

Original articles

J. Perinat. Med.
3 (1975) 226

Some remarks concerning the fetal heart rate total dip areas

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Received February 3, 1975 Accepted March 4, 1975.

Some reports indicate that the total fetal heart rate (FHR) deceleration areas in themselves are a sufficient parameter for assessing the fetal state 60 minutes before birth [3,8]. TOURNAIRE et al. [9] found a correlation between the total deceleration areas, the APGAR score and the pH in the umbilical artery. They stressed, however, that **in addition to the total FHR deceleration areas, other FHR parameters must be used in order to assess the fetal state.**

We found a significant difference between normal and pathological newborn states with regard to deceleration areas [1]. This difference, however, is no larger than that between numerous other parameters, e. g. **lag time, recovery time or fluctuation within the dip.** Since the report of the above mentioned authors leaves the impression that the total deceleration areas during the last phase of delivery, independently from other FHR parameters, are a reliable indicator of the fetal state, it seemed worth while to re-examine this question.

1 Material and methods

Using a computer program numerous dip parameters, such as the **amplitude, duration, lag time, decrement time, recovery time and fluctuation** before, within and after the dip determined from digitalized cardiotokograms (CTG) (technique of MORGENSTERN et al. [5]). Cardiotokograms were computed in 385 patients, 255 with normal newborns (**normal newborn index**) and 130 with pathologically altered newborns (**pathological index**). This newborn asphyxia index includes essentially the APGAR score after 1, 5 and 10 minutes, the performed reanimation proce-

dures, and the adaptation of the newborn during the first seven days of life. Only those CTG sectors occurring 60 min. before delivery and showing at least two decelerations were included. This reduced the number of normal newborn indices to 62 and those with pathological indices to 40. Only the state of the newborn was considered [6]. Thus a selected group of e. g. pregnancies at risk or certain pathological CTG courses was avoided. In both groups CTGs were computerized.

2 Results

In order to compare our data with those of TOURNAIRE et al. [9] the total FHR dip areas were determined. Fig. 1 shows TOURNAIRE's mean values on the left. This was, as stated by TOURNAIRE, a selected group with numerous or severe decelerations and pregnancies at higher risk. The difference between his two groups is highly significant ($p < 0.001$, separate variance t-test), i. e. APGAR scores below seven are more often associated with large total deceleration areas.

Our data are shown on the right side of Fig. 1. Only cardiotokograms with at least two decelerations were used in both groups. The mean of the total dip areas is larger in the group with a pathological newborn index than in the normal one, but this difference is not significant using either the t-test or the WILCOXON test*). This result shows that **the total dip areas alone are an unreliable parameter from which to judge the fetal state.** It seemed of interest to examine the

*) As suggested by K. Schmidt, Inst. for Med. Statistics and Documentation, Steglitz Clinic, Berlin

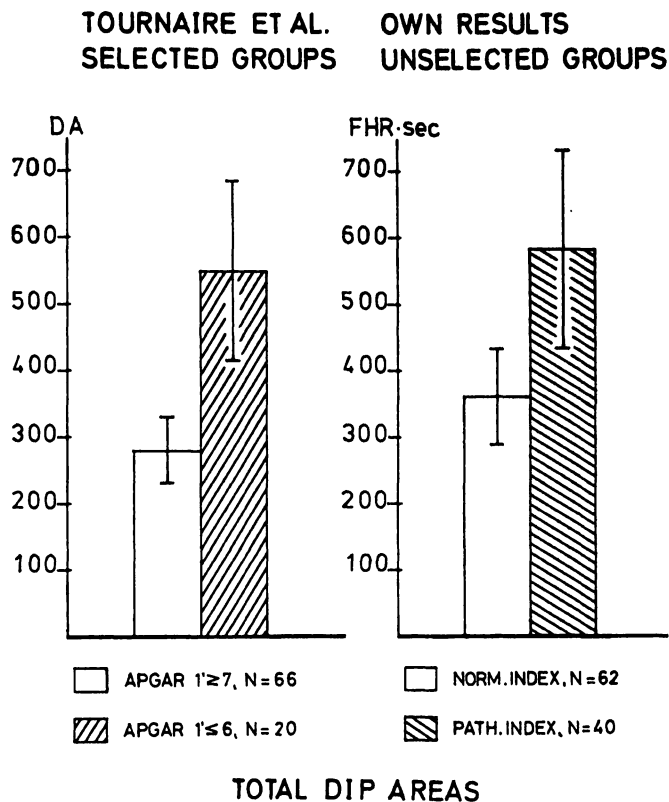


Fig. 1. Means of the sum of total dip areas of cardiokograms from normal and pathological newborns. TOURNAIRE et al., $p < 0.001$ separate variance test. Own results, not significant in t-test and WILCOXON test.

