia approved the study (No. 32/01/97) and an informed consent was obtained from each woman before being enrolled in the study.

Patient preparation and EMG and IUP measurements procedure

After admission to the delivery room, cervical ripeness was estimated according to the Bishop score. Amniotomy was performed and a fluid-filled, open-end intra-amniotic catheter (Hewlett Packard 1286) for measuring and recording the intrauterine pressure (IUP) was inserted in the uterine cavity. An ECG fetal spiral steel electrode (Hewlett Packard 15130A) was attached to the infant's head to monitor the fetal heart rate. To record the EMG activity of smooth muscle tissue at the exterior wall of the cervix, two identical fetal spiral steel electrodes (Hewlett Packard 15130A) as for ECG measurements were inserted directly into the cervical tissue from the vaginal side, 2-3 mm deep in the outer aspect of the cervix (proximal part of the portio), circumferential to the cervical canal (at 9 o'clock and 12 o'clock).[23,28,29] The calculated average initial inter-electrode distance was 31.7 mm (SD 0.63 mm), and at the end of the observed period it was 33.9 mm (SD 0.70 mm). A reference flat metal (Sn) electrode was attached to the woman's thigh. Neither the electrodes themselves nor their application caused any pain or discomfort to the women.

A miniature differential preamplifier and a portable amplifier with an isolation unit were used to amplify (A = 2000) and condition EMG signals. To identify uterine contractions, the intrauterine pressure (IUP) was measured by the intra-amniotic catheter and recorded by cardiotocograph (CTG; Hewlett Packard HP8030A). Analogue signals of EMG and IUP were registered on the monitor chart recorder. A personal computer was used for data acquisition with 12-bit A/D conversion (DAS-8PGA Data Acquisition and Control Board – Metrabyte Inc., USA). EMG and IUP were sampled at 18.2 Hz and the data were written to a personal computer hard disk for later processing. The registration of EMG and IUP began approximately 10 minutes after amniotomy and lasted throughout the duration of labour.

Bishop score values for each labour were collected from the patient's labour documentation. Average values of Bishop score, duration of latent phase and number of contractions in the selected interval are listed in Table 1.

Identification of uterine contractions

IUP signal was recorded to get information on uterine contractions. An increase in IUP above 10 % of its basal level for a period above 30 seconds was classified as a contraction. Periods with contractions were visually determined to distinguish them from periods without contractions. The information was used only for the purpose of proper selection of EMG signal time-intervals that were processed.

Selection of EMG signal intervals

Each EMG record of the selected labours was peer-reviewed for the quality of the recording. For the purpose of the study, one 20-minute measurement interval was selected from each labour record containing no major artefacts in EMG. The interval was selected as close to the onset of labour as possible.

Within the selected 20-minute intervals, the periods with no uterine contractions and the periods with contractions were visually determined for each labour. Periods containing neither uterine contractions nor bursts in EMG activity were classified as periods of *basal EMG activity*. The selected EMG intervals were then grouped to form a collage of shorter periods of EMG activity. Total duration of these periods in each labour was from 3.3 to 13.0 minutes. The periods of EMG activity recorded during uterine contractions at which bursts in EMG activity appeared were classifies as periods of *EMG activity at contractions*. The duration of such intervals ranged from 1.0 to 5.0 minutes.

EMG signal processing

The selected EMG recordings for each labour were filtered digitally (2nd order Butterworth band pass filter 0.3 Hz – 3.0 Hz) for diminishing the influence of artefacts and noise. Then they were collated and processed as a joined signal in time and frequency domain. The Root Mean Square (U_{RMS}) of the EMG signal voltage and median frequency (MF) of the EMG signal were calculated for each 5-second interval of the selected intervals and average values were determined (U_{RMSA}, MF_A). Power Spectra Density (PSD) spectrum was also calculated for the joint intervals. Descriptive statistics for the EMG values for the three groups of labours are given in Table 2. MathLab software (MathLab Inc., Ver. 4) was used for signal processing, analyses and graphic presentation.

Statistical analysis

The following parameters of each labour were used in the statistical analyses: cumulative Bishop score

(CBS), values of Bishop score components (effacement – EFFA, dilation – DILA, consistency – CONS, position of the cervix – POCE; station of the presenting part – PRES), duration of the latent phase (LATPH) and the results of EMG signal processing (U_{RMSA}, MF_A). For all the variables, descriptive statistics were calculated and distributions were examined univariately and bivariately.

