EL FETO EN EL MEDIO INTRAUTERINO

Supervision of the fetus during late pregnancy and during labor, scoring of the newborn immediately after delivery. Recent organisatoric and methodic aspects.

DR. ERICH SALING

The aim of modern antenatal care is to recognise any irregularities as early as possible, so that prompt and appropriate measures can be taken for the protection of mother and child. The particular purpose of monitoring of the fetus is not merely to attain a live infant, but to ensure that the newborn is in the best possible health condition. To avert the greatest danger — intrauterine and postnatal hypoxia and its irreversible sequelae — the obstetrician must pay attention to every warning sign of a possible threat to the fetus.

Naturally the necessary diagnostic equipment exceeds that of the stethoscope era in obstetrics; results which can be expected however, justify such intensive use.

At the present time — at least in my country — not every even normal looking pregnancy can be supervised at short intervals, once a week for instance, and not all deliveries can be monitored continuously apparatively and biochemically; this is due to the rather high expense on time and on diagnostic equipment. Therefore it is necessary to settle on a compromise.

Even primarily normal looking preanancies should be controlled not too seldom. In our view 15 consultations seem to offer a useful approach to the question of how often a woman should attend her doctor during pregnancy (22). The frequency and the interval between consultations during the course of pregnancy can easily be reminded by our newly recommended 4-finger-rule (Fig. 1). The first 4 months every 4 weeks, the next 3 months every 3 weeks, the next 2 months every second week and the last months every week.

In this way the totality of all pregnant women has to be covered almost completely. Then, at the first consultation or according to the development of symptoms during the following consultations, a selection of all cases with an increased risk for the mother or for the child must be carried out; the basis for this selection is a catalogue of risk factors. The adequate diagnostic procedure and, if necessary, therapeutic measures then have to be carried out on this selected group of high risk patients.

Often there is doubt on the question whether fetal and neonatal mortality really is confined predominantly to this high risk collective.Still the old but widely accepted opinion seems to prevail, that fetal death often is a sudden event without preceding warning symptomes; therefore early diagnosis before the fatal event is often impossible.

Together with WAGNER (23), we searched in 300 perinatal deaths for preexisting factors indicating an increased risk for the fetus and the newborn. In 1% of the cases only, that is in two infants, death occured without any previously detectable risk symptoms. One fetus died ante partum by a cord complication — (cord around the neck) — as could be seen afterwards; the other infant died on the third day post partum due to food aspiration.