behavior of other dip parameters during the last 60 min. before delivery. Hence for a few descriptive parameters, e. g. the fluctuation of FHR before, within, and after the dip, the mean was determined for these 60 minutes. Fig. 2 shows differences between the two groups (normal and pathological newborn indices) are only slight. It follows that **the fetal state can hardly be determined from another single parameter.**

The prediction of the fetal state can be improved by simultaneous consideration of several descriptive dip parameters (SCHMIDT et al. [7]). The various descriptive parameters of each deceleration were given different weights depending on their value and were added. In this way a valuating parameter was calculated for each deceleration. In order to obtain this parameter the **fluctuation of the FHR** before, within, and after the dip,

Fig. 3. Means of the sum of total dip areas (not significant) and the sum total of evaluating dip parameters ($p < 0.01$ in t-test and WILCOXON test).

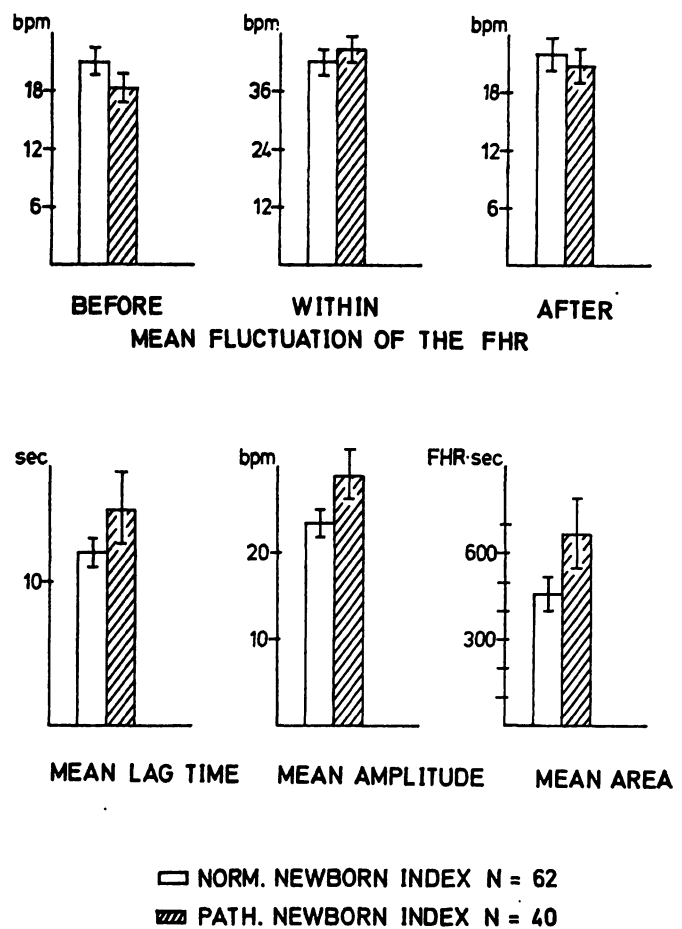
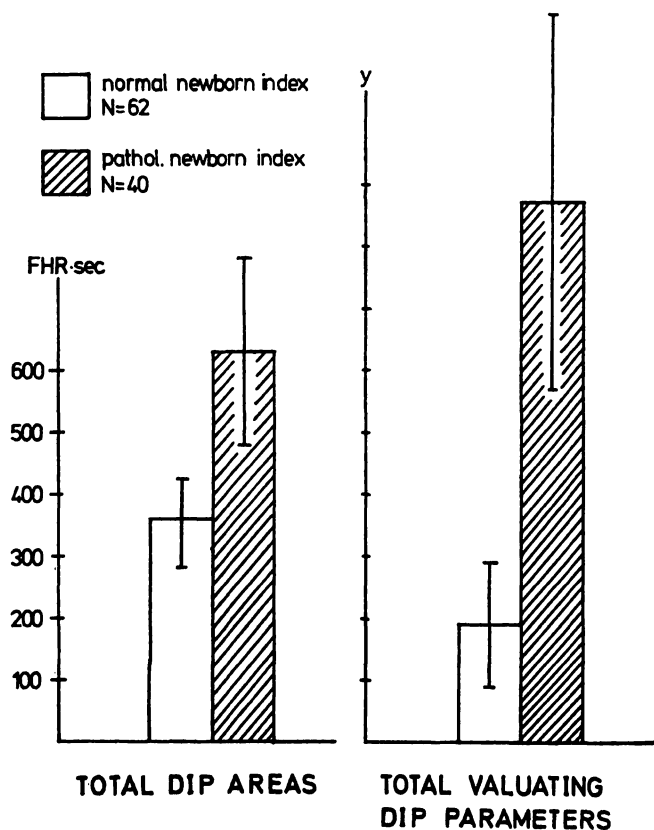


Fig. 2. Mean values of different mean dip parameters.



the decrement time, the amplitude, the recovery time, the duration at dip minimum, the duration at half amplitude and the total dip duration were all taken into account.