To assure validity of the findings, the influence of oxytocin during the observed interval on U_{RMSA} and MF_A was tested using weighted least-squares linear regression (WLS) with cases weighted by total duration of the selected EMG intervals. No statistically significant association was found between time of oxytocin injection and either U_{RMSA} ($p = 0.081$) or MF_A ($p = 0.232$), hence all the labours (i.e., cases) were retained in the subsequent analysis.

The ability of EMG characteristics to predict the Bishop score component values was then tested using regression models with U_{RMSA} and MF_A as independent variables. To test the association of EMG signal characteristics with CBS, LATPH and number of uterine contractions (NC), WLS was applied (with case weights calculated from the duration of the selected EMG intervals). The statistically significant associations were visualised using 3D-scatterplot with local regression smoother (with Epanechnikov kernel). Exact binomial logistic regression was used for testing the association with individual components of the Bishop score, which were dichotomised for the purpose.

Statistical analyses were performed using SPSS for Windows 13.0.1 (SPSS Inc., Chicago, IL, 2004) and Cytel Studio 7.0.0 (Cytel Software Corp., MA, 2005).

Table 1 Descriptive statistics of clinical data for the three groups of labours according to cumulative Bishop score.

Document type	CBS 1-4 (12 labours; median 3)	CBS 5-6 (21 labours; median 6)	CBS 7-9 (13 labours; median 8)	*p*
CBS component				
EFFA – Effacement	1.0 (1.0) [0..3]	2.2 (0.7) [1..3]	2.8 (0.4) [2..3]	
DILA – Dilatation	1.0 (0.0) [1..1]	1.0 (0.2) [1..2]	1.4 (0.5) [1..2]	
CONS – Consistency	0.8 (0.9) [0..2]	1.4 (0.6) [0..2]	1.9 (0.3) [1..2]	
POCE – Position of the cervix	0.08 (0.29) [0..1]	0.86 (0.56) [0..2]	1.23 (0.44) [1..2]	
PRES – Station of the presenting part	0.1 (0.3) [0..1]	0.1 (0.4) [0..1]	0.6 (0.6) [0..2]	
Duration of latent phase (minutes)	242 (113) [105..420]	115 (78) [0..292]	42 (47) [0..150]	< 0.001
No. of contractions in the selected 20' interval	4.7 (1.7) [2..8]	5.3 (3.0) [0..11]	4.8 (2.6) [1..10]	0.787

Legend: CBS – cumulative Bishop score; descriptive statistics are reported as Mean (Standard Deviation) [Range]; where sensible, statistical significance of the difference between groups is also reported.

Table 2 Comparison of the selected cervical EMG activity intervals and the values of the calculated parameters for the three groups of labours separately for the basal EMG activity and EMG activity at contractions.

Document type		CBS 1-4 (12 labours)	CBS 5-6 (21 labours)	CBS 7-9 (13 labours)
Basal EMG activity				
Number of selected EMG intervals		3.3 (0.5)	3.0 (1.0)	3.0 (0.9)
Mean duration of selected EMG intervals (s)		148 (47)	169 (154)	141 (73)
Total duration of selected EMG intervals (s)		485 (140)	407 (162)	377 (125)
EMG activity at contractions				
Number of labours included		11	18	11
Number of selected EMG intervals		2.4 (1.3)	2.6 (1.1)	2.5 (1.1)
Mean duration of selected EMG intervals (s)		107 (61)	67 (23)	84 (35)
Total duration of selected EMG intervals (s)		220 (106)	167 (84)	210 (136)
EMG parameters				
U_{RMSA} (μV)	Basal EMG activity	30.0 (21.3)	22.4 (16.5)	22.1 (10.7)
	EMG activity at contractions	46.3 (29.1)	54.6 (47.1)	43.0 (31.1)
MF_A (Hz)	Basal EMG activity	0.79 (0.37	0.70 (0.37)	0.71 (0.23)
	EMG activity at contractions	0.67 (0 .29	0.58 (0.19)	0.69 (0.26)

Legend: numerical variables are reported as Mean (Standard Deviation).

Results

To illustrate differences in EMG activity pattern, two labours with their joined selected intervals of EMG signals are presented together with the EMG parameters (U_{RMSA}, MF_A) calculated from them. In Figure 1, the cervical basal EMG activity is displayed: on the left for a representative labour of the CBS 1-4 group (CBS = 3 case) and on the right for a representative labour of the CBS 7-9 group (CBS = 8 case). The filtered EMG signal (top trace) is composed of several manually selected sections of basal EMG activity in both cases. EMG activity clearly differs between group representatives in its amplitude and density (frequency contents); details are described below.

