Original articles

J. Perinat. Med.
6 (1978) 69

Early decelerations of the fetal heart rate from occlusion of the umbilical cord

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1 Introduction

Analysis of fetal deaths prior to the onset of labor at the Maternidad "Santa Cristina" during the period from June 1972 to September 1974 suggested that cord complications were the probable cause of death in 62% of the cases. Similar findings have been reported by other centers [3, 18, 21].

In an attempt to reduce this number of antepartum fetal deaths we decided to monitor the fetal heart rate in patients admitted prior to labor (during the first 24 hours after admission). A decrease in the fetal heart rate resembling the pattern of early deceleration or type I dip was frequently seen. It is currently believed that this heart rate pattern is caused by compression of the fetal head during uterine contractions [1, 5, 11, 13, 15, 19]. This belief is based on clinical observations and experiments in human fetuses [1, 15]. At the time our patients were monitored, most had intact membranes and the fetal head was not engaged, or the presentation was by breech, making it very unlikely that the fetal head could be compressed during a uterine contraction. We therefore embarked on a search for an alternate explanation for these changes in fetal heart rate.

The fetal heart rate pattern associated with cord compression has been described as "variable" [11, 13]. This description alludes mainly to the different shape of successive decelerations (for their different amplitude and/or duration) as well as to the different time relationships between the onset of the contraction and the corresponding deceleration [5, 11, 13]. The variability of this pattern, when typical, is easily recognized over periods of 15 to 30 minutes of continuous recording.

In our patients monitored during late pregnancy, this "variable" pattern was relatively infrequent. On the contrary, early decelerations following a rather non-variable pattern, were often seen in fetuses who later evidenced cord complications at birth.

This suggested that compression of the umbilical cord might be causing the heart rate patterns which we were observing. Other authors have also proposed that early decelerations or type I dips could be related to compression of the umbilical cord [5, 22] or to other unknown factors [20]. In order to explore this possibility in greater detail we have analyzed the heart rate changes, in a selected group of patients during the late antepartum period, and related these to the presence or absence of umbilical cord complications at birth.

2 Material and methods

Patients in whom the fetal heart rate had been monitored during the antepartum period were

selected on the basis of the following criteria: 1) intact membranes; 2) clinically normal amount of amniotic fluid; 3) unengaged vertex presentation or breech presentation and 4) no cervical dilatation. **These conditions were requested to diminish the likelihood of fetal head compression during uterine contractions.** 5) An additional criterion for selecting the tracings was a minimum of 15 uterine contractions, either spontaneous or induced. The most common reason for admission prior to labor (34 out 45 patients) was prolonged pregnancy (over 42 weeks of amenorrhea). Other indications were toxemia – 4 patients, diabetes – 4 patients, heart disease – 2 patients, and Rh isoimmunization. Gestational ages ranged from 37–44 weeks.

None of the patients received any analgesic or anesthetic agents. Oxytocin* was given to induce or enhance uterine contractions, by continuous infusion at an initial rate of 10 mu/min, the dose being adjusted according to the needs in each case after the first 10 minutes of observation.

The fetal heart rate was monitored over periods ranging from 24 hours to one week prior to delivery. Both uterine contractility and fetal heart rate were monitored using external techniques only, the fetal heart rate being monitored continuously by ultrasound**.

2.1 Analysis of FHR tracings

The FHR tracings were analyzed for the occurrence and frequency of type I dips [5] or early decelerations [13]. Tracings showing typical variable or late decelerations [11] were not included. Early decelerations were defined as follows: 1) Any transient deceleration occurring repeatedly with uterine contractions and having a lagtime between the nadir of FHR (point of maximal fall) and the peak of contraction between ± 18 seconds, [5, 15]; 2) when one contraction produced two successive falls (W-shaped) in the FHR, the nadir of the first fall was used to measure the lagtime. When it ranged between ± 18 seconds, the first fall of the deceleration was considered as the early deceleration. Only decelerations fulfilling one or both of the above criteria were considered as early. Other concomitant changes in FHR (related to deceleration), such as transient accelerations (pre or postdecelerations), spikes, etc. were not taken into account for classifying purposes.

The criteria for selection were met by 45 patients who were then classified according to the presence or absence of umbilical cord complications at birth. In eleven of these patients, the umbilical cord was found to be wound around fetal neck or body or having true knots. In the remaining 34 patients no overt cord complications were found at birth. The records of these 45 patients were then classified according to the presence or absence of decelerations (positive or negative respectively), according to the above definitions. A minimum of three early decelerations in the 15 recorded uterine contractions was required to classify the tracing as positive.

3 Results

Analysis of the 45 FHR records obtained before labor revealed an association between the presence of early decelerations and cord complications at birth (Tab. I). Only 4 fetuses showed early decelerations in the absence of overt cord complications (false positives) and one had a cord complication without evidence of early decelerations at the time of minitoring (false negative). This association was

Tab. I. Association between early decelerations and cord complications.

	Type I dip early deceleration		
	with	without	
	10	1	11
	4	30	34
	14	31	45

Exact FISHER's test P = 0.0000030

* (Pitocin, Parke Davis)

** The monitoring equipment used has been Mod 8021 A Hewlett-Packard or Mod FM2 Sonicaid Cardiotachograph.

statistically significant ($p = 0.000030$, by an exact FISHER's test).