The sum of total valuating dip parameters in both groups was calculated for each CTG run in a way similar to the total dip areas. The means of the dip areas in both groups were compared with the means of the total valuating dip parameters (Fig. 3). The two groups differ significantly (t-test $p < 0.01$, WILCOXON Test $p < 0.01$) when the total valuating dip parameters are considered, which was not the case with the sum total of the dip areas.

3 Discussion

We have shown that the total dip areas differ only slightly between normal and pathological newborn states. We think that the fetal state cannot be evaluated satisfactorily from the

total dip areas. Prediction is already improved, when two parameters, e. g. recovery time or dip fluctuation together with the lag time are considered [1]. KIMURA [4] and HAMMACHER [2] developed a FHR score for visual evaluation of cardiotokograms. This FHR score considers as many parameters as possible, each receiving a different number of points depending on its weight. Both authors claim that the fetal state is better evaluated by this score. For the dip valuating parameter computed by us descriptive dip parameters are considered and evaluation occurs through statistical calculations using discrimination analysis. The calculated weights of the dip parameters agree with clinical experience [7]. Our results have already significantly improved the assessment of the fetal state although the dip valuating parameter is only a part of our routine CTG evaluation.

Summary

It was ascertained whether the sum total of the dip areas 60 minutes prior to delivery is an evaluating parameter for judging the fetal state. The cardiotokograms of 62 deliveries with a normal newborn state (newborn index 1) and forty with a pathological newborn state (newborn index 2 and 3) were digitally computed [5]. By proper programming numerous descriptive dip parameter can be determined, e. g. the amplitude, duration, area, lag time, recovery time, fluctuation before, within, and after the dip.

The sum total of the dip areas was calculated from the CTG 60 minutes before delivery. Only cardiotokograms with at least two decelerations were included. The pathological newborn group has a larger mean sum total of dip areas than the group with a normal index (Fig. 1). This difference, however, is not significant. Mean values were calculated for other descriptive parameters, e. g. dip fluctua-

tions, lag time, dip amplitude etc. These also differ only slightly between the two groups. (Fig. 2). Hence they give no satisfactory decription of the fetal state.

By including several dip parameters simultaneously [7] an evaluating parameter can be determined for both decelerations. The various descriptive parameter are given different weights and are added up (discrimination analysis). In analogy to the sum total of the dip areas the sum total of the evaluating parameters was calculated. The difference between the two groups with respect to these evaluating parameter sums is significant. (Fig. 3). The sum of total dip areas alone does not appear to be a sufficient FHR parameter for evaluating the fetal state. Evaluation is significantly improved by considering simultaneously several descriptive parameters.

Keywords: Asphyxia index, deceleration, deceleration parameter, digitally computerized data, electronic data treatment, fetal heart frequency, fetus.

Zusammenfassung

Einige Bemerkungen über die „total dip area“ bei der fetalen Herzschlagfrequenz

In der vorliegenden Arbeit ist untersucht worden, ob die Summe der Dip-Flächen in der Zeit 60 min vor der Geburt für die Beurteilung des fetalen Zustandes ein aussagekräftiger Parameter sei. Dazu wurden die Kardiotokographie-Verläufe von 62 Geburten mit einem normalen Neugeborenenzustand (Neugeborenenindex 1) und 40 Geburten mit einem pathologischen Neugeborenenzustand (Neugeborenenindex 2 u. 3) digitalisiert [5], d. h. für die Auswertung mit einem Computer aufbereitet. Durch ein Programmsystem lassen sich zahlreiche beschreibende Dip-

Parameter wie z. B. die Tiefe, Breite, Fläche, lag time, Abstiegszeit, Anstiegszeit und die Fluktuation vor, im und nach dem Dip bestimmen.