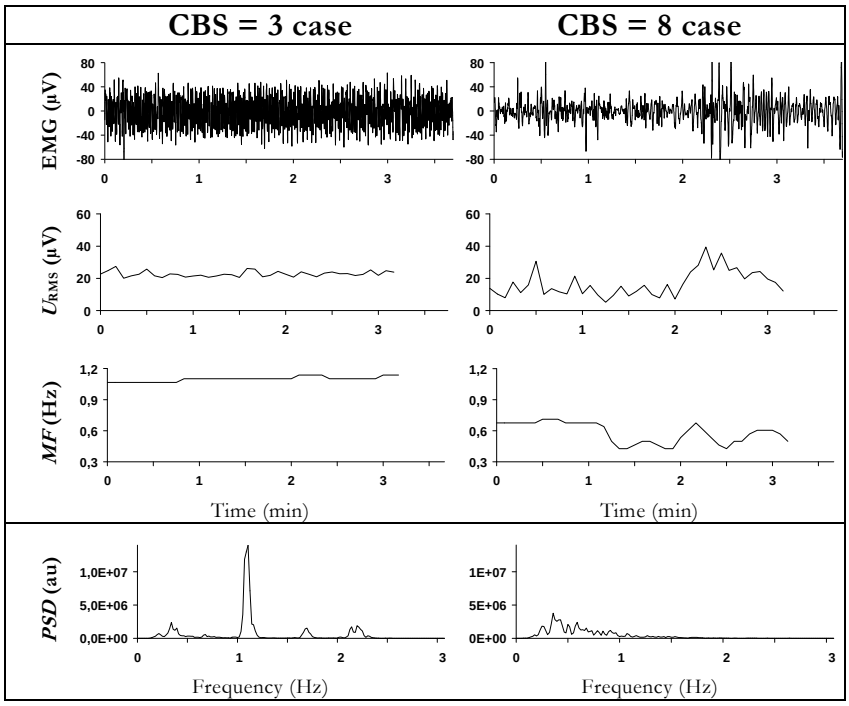

Figure 1 Cervical **basal EMG activity** of two labours having CBS = 3 and CBS = 8, respectively. Traces: combined intervals of filtered EMG signal (upper trace), EMG signal effective value (U_{RMS}, second trace), EMG signal median frequency (*MF*, third trace) and the corresponding power spectrum density (*PSD*, bottom trace).

On the left (CBS = 3 case), the amplitude of the basal EMG activity U_{RMS} (trace 2) is relatively high and constant around 20 μV. The median frequency (trace 3) of the activity is high and above 1 Hz. The peak frequency in Power Spectra Density (*PSD*; bottom trace) is at 1.2 Hz where also the majority of the EMG signal energy is grouped. Two minor groups of frequency components are also around 0.4 Hz and 2.4 Hz. Gaps between the groups of the frequency spectrum are evident.

On the right (CBS = 8 case), the EMG basal activity has lower amplitude values (U_{RMS}; trace 2) and much lower MF values (below 0.7 Hz; trace 3) with respect to CBS = 3 case. *PSD* (bottom trace) has its peak value at 0.4 Hz where also the majority of the EMG signal energy is condensed, so there are large differences in frequency content distribution between the two labour representatives.

In Figure 2, the cervical EMG activity at contractions and calculated values U_{RMS}, *MF* and *PSD* are presented in the same way as for the basal activity in Figure 1. The increase in amplitude with respect to the basal activity is particularly evident in the CBS = 8 case in the raw signal (upper trace) as well as in the U_{RMS} values (trace 2). The shift in frequency content toward lower values is clearly reflected in lower *MF* values (trace 3) for the CBS = 3 case, while *PSD* shows pronounced activity at up to about 0.5 Hz for both cases.

Results of the statistical analyses are presented in Table 1, Table 2 and Figure 3. In Table 2, descriptive statistics characterising the selected cervical EMG intervals are given, then the averaged EMG signal parameters U_{RMSA} and MF_A are summarised for the three CBS groups. Values are reported separately for the basal EMG activity and the EMG activity at contractions.