Among the ten patients with cord complications at birth, 124 early decelerations in the pre-labor record were available for analysis. The shapes of these early decelerations were not uniform and were of six main types (Fig. 1). The most frequent one (present in 8 out of 10 patients) (Fig. 1a) showed a transient acceleration in FHR prior to the deceleration. Early decelerations without any associated transient acceleration were found in 6 patients, either having a large or small amplitude (Fig. 1b and f respectively). Another complex shape found in 3 patients was a transient acceleration following the decelerations (Fig. 1c). More complex shapes were also seen, having transient accelerations before and after the deceleration (Fig. 1d). Finally, the W-shaped decelerations, resembling those recorded by manually compressing the umbilical cord in humans (Fig. 2) [1] were present in 4 out of 10 patients studied (Fig. 1e).

The characteristics (mode values) of the most frequent early decelerations (Fig. 1a) were statistically analyzed. The mode values found are presented in Tab. II.

A detailed examination of several individual cases amplifies this analysis and emphasizes several important points.

Tab. II. Characteristics (mode values) of early decelerations.

Basal FHR (before and after deceleration)	= 140–149 beats/min
Cenit of preceeding transient acceleration	= 150–159 beats/min
Nadir of early deceleration	= 110–119 beats/min
Total duration (including transient acceleration)	= 40–49 sec.
Lagtime: nadir of dip – cenit of contraction	= 0 ± 5 sec.

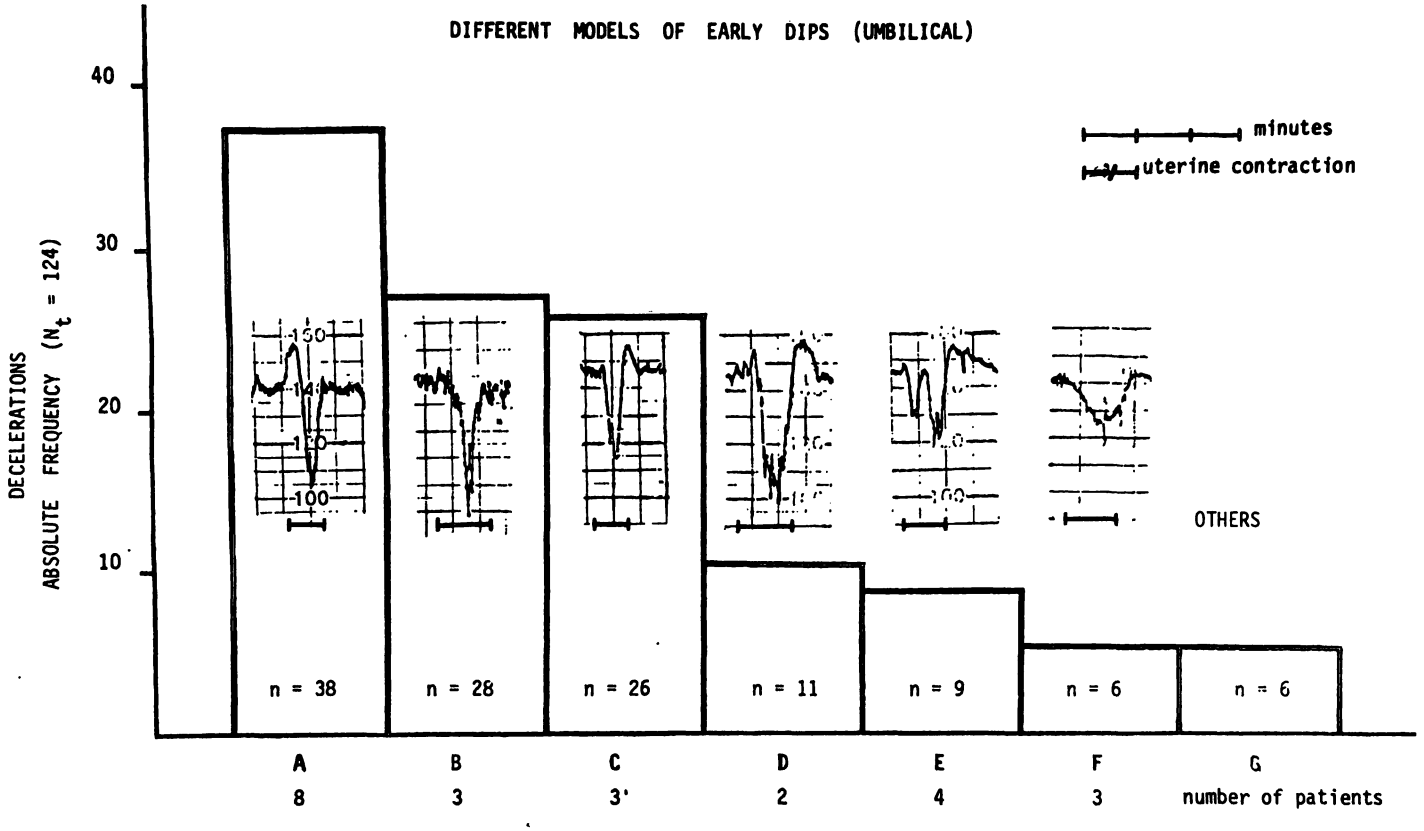

Fig. 1. Different shapes of FHR changes found in the 124 type I dips studied. The most frequent pattern (A) has a transient acceleration of the FHR, preceding the dip. In model C, the transient acceleration occurred after the dip and in model D, a transient acceleration was present both before and after the dip.: Model E shows a W-shaped complex deceleration. The first fall was considered as a type I dip. Models B and F are early decelerations of different duration and amplitude. "n" indicates the absolute frequency of early decelerations found for each shape. Six decelerations out of the 124 recorded, showed shapes other than models A, B, C, D, E or F.