INTERVAL BETWEEN CONSULTATIONS IN NORMAL PREGNANCIES

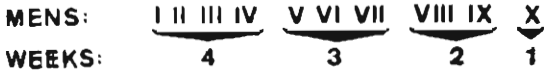


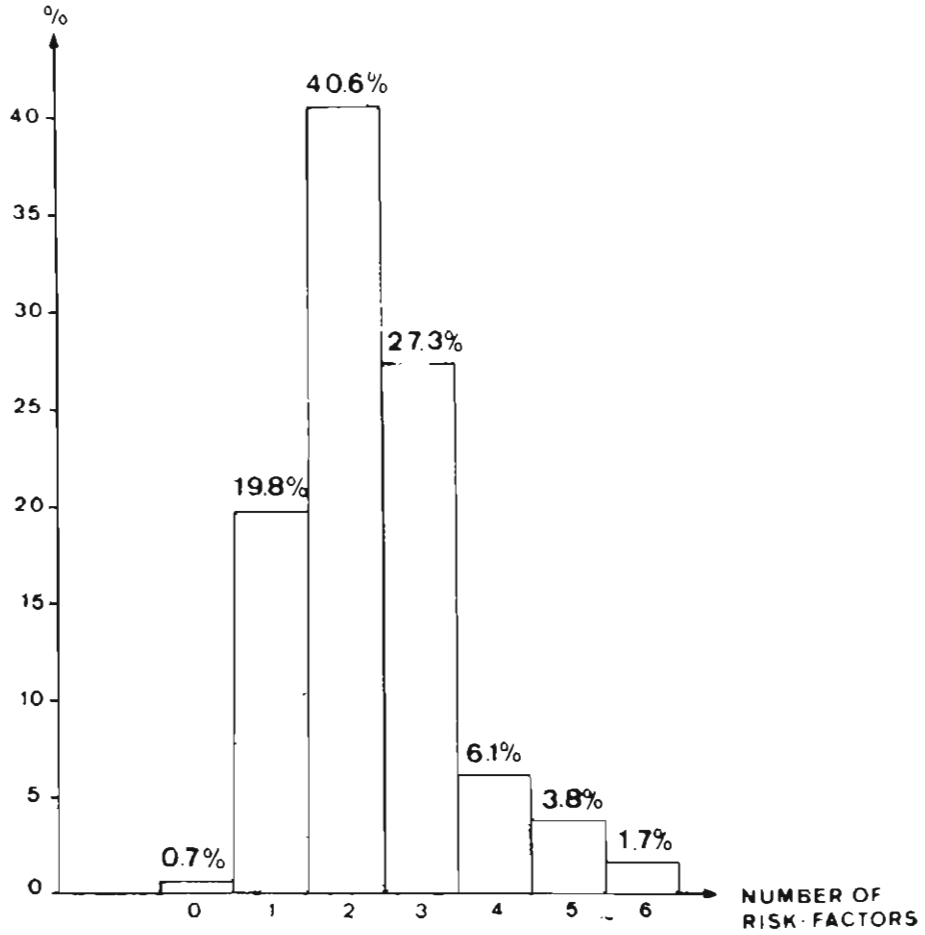
Fig. 1

As you may see from Fig. 2 in 40.6% there were two and in 38.9% even three and more ante partum detectable risk symptomes. The distribution of the frequency of the different risk symptomes is demonstrate in Fig. 3. This is, at the same time and according to our experiencies, the catalogue of main risk symptomes.

One of the most important measures for the lowering of perinatal mortality is the intensive supervision of high-risk pregnancies. Here, special care has to be taken for the diagnosis of intrauterine hypoxia in order to begin as early as possible therapeutic or further diagnostic measures.

Supervision of the high-risk fetus during late pregnancy.

For the supervision of high risk fetuses endangered by hypoxia, predominantly amnioscopy is employed during the last 4-6 weeks of pregnancy. The principle of amnioscopy is the introduction of a cone-



FREQUENCY OF RISK-FACTORS IN 293 PREGNANCIES WITH 300 CHILDREN WHO DIED IN THE PERINATAL PERIOD

Fig. 2

FREQUENCY OF THE DIFFERENT RISK FACTORS IN 293 MOTHERS OF 300 CHILDREN WHO DIED IN THE PERINATAL PERIOD

K.WAGNER E.SALING

risk-factor	ante partum deaths n 75	sub partu deaths n 16	post partum deaths n 202	number of all perinatal deaths with the corresponding risk-factor
symptoms of toxemia	41	8	92	141 = 48.1%
primipara <20 years or ≥30 years pluripara ≥40 years multipara ≥V para	34	10	92	136 = 46.4%
suspicious obstetric history: ≥2 abortions	11	4	66	133 = 45.4 %
suspicious obstetric history: stillbirth	6	2	7	
suspicious obstetric history: previous premature birth	4	–	17	
suspicious obstetric history: previous caes.section	5	2	1	
suspicious obstetric history: other	–	–	8	
bleeding in the 2nd half of pregnancy	11	4	41	56 = 19.1 %
breech	10	7	35	52 = 17.7 %
suspected prematurity	6	3	25	34 = 11.6 %
diabetes mellitus: clinical	3	–	1	26 = 8.9%
diabetes mellitus: anamnestic clue	6	3	13	
organic diseases	9	–	16	25 = 8.5%
severe maternal anemia	6	2	12	20 = 6.8%
obesity	4	3	9	16 = 5.5%
morbus haemol. fetalis / neon.	4	1	9	14 = 4.8 %
twin pregnancy	–	2	10	12 = 4.1%
disproportion between uterine size and duration of pregnancy	2	1	9	12 = 4.1%
cervical insufficiency	–	–	9	9 = 3.1%
amnioscopical meconium stained liquor	3	1	1	5 = 1.7%
suspected infectious disease of the mother	–	–	2	2 = 0.7%
no risk-factors	1	–	1	2 = 0.7%

Fig. 3

shaped tube into the cervical canal in order to observe the amniotic fluid through the transparent membranes. Positive results are meconium stained (greenish) amniotic fluid, oligohy-dramnios or absence of liquor.

The passage of meconium is an early warning symptom (Fig. 4); so occurs in only 1.7% of the amnioscopically supervised fetuses with positive amnioscopic findings, as light metabolic acidosis can be detected by fetal blood analysis.

half thousand (8.569) women. The total number of birth during this period was about twenty five thousand (25.602). After subtractions of 60 cases where amnioscopy was performed for the additional diagnosis of intrauterine fetal death, and further subtraction of 332 cases in which amnioscopy has been performed for suspicion of premature rupture of the membranes, there remain 8.177 cases or 32% of all pregnancies where amnioscopy was done for the supervision of high-risk

PH OU 40	SUSPECTED CASES OF POSTMATURITY	CASES OF MATERNAL TOXEMIA	SUSPECTED CASES OF POSTMATURITY AND TOXEMIA	ALL CASES
below 7,15	-	-	-	0 = 0 %
7,15 - 7,19	2	-	1	3 = 1,7 %
7,20 - 7,24	3	5	4	12 = 6,8 %
7,25 and more	34	111	16	161 = 91,5%
total	39	116	21	176 = 100 %

Fig. 4

The therapeutic consequences out of a positive amnioscopic finding is, that the membranes should be ruptured to start the labor and to allow the determination of the fetal acidity by means of fetal blood analysis. The result of this biochemical evaluation of the fetal condition is the basis for adequate decisions for further measures. The main task of this biochemical evaluation is the decision whether a spontaneous delivery can be expected or whether an operative termination of labor is indicated.

From 1961 until 1970, according to a survey in cooperation with DUDENHAUSEN (4) about twenty three thousand (23.533) amnioscopies were performed in eight and