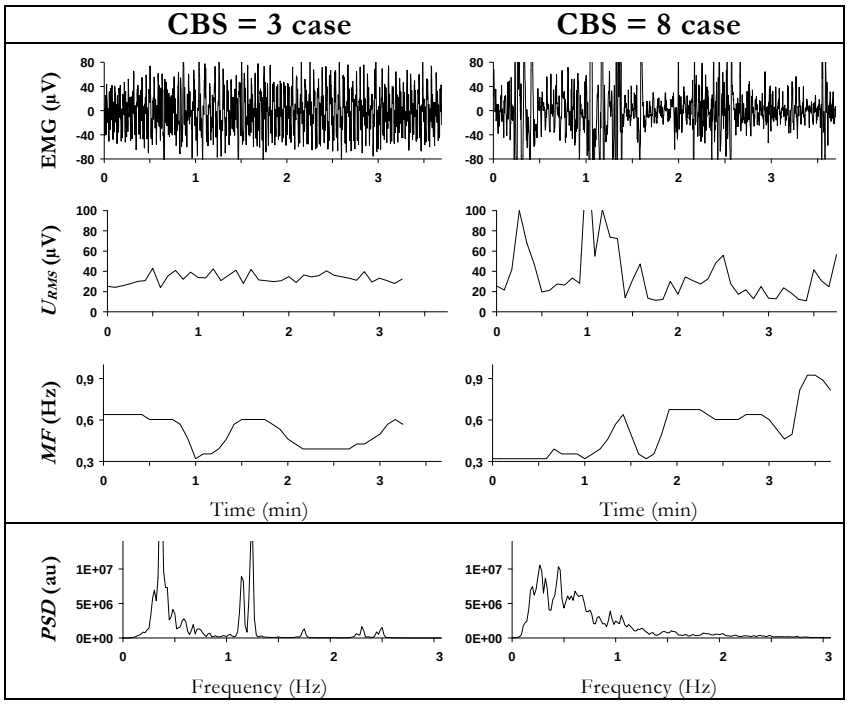

Figure 2 Cervical EMG activity of the same sample labours as in Figure 2 but for selected and jointly **presented periods at uterine contractions and bursts in the cervical EMG**. Traces: combined intervals of filtered EMG signal (upper trace), EMG signal effective value (U_{RMS}, second trace), EMG signal median frequency (*MF*, third trace) and the corresponding power spectrum density (*PSD*, bottom trace).

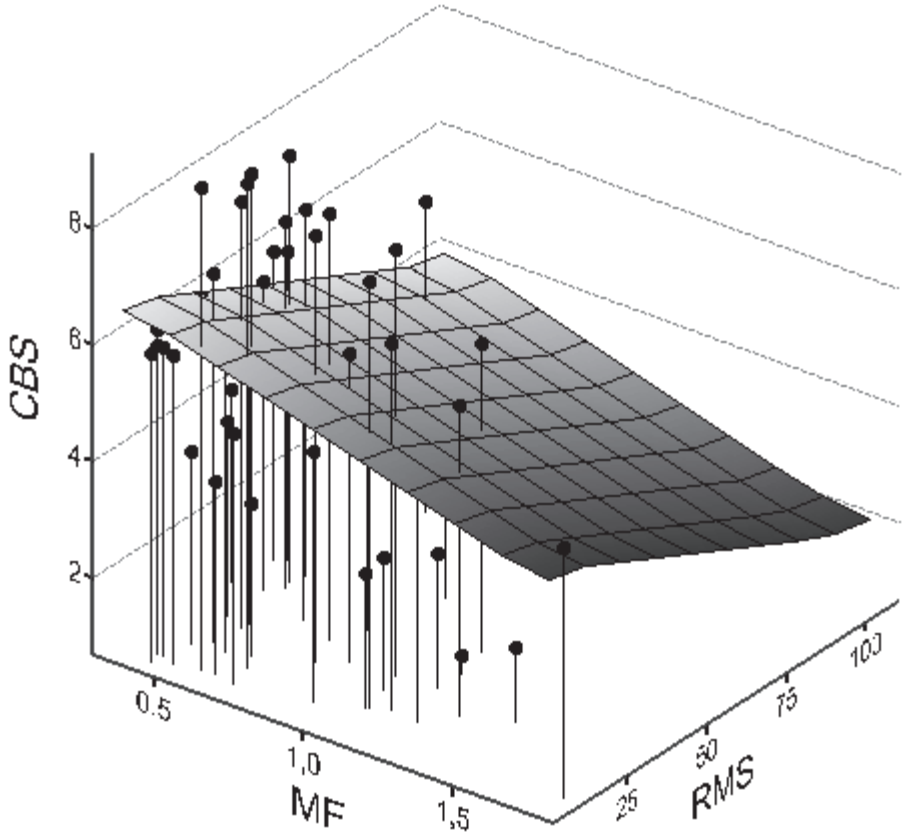

Figure 3 Association of the basal EMG activity parameters (URMSA and MFA) with the cumulative Bishop score. Local regression smoother is superimposed on the point-cloud.