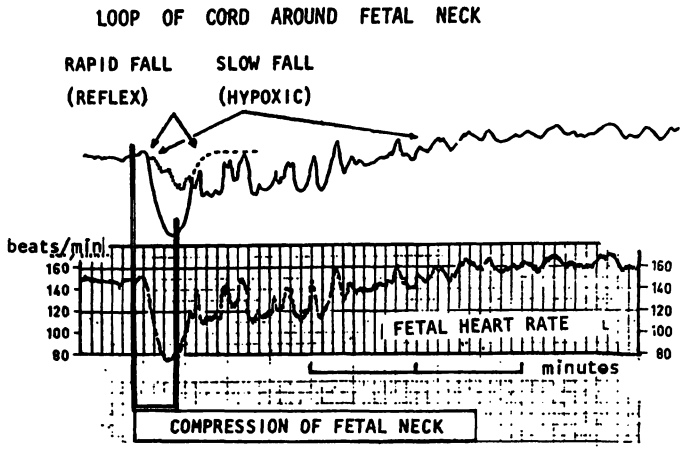

Fig. 2. Transabdominal compression of fetal neck at solid vertical bars. At birth a loop of cord was found wounded around fetal neck. It is assumed that the compressions of fetal neck may be actually compressing the umbilical cord. Recording paper goes at high speed. The compression produced a complex deceleration, interpreted as the addition of two components: a rapid reflex FHR fall (type I dip component) and a slower hypoxic fall (type II dip component). At a lower speed, the tracing would resemble a W-shaped deceleration (see Fig. 6, E). Both components are hypothetically represented at the top of the illustration (type I dip and type II dip). (Redrawn and modified from G. Arellano-Hernandez et al. [1].

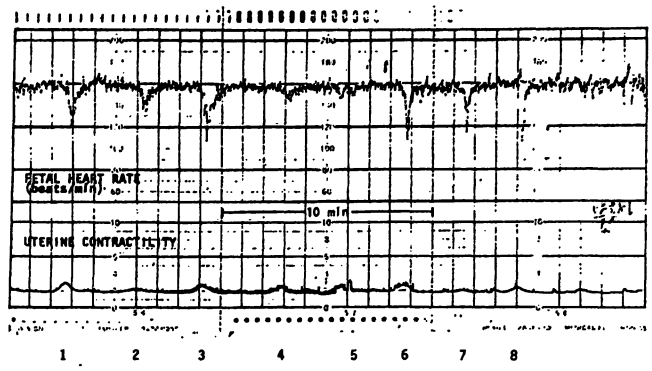

Fig. 3. Example of "positive" tracing, i.e. having type I dips (see text). Recording obtained at the 43rd week of amenorrhea. Contractility induced by oxytocin i/v. Intact membranes and unengaged head at the time of minotiring. Newborn's weight 3500 g, Apgar score 7-7-9. At birth two loops of cord were found wounded around fetal neck. Early deceleration of similar shape are recorded in some contractions.

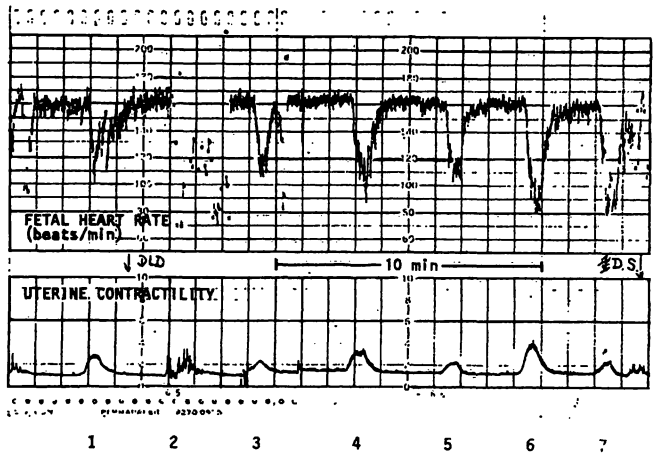

Fig. 4. Same patient as in Figure 1, monitored 24 hours later. Same obstetrical conditions. Early decelerations are consistently present in almost every contraction giving to the tracing a rather non variable appearance (see text). Fetal heart beats (picked up by ultrasonics) were lost along contraction number 2. Patient classified as "positive".

The first example is a record obtained at the 43rd week of amenorrhea. Uterine contractions were induced by intravenous oxytocin; the membranes were intact and the head not engaged at the time of monitoring. The tracing (Fig. 3) shows early decelerations which are quite constant in duration and shape. However, there is some variability in the pattern, mainly as a consequence of two facts: 1) not all the contractions produced early decelerations; 2) the amplitudes of the decelerations are not constant, in part due to the different amplitude of succession of contractions. This tracing could therefore be categorized by our criteria as an early deceleration, but also as a variable deceleration using HON's definition [11, 12].