Aus den CTG-Abschnitten 60 min vor der Geburt ist die Summe der Dip-Flächen berechnet worden. Werden dabei nur Kardiotokogramme mit mindestens zwei Dezelerationen zugelassen, so ist in der Gruppe mit einem pathologischen Neugeborenenindex im Mittel die Summe der Dip-Flächen größer als in den Gruppen mit einem normalen Index. Der Unterschied ist jedoch statistisch nicht signifikant (Abb. 1). Für einige andere beschreibende Parameter wie z. B. die Fluktuation im Dip,

die lag time, die Dip-Tiefe usw. werden die Durchschnittswerte über die 60 min CTG-Strecke berechnet. Die untersuchten, beschreibenden Dip-Parameter unterscheiden sich bezüglich der beiden Kollektive ebenfalls nur gering (Abb. 2) und lassen keine befriedigende Beurteilung des fetalen Zustandes zu.

Durch die gleichzeitige Berücksichtigung von mehreren Dip-Parametern [7] läßt sich für beide Dezelerationen ein bewertender Parameter bestimmen. Dabei werden die beschreibenden Dip-Parameter mit verschiedenen Gewichten versehen und aufaddiert (Diskriminanzanalyse). Analog zur

Summe der Dip-Fläche ist die Summe der bewertenden Dip-Parameter berechnet worden. Im Gegensatz zur Summe der Dip-Flächen unterscheiden sich die beiden Kollektive bezüglich der Summe der bewertenden Dip-Parameter signifikant (Abb. 3). Die Summe der Dip-Flächen scheint allein kein ausreichender FHR-Parameter zu sein. Dagegen führt die gleichzeitige Berücksichtigung mehrerer beschreibender Dip-Parameter zu einer signifikanten Verbesserung in der Beurteilung der FHR.

Schlüsselwörter: Asphyxieindex, Dezelerationen, Dezelerations-Parameter, digitalisierte Daten, elektronische Datenverarbeitung, fetale Herzfrequenz, Fetus.

Résumé

Quelques remarques sur les surfaces Dip totales du rythme cardiaque foetal

Dans le présent article, on s'est posé la question de savoir si la somme des surfaces Dip dans le temps de 60 min avant la naissance représente un paramètre suffisant sur l'état du foetus. A cet effet, on a digitalisé les tracés cardiocardiographiques de 62 accouchements avec un état de nouveau-né normal (index de nouveau-né 1) et de 40 accouchements avec un état de nouveau-né pathologique (index de nouveau-né 2 et 3) [5], c. à. d. qu'on les a préparés pour évaluation par computer. Un système programmé permet de définir de nombreux paramètres Dip descriptifs tels que, par ex., la profondeur, la largeur, la surface, le lag time, le temps de décroissance, le temps de croissance et la fluctuation avant, pendant et après le Dip.

La somme des surfaces Dip a été calculée à partir des segments CTG 60 min avant l'accouchement. Si on ne retient que les cardiocardiogrammes avec au moins deux décélérations, on constate qu'en moyenne la somme des surfaces Dip est plus grande dans le groupe à l'index de nouveau-né pathologique que dans celui à l'index de nouveau-né normal. La différence n'est toutefois, pas significative

sur le plan statistique (Fig. 1). Pour divers autres paramètres descriptifs tels que, par ex., celui de la fluctuation dans le Dip, du lag time, de la profondeur Dip etc., on a calculé les valeurs moyennes sur le tracé CTG de 60 min. Les paramètres Dip descriptifs examinés ne diffèrent guère davantage entre les deux groupes (Fig. 2) et n'autorisent aucune appréciation satisfaisante de l'état foetal.

En tenant compte à la fois de divers paramètres Dip [7] il est possible de définir un paramètre évaluable pour les deux décélérations. Les paramètres Dip descriptifs sont, à cet effet, munis de divers poids et additionnés (analyse discriminatoire). De façon analogue à la somme de la surface Dip, on calcule la somme des paramètres Dip évaluable. Au contraire de la somme des surfaces Dip, les deux groupes diffèrent de façon significative en ce qui concerne la somme des paramètres Dip (Fig. 3). La somme des surfaces Dip ne semble pas suffire à elle seule comme paramètres FHR pour évaluer l'état foetal. Par contre, la considération simultanée de plusieurs paramètres Dip descriptifs permet d'améliorer de façon significative l'appréciation du FHR.

Mots-clés: Calcul électronique de données, décélérations, données digitalisées, foetus, fréquence cardiaque foetale, index d'asphyxie, paramètre de décélération.

Acknowledgment: This work was supported by the Ministry of Science and Research, State of Nordrhein-Westfalen, Landesamt für Forschung.

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