The average value of the basal EMG activity signal amplitude (U_{RMSA}) decreases from 30 μV in the CBS 1-4 group to 22 μV in the CBS 7-9 group. In all three groups, U_{RMSA} values of the EMG activity at contractions are about twice as high as those of the basal EMG activity. The average median frequency values (MF_A) for the basal EMG activity are at 0.7 Hz for all three groups. The values are slightly higher than those of the EMG activity at contractions in all three groups.

The statistical analysis illustrated in Figure 3 shows that the average EMG amplitude U_{RMSA} and the average median frequency MF_A as the characteristic parameters of the selected intervals of the basal EMG activity are predictive of the cumulative Bishop score CBS ($p = 0.017$ for the model from ANOVA; adjusted $R^2 = 0.131$). Both U_{RMSA} and MF_A are negatively associated with CBS ($\beta = -0.364$, $p = 0.013$ for U_{RMSA}; and ß = -0.045, $p = 0.045$, for MF_A). CBS is high when both U_{RMSA} and MF_A have low values, and vice versa, its value is low when both U_{RMSA} and MF_A have high values.

No statistically significant association of U_{RMSA} or MF_A was found among with the individual Bishop score components: cervical channel dilatation DILA, dichotomized as 2-3 vs. 0-1: $p = 0.104$ for the model from Likelihood Ratio (LR) test; cervical effacement EFFA, 2-3 vs. 0-1: $p = 0.105$ for the model from LR test; and cervical consistency CONS, 2 vs. 0-1: $p = 0.311$ for the model from LR test. Similarly, no statistically significant association of U_{RMSA} or MF_A was found with time to delivery ($p = 0.816$ for the model from ANOVA), or with number of contractions ($p = 0.475$ for the model from ANOVA).

Discussion

The cumulative Bishop score values in Table 1 indicate that patients belonging to the CBS 1-4 and CBS 5-6 groups had partially unripe cervices while patients in the CBS 7-9 group had ripe cervices. The groups were formed adequately because average values of Bishop score components (EFFA, DILA, CONS, PRES, POCE) increase from the CBS 1-4 group to the CBS 7-9 group. The average latent phase duration decreases adequately from the longest in CBS 1-4 to the shortest in CBS 7-9. The CBS 1-4 group also has the longest average time to delivery and the lowest number of contractions.

Assessment of the cervical ripeness according to Bishop at the onset of labour is a subjective procedure performed by an obstetrician that tends to predict the labour outcome. Clinical practice experiences phenomena where quite rapid changes in cervical tonus (consistency) are detected at digital examination. Changes may happen in minutes and may influence the results of a single assessment of Bishop score values of the cervix at the onset of labour. This speaks in favour of introducing methods for continuous objective assessment of cervical ripeness.

Cervical smooth muscle tissue is active at the onset of labour[28,29] and consequently generates its own electrical activity that can be detected at the cervix as an EMG activity.[8,23,27-29] The basal EMG activity of the cervix was in the focus of our study. It is defined as the EMG activity registered in the periods when there are no uterine contractions and no bursts in the cervical EMG signal.[29] We may expect that at the site of the EMG signal detection in the cervix, the electrodes picked up not only the EMG signal originating in the cervix but also some EMG activity originating in the uterine corpus myometrium and being conducted through a layer of the uterine wall tissue to the cervix. The amount of the EMG derived from the cervix having such origin would be higher during uterine contractions when high amplitude EMG bursts are generated in the uterine corpus. In the periods with no contractions, we may expect that the registered EMG activity has mainly its local origin in the contracting cervical smooth musculature.

The basal EMG activity of an unripe cervix is characterized by relatively high amplitudes and high frequency content.[28,29] As the labour progresses and the cervix ripens, the EMG activity gradually diminishes in amplitude and in median frequency.[23] In a ripe cervix, the basal EMG activity is of low amplitude and low EMG frequencies. As such, the basal EMG activity could reflect the stage (status) of the cervical ripeness and thus readiness of the cervix for successful labour. A close relation is therefore expected between the assessed cumulative Bishop value and the EMG parameters of the basal EMG activity.