Twenty-four hours later and under similar obstetrical conditions, the fetal heart rate record (Fig. 4) showed early decelerations with almost every contraction, which were of greater amplitude than in the earlier recording. This tracing was classified as positive since early decelerations were clearly recognizable according to our definition.

At delivery several hours later, two loops of the umbilical cord were found tightly wound around the fetal neck. The APGAR score was 7,7 and 9. Newborn weighed 3500 grams.

The second example (Fig. 5) is a record taken prior to labor with the membranes intact and the fetal head not engaged. There was no dilation of the cervix. This record was classified as positive for early decelerations and the pattern was consistently consistant showing no evidence of a variable deceleration pattern. The decelerations were initially

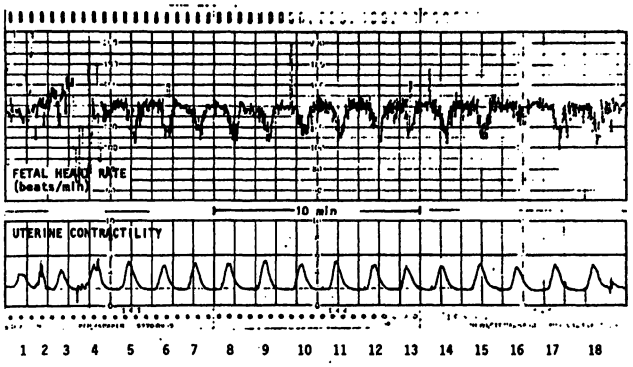

Fig. 5. A typical non variable pattern of type I dips, erroneously interpreted as produced by cephalic compressions of the fetus. Membranes were intact and fetal head not engaged. No cervical dilation. At birth it was found one loop of the cord around the fetal neck. Apgar score 7-7-9, newborn's weight 3500 g.

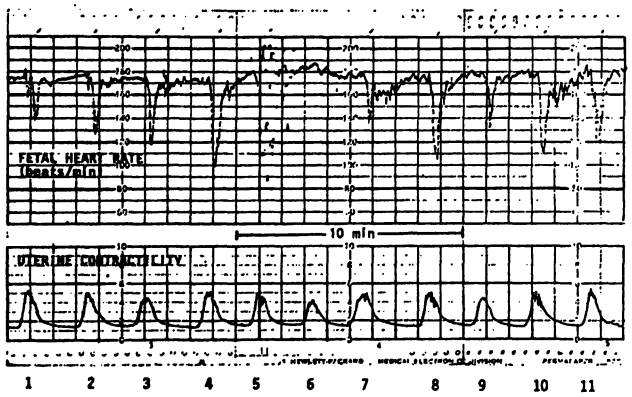

Fig. 6. Breech presentation in a 41 weeks pregnancy. There is some variability in the shape of the decelerations corresponding to contractions 1, 7, 8 and 10 (see text). There is no variability in the time relationships between contractions and dips. One loop of cord around fetal neck was found at birth. Newborn's weight 3200 g, Apgar score 8-9-9. The tracing was easily classified as having type I dips ("positive").

interpreted as being produced by fetal head compression [1, 11, 12, 15]. However, because of the floating head and the absence of ruptured membranes, it was unlikely that the heart rate changes could have been caused by head compression. At birth, 12 hours later, there was one loop of umbilical cord around the neck. The Apgar score of the newborn infant was 7, 7 and 9; the infant weighed 3500 grams.

The third example is a recording of a fetal heart rate from a breech presentation at 41 weeks gestation (Fig. 6). She was monitored 20 hours prior to the spontaneous onset of labor and the membranes were intact. The time relationships between the contractions and the decelerations are quite constant [13] and the record was classified as positive, as the early decelerations were clearly recognizable in almost 100% of the contractions. However, the tracing might also be classified as variable based on the overall appearance and the shape of the decelerations corresponding to contractions 1, 7, 8, 10 [11, 12]. At birth one loop of cord was wound round the fetal neck. The infant weighed 3200 grams and the APGAR score was 8, 9 and 9 at 1, 2 and 5 minutes.

In the foregoing examples all of the infants were delivered in good condition and the early decelerations could be considered as "innocuous". In the fourth example (Fig. 7) a pattern of early deceleration was seen, but in this instance the fetus died in utero. The tracing was obtained at 42nd week

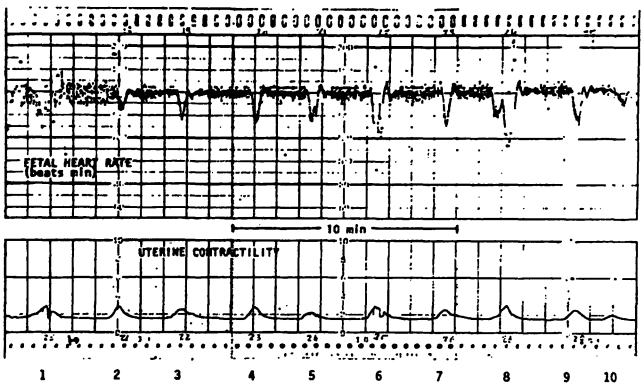

Fig. 7. Ominous evolution of a non variable pattern of type I dips. Tracing obtained at the 42nd week of amenorrhea. Intact membranes and unengaged head. Cervical dilatation absent. The pattern was erroneously interpreted as a consequence of fetal head compressions. The fetus died in utero two days later. Newborn's weight 4100 g. Two loops of the umbilical cord were tightly wounded around the fetal neck. Tracing classified as "positive".

of pregnancy. The membranes were intact, the cervix was closed and the head was not engaged. This tracing was obtained two days before completing the 42nd week of pregnancy. It was interpreted as early deceleration, erroneously attributed to fetal head compression, although this was very unlikely. A mild fetal tachycardia with a baseline

rate of 160 beats per minute was overlooked. Because of these apparent "innocuous" early decelerations the pregnancy was allowed to proceed to complete the 42nd week. Unfortunately, the fetus died 48 hours later. At birth two loops of the umbilical cord were found tightly wound around the fetal neck.