In our study, the average EMG signal parameter values (U_{RMSA}, MF_A) of the basal EMG activity and the EMG activity at contraction were compared for three groups of labours (CBS 1-4, CBS 5-6, CBS 7-9). Differences in the cervical ripeness between the groups are naturally reflected in the differences in Bishop score component average values (Table 1), but they are also reflected in different EMG signal patterns (Figure 1) belonging to representatives of the two labour groups, as well as in differences in the average EMG signal parameter values U_{RMSA} and MF_A

(Table 2). Average scores for effacement (EFFA) and consistency (CONS) increase from CBS 1-4 group to CBS 7-9 group (Table 1), while both U_{RMSA} and MF_A of the basal EMG activity decreases from CBS 1-4 to CBS 7-9 (Table 2). Hence, the riper the cervix (higher CBS, CONS and EFFA values), the lower are the basal EMG average amplitude U_{RMSA} and average median frequency MF_A.

In riper cervices, i.e., in the CBS 5-6 and CBS 7-9 groups, MF_A values are lower than in the CBS 1-4 group (Table 2). In Figure 1 (right side, lower trace), *PSD* of the representative of the CBS 7-9 group with a ripe cervix has only one group of frequencies, all lying below 1 Hz. Absence of higher frequency components decreases the average median frequency of the EMG signals. This is consistent with previous findings at the onset of labour.[28,29,35] Analogously, extinguishing of high frequency EMG activity, being characteristics of an unripe cervix smooth muscle tissue activity, was noticed with the ripening of the cervix.[23,37] It can therefore be concluded that richness of EMG signal in frequency diminishes as the cervix ripens, so labours in which rich EMG activity is detected in the cervix at the onset of labour should have lower CBS values.

U_{RMSA} of EMG at contractions was always higher than U_{RMSA} of the basal EMG activity (Figure 2, Table 2), which is also in line with previous results.[28,29] As expected, the MF_A values of the cervical EMG activity at contractions were lower in all groups than during basal EMG activity. The drop in MF_A could be attributed to a stronger presence of the uterine corpus low frequency EMG activity in the cervical EMG at contractions. Because of that, MF_A at contractions did not differ between the groups.

Figure 3 demonstrates that at the onset of an induced labour, the average cervical EMG signal amplitude (U_{RMSA}) and the average median frequency (MF_A) are negatively associated with the cumulative Bishop score. An obstetrician may expect a high CBS value for the cervix when EMG signal is of low amplitude (e.g., $U_{RMSA} < 25$ μV) and has low median frequency value ($MF_A < 0.5$ Hz). In the case that the EMG signal is visualised on a graphic monitor, EMG indicating a ripe cervix would be of low amplitude and its polarity would change slowly. Conversely, the obstetrician may expect low cumulative Bishop score value when both the EMG amplitude and the EMG median frequency have high values (e.g., $U_{RMSA} > 50$ μV, $MF_A >> 1$ Hz). In such case of an unripe cervix, EMG on the monitor would have high amplitude and a dense trace.

As the basal EMG activity derived from the cervix relates well to the cumulative Bishop score, we may conclude that the basal EMG activity reflects the stage of the cervical ripening process and thus the level of readiness of the cervix for labour. Consequently, the EMG parameters U_{RMSA} and MF_A can be deemed indicators of cervical ripeness. If so, an adequately processed cervical EMG signal, when visually presented in a delivery room, could help an obstetrician to better assess cervical ripeness at the onset of labour, thus facilitating the decision how to better conduct the labour.

Conclusion

At the onset of an induced labour, EMG activity derived from the cervix and registered in the periods when there are no uterine contractions and no bursts in the cervical EMG signal is considered the basal EMG activity of the cervix. Its average amplitude (U_{RMSA}) and average median frequency (MF_A) are negatively associated with the cumulative Bishop score, the latter being a clinical measure of cervical ripeness. High U_{RMSA} and high MF_A advocate for low Bishop score values indicating an unripe cervix, while low U_{RMSA} and low MF_A advocate for high Bishop score values indicating a ripe cervix. It may thus be concluded that the basal EMG activity reflects the stage of the cervical ripening process and thus the level of readiness of the cervix for labour. Consequently, the EMG parameters U_{RMSA} and MF_A are potential indicators of cervical ripeness or lack thereof.

Acknowledgements

The authors are grateful to Mr. Darko Oberžan, MKS Ltd. Ljubljana, for his help with EMG signal processing.

The study was supported by the Ministry of Science and Technology of the Republic of Slovenia (grants L3-7365, J3-8759, J3-5342, J3-2361).

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