4 Discussion

The results presented in this paper demonstrate that early decelerations, either alone or combined with transient accelerations of FHR and following variable or non-variable patterns were significantly present in cases in which the umbilical cord was likely to be compressed. It is unlikely that these decelerations could be attributed to fetal head compressions, since the membranes were intact and the head not engaged. The alternative explanation for them is cord compression.

Several authors [1, 4, 5, 8, 11, 12, 13, 15, 19, 22] have postulated that uterine contractions may slow down the fetal heart rate by three different pathways: a) producing a generalized fetal hypoxia by interfering with the maternal circulation to the placenta; b) increasing fetal intracranial pressure; c) compressing the umbilical cord. Mechanisms b) and c) are summarized in Fig. 8. Both compression of the fetal head and the occlusion of the umbilical cord can produce an early slowing of the FHR, since only a few seconds elapse between the onset of the stimulus (contraction), the vagal discharge and consequent fetal bradycardia. If the occlusion is of short duration, the FHR will rapidly recover to the baseline level. It is therefore reasonable to conclude that a brief period of cord occlusion could produce early decelerations of short duration (type I dips) (Fig. 8, "rapid FHR fall"). The cord occlusion may, in addition, decrease the fetal heart rate following a slower pathway when the cord compression lasts long enough to produce generalized fetal hypoxia (see Fig. 8, "slow FHR fall"). From experiments in the fetal lambs, BARCROFT [2] proposed that pathways were additive. The early and precipitous slowing of the FHR following complete occlusion of the cord was due to a vagal reflex. If the occlusion persisted the bradycardia would continue as a consequence of a generalized fetal hypoxia, further vagal stimulation and depression of the fetal myocardium.

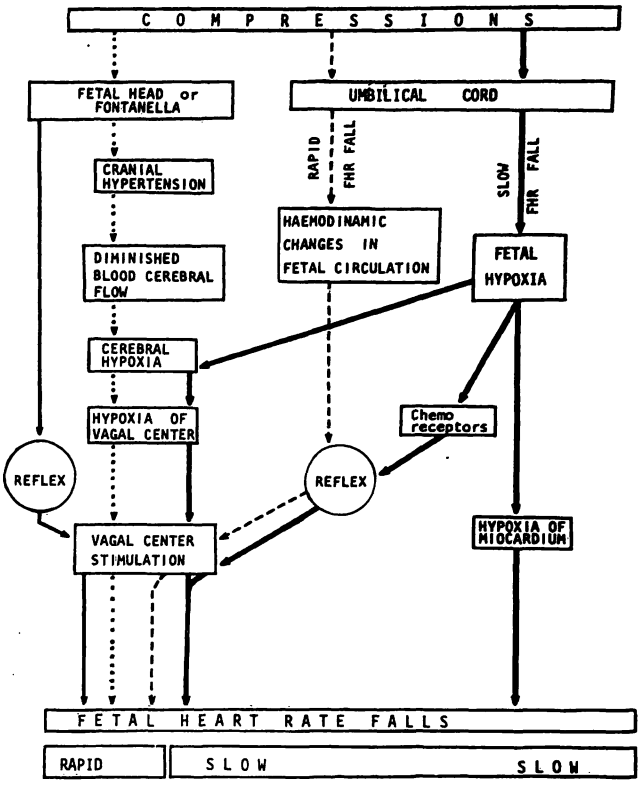

Fig. 8. Pathophysiological mechanisms of fetal heart rate falls produced by the compression of 1) fetal head or 2) umbilical cord. Both compressions may produce a rapid fall in fetal heart rate, via a stimulation of the vagal center. Two pathways (dotted and discontinued lines) may produce rapid fetal heart rate falls (early decelerations or type I dips). The umbilical cord compression if more prolonged, may also produce a slow fetal heart rate fall by a generalized fetal hypoxia (thick continuous line). A rapid fall in fetal heart rate can be thus obtained either by a compression of fetal head or by a short-lasting compression of the umbilical cord. (Modified from G. Arellano-Hernandez et al. [1]).

For these reasons, the Montevideo's group interpreted the prolonged FHR decelerations often seen accompanying cord compressions in the human fetus as the eventual contribution of these two components: 1) a purely reflex one (the type I dip or rapid component), and 2) a hypoxic one (the type II dip or slow component) (see Fig. 8) [1, 5]. This interpretation has some experimental support in humans (see Fig. 2) [1, 11, 12, 13].

In clinical obstetrics the conditions that allow for compression of the umbilical cord during uterine

contractions may vary from one contraction to another, particularly if both the fetus and the cord are mobile. Consequently, both factors, the reflex and the hypoxic, may combine to different degrees during successive contractions. This could account for the variable appearance of the cord compression pattern, as described by HON [11, 13]. However, if the cord is relatively fixed, such as being wound twice around the fetal neck, uniform uterine contractions will produce a uniform degree of occlusion with each contraction and a constantly repeated (or non-variable) pattern will result [5].

The characteristics of the early decelerations in FHR which we have observed suggest the presence of two conditions: 1) the uterine contractions occluding the umbilical cord for brief periods; this would explain the relative absence of the hypoxic slow component (late deceleration) and the presence only of the rapid reflex component (early deceleration in Fig. 2); 2) the physical relationships between the cord and some fetal or maternal part being constant, particularly if the cord was around the neck, with successive contractions, a similar degree of cord occlusion would occur. This could account for the regularly recurring early deceleration in our records. The clinical state of our patients was consistent with the presence of both of these conditions. The small regularly occurring contractions would have occluded the fixed cord repeatedly for short periods.

Our study has indicated a number of patterns which fit the category of early deceleration. A more detailed examination of these patterns is needed if potential hazards are not to be overlooked. A useful early indication is the transient acceleration of the heart rate occurring either before or after the deceleration (Fig. 1, A, C, D). This can be explained by partial occlusion of the umbilical cord [8, 9, 10]. JAMES and co-workers have recently demonstrated experimentally that partial occlusion of the umbilical cord can produce a cardiac acceleration of this type even without any deceleration occurring, and have proposed that it be an early warning sign of cord entanglement [14].

In interpreting the three generally accepted fetal heart rate patterns – early, variable, and late deceleration – errors are most frequently made in distinguishing between early deceleration due to compression of the fetal head which is benign and early deceleration due to compression of the cord. While the general classification into three major heart rate patterns has been useful, it is also an oversimplification. Variable deceleration, diagnostic of cord occlusion, is defined as having "a variable time of onset, recovery and/or wave form". This definition applies primarily to those cases where the cord is mobile and will be compressed irregularly. It does not take into account those cases when the cord is relatively fixed, such as round the neck, where it is susceptible to be compressed regularly and repeatedly with each uterine contraction. Under these circumstances the decelerations will not be variable in time of onset nor in recovery. Although it is difficult in retrospective analysis to be certain of the cause and effect relationship between cord complications and fetal death, our retrospective analysis is in agreement with that of OTT [16] in which umbilical cord complications accounted for 23% of stillbirths. As long as early decelerations are always interpreted as being due to head compression and are therefore "innocuous" or "benign", the potential hazard of a severe cord occlusion later during the course of labor will be overlooked.

5 Conclusion

Early decelerations occurring when compression of the fetal head is unlikely, often reflect cord compression [5]. If recorded prior to labor, such decelerations are often disregarded [6, 7, 18] either because they are considered just as a sign of fetal head compression or because most of the pre-labor monitoring is at present devoted to the diagnosis of latent fetal distress [17].

From a clinical viewpoint the diagnostic significance of early decelerations should include the possibility of umbilical cord compression. They could then serve as an important warning of impending fetal difficulty which could lead to prevention of fetal death or damage.

Summary

Cord complications accounted for 62% of the fetal deaths that occurred in the Maternidad Santa Cristina in a period of about 2 years.
Prelabor monitorings were then performed, in order to prove whether the early diagnose of cord complications patterns could contribute to reduce the incidence of antepartum fetal deaths.
As indicative of cord compression, it was decided to consider not only the variable pattern, but also, the early decelerations or type I dips, in those cases in which the obstetrical conditions were such as to minimize the possibility of fetal head compressions during uterine contractions.
The prelabor monitoring tracings obtained during a six month period were selected to fulfill the following conditions: 1) intact membranes, 2) normal amount of amniotic fluid, 3) unengaged vertex or breech presentations and 4) no cervical dilatation. These conditions were requested to diminish the likelihood of fetal head compressions during uterine contractions.
The resulting group of 45 monitored patients was then classified according to the presence or absence of the umbilical cord complications at birth.
Fetal heart rate tracings were analyzed looking for early decelerations or type I dips [5, 11, 13]. Tracings showing the typical variable deceleration pattern [11] were excluded for this study.
Type I dips or early decelerations were defined by the lagtime elapsed between the nadir of the FHR deceleration and the cenit of the corresponding contraction (± 18 seconds).
The tracings were classified in two groups: "positive", those having three or more early decelerations in the 15 recorded uterine contractions and "negative", those who have no type I dips. Examples of positive tracings are shown in Figs. 3, 4, 5, 6 and 7.
In the group of 45 fetuses thus selected, it was found an association between the presence of early decelerations and complications of umbilical cord at birth (Tab. I). Falses positives and negatives were not frequent. The association resulted statistically significant.
These type I dips appeared either isolated or following a non-variable pattern.
The 124 early decelerations recorded showed different shapes and variable degrees of combination with transient fetal heart rate accelerations. The most common models found are shown in Fig. 1.
Our findings demonstrate that early decelerations are reflecting cord compressions, when they occur in the absence of fetal head compressions [5]. The most convenient way of identifying them has been their lagtime. They may appear occasionally (Fig. 3) or following a non-variable pattern (Fig. 4, 5, 6), if the relationships between the cord and fetal or maternal parts remain constant. They may combine with transient accelerations of FHR, (Fig. 1).
Decelerations produced by fetal head compression and by brief umbilical cord occlusions, have probably a common vagal mechanism (Fig. 8); for this reason, they may have a similar shape, provided cord occlusion does not last long enough as to develop a generalized fetal hypoxia.
If recorded prior to labor early decelerations are often disregarded [6, 7, 18], either because they are considered just as a sign of head compression, or because prelabor monitoring is mostly intended to diagnose latent fetal distress [17].
But, from a clinical viewpoint, one should recall that the diagnostic significance of early decelerations includes the compression of the umbilical cord. They could then serve as an important warning of impending fetal difficulty which should lead to prevent fetal death or damage.

Keywords: Cord complications, decelerations, fetal heart rate, accelerations, type I dips, umbilical cord complications, umbilical cord occlusion, variable pattern of fetal heart rate.

Zusammenfassung

Frühe Akzelerationen der fetalen Herzfrequenz bedingt durch Nabelschnurkompression

Während eines Zeitraumes von 2 Jahren waren Nabelschnurumschlingungen in 62% aller fetalen Todesfälle, die in der Santa Christina Klinik zur Beobachtung kamen, ursächlich im Spiele. Daraufhin haben wir antepartuale Kardiotokogramme geschrieben, um zu überprüfen, ob das Früherkennen von Nabelschnurkomplikationen geeignet ist, die Häufigkeit antepartualer Todesfälle zu reduzieren. Als Hinweis für eine Nabelschnurkompression wurde nicht nur die variable Dezeleration sondern auch die Frühdezeleration bzw. der dip I gewählt, letzteres erfolgte in jenen Fällen, in denen die geburtshilfliche Situation so war, daß die Wahrscheinlichkeit einer fetalen Kopfkompression während einer Wehe minimal erschien. Die antepartualen Kardiotokogramme, die während einer Periode von 6 Monaten registriert worden waren, wurden aufgrund folgender Bedingungen ausgewählt:
Intakte Fruchtblase, normale Fruchtwassermenge, hochstehender vorangehender Teil (Steiß oder Kopf), erhaltene Zervix.
Aufgrund dieser Bedingungen erschien die Wahrscheinlichkeit einer fetalen Kopfkompression während der Wehe deutlich verringert. Die verbleibende Gruppe von 45 überwachten Patientinnen wurde nun nach dem Vorliegen bzw. dem Fehlen von Nabelschnurkomplikationen bei der Geburt aufgeteilt. Die Kardiotokogramme wurden durchgesehen im Hinblick auf Frühdezelerationen bzw. dip I [5, 11, 13]. Antepartuale CTG's mit dem typischen Bild der variablen Dezelerationen [11] wurden in dieser Studie nicht berücksichtigt. Dip I oder Frühdezelerationen wurden nach der lagtime definiert, d. h. jener Zeit, die gemessen wird zwischen dem Tiefpunkt der Dezelerationen und dem Hochpunkt der Wehe (± 18 sec). Die CTG'c wurden in zwei Gruppen eingeteilt "positive" d. h. jene, die drei oder mehr frühe Dezelerationen während der

15 registrierten Wehen zeigten und "negative" d. h. jene, bei denen keine dip I beobachtet wurde. Beispiele von positiven Kardiotokogrammen sind in **Abb. 3, 4, 5, 6 und 7** wiedergegeben. In der Gruppe der 45 so ausgewählten Feten fand sich eine **Beziehung zwischen dem Auftreten von frühen Dezelerationen und der Häufigkeit von Nabelschnurumschlingungen bei der Geburt (Tab. I).** Es gab wenig falsch-positive und -negative Beobachtungen. Die Beziehung war statistisch signifikant. Diese dip I traten entweder isoliert auf oder folgten auf ein nicht variables Dezelerationsmuster. Die 124 beobachteten Frühdezelerationen zeigten verschiedene Formen und in unterschiedlichem Umfang auch Kombinationen mit vorübergehenden fetalen Herzfrequenzakzelerationen. Die häufigsten Frequenzmuster sind in Abb. 1 wiedergegeben. Unsere Beobachtungen belegen, daß Frühdezelerationen ein Hinweis auf Nabelschnurkompression sind, wenn sie in Abwesenheit einer fetalen Kopfkompression auftreten [5]. Die einfachste Art sie zu erkennen war bisher ihre lagtime. Sie können zufällig auftreten (Abb. 3) oder im Gefolge nicht variabler Frequenzmuster (Abb. 4, 5 und 6). Vorausgesetzt, daß die anatomische Beziehung zwischen der Nabelschnur und dem fetalen bzw. mütterlichen Körperteil konstant bleibt. Sie können zusammen mit vorübergehenden Akzelerationen der fetalen Herzfrequenz einhergehen (Abb. 1). Möglicherweise haben die durch fetale Kopfkompression und kurze Nabelschnurokklusion hervorgerufene Dezelerationen einen gemeinsamen, vagalen Entstehungsmechanismus (Abb. 8). Dies mag ihre ähnliche Erscheinungsform erklären, vorausgesetzt, daß die Nabelschnurverlegung nicht so lange dauert, daß sich eine generalisierte fetale Hypoxie daraus entwickelt. Frühdezelerationen, die vor Einsetzen der Wehen auftreten, werden häufig wenig beachtet [6, 7, 8]. Sei es, weil sie nur als Zeichen einer Kopfkompression aufgefaßt werden oder sei es, weil in der antepartualen Kardiotokographie vorwiegend das Erkennen einer chronischen fetalen Hypoxie im Vordergrund steht [17]. Aus klinischer Sicht sollte doch daran erinnert werden, daß die prognostische Bedeutung von Frühdezelerationen eine Nabelschnurkomplikation mit einschließt. Sie dienen dann als Warnsymptom für intrauterine fetale Schwierigkeiten und sollten beitragen, den intrauterinen Fruchttod und den fetalen Zerebralschaden zu vermeiden.

Schlüsselwörter: Akzeleration, Dezeleration, dip I, Herzfrequenz (fetale), Nabelschnurkomplikationen, Nabelschnurkompression, Nabelschnurumschlingung.

Résumé

Décelerations précoces de la fréquence cardiaque du foetus conséquentes a l'occlusion du cordon ombilical.

62% des morts foetales enregistrées à la Maternidad Santa Cristina sur une période de deux années environ ont été dûes à des complications du cordon ombilical. A la suite de cela, on a décidé d'effectuer des enregistrements antérieurs au travail de l'accouchement afin d'établir si le diagnostic précoce de complications ombilicales types pourrait aider à réduire l'incidence des morts foetales ante partum.

Pour cela on a déterminé comme indicateurs de compression ombilicale non seulement le modèle variable, mais aussi les décélérations précoces ou les dips de type I dans les cas où les conditions obstétriques réduisaient au minimum l'éventualité de compressions de la tête du foetus pendant les contractions utérines.

Les courbes enregistrées lors des observations antérieures au travail pendant une période de six mois ont été sélectionnées selon les critères suivants: 1) membranes intactes, 2) volume normal de liquide amniotique, 3) vertex non engagé ou présentations par le siège, 4) absence de dilatation cervicale. Ces conditions ont été requises pour diminuer la probabilité de compressions crâniennes foetales pendant les contractions utérines.

Les résultats du groupe des 45 parturientes ayant rempli ces conditions ont été classés ensuite selon qu'il y a eu ou non des complications du cordon ombilical au moment de l'accouchement.

Les courbes de la fréquence cardiaque du foetus (FCF) ont été analysées en vue de déceler des décélérations précoces ou des dips de type I [5, 11, 13]' On a éliminé pour cette étude les courbes du modèle de décélération variable typique [11].

Les dips de type I ou décélérations précoces ont été définis par le lagtime écoulé entre le nadir de la décélération de la FCF et le zénith de la contraction correspondante (± 18 secondes).

Les courbes ont été classées en deux groupes: «positif» pour celles témoignant 3 ou plus de décélérations précoces dans les 15 contractions utérines enregistrées et «négatif» pour celles ne montrant aucun dip de type I. Les **Fig. 3, 4, 5, 6 et 7** montrent des exemples de courbes positives.

Dans le groupe des 45 foetus ainsi sélectionnés on a pu **constater un rapport entre la présence de décélérations précoces et les complications du cordon ombilical à la naissance (Tab. I).** Les erreurs positives et négatives ont été rares et ces rapports se sont révélés d'une importance statistique certaine.

Ces dips de type I se sont manifestés isolément ou selon un modèle invariable.

Les 124 décélérations précoces enregistrées ont montré des formes différentes et des degrés variables d'association avec des accélérations momentanées de la FCF. Les modèles les plus courants que nous avons pu observer sont exposés fig. 1.

Nos résultats prouvent que les décélérations précoces reflètent les compressions ombilicales en l'absence de compressions crâniennes foetales [5]. Le moyen le plus approprié de les identifier a été d'observer leur lagtime. Elles se manifestent soit par intervalles (fig. 3), soit selon un modèle invariable (fig. 4, 5, 6) lorsque les rapports entre le cordon et les organes foetaux et maternels restent constants. Elles peuvent se produire en corrélation avec des accélérations transitoires de la FCF (fig. 1).

Les décélérations produites par la compression crânienne foetale et par les occlusions brèves du cordon ombilical

relèvent probablement d'un même mécanisme vase-moteur (fig. 8), ce qui peut leur conférer une forme identique si l'occlusion ombilicale est suffisamment brève pour ne pas provoquer une hypoxie foetale généralisée.
Si les décélérations précoces enregistrées avant le travail ne sont bien souvent pas prises en considération [6, 7, 18], c'est soit qu'elles apparaissent uniquement comme un signe de compression crânienne, soit que les observations effectuées avant le travail visent surtout à diagnostiquer un distress foetal éventuel [17].
Mais, d'un point-de-vue clinique, il est bon de rappeler que le diagnostic des décélérations précoces inclut aussi les compressions du cordon ombilical et, qu'en conséquence, il peut servir d'avertissement important de difficulté foetale imminente obligeant à prendre des mesures préventives contre la mort ou les lésions foetales.

Mots-clés: Accélérations de courte durée, complications du cordon ombilical, décélérations précoces, diagnostic de complications ombilicales, dips de type I, frequence cardiaque foetale, modèle variable de la fréquence cardiaque foetale, occlusion du cordon ombilical.

Acknowledgement

This research has been partially sponsored by a grant from the SEREM (Servicio de Recuperacion de Minusvalidos, Ministerio de Trabajo, Spain).

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Received June 13, 1976. Revised February 27, 1977. Accepted August 20, 1977.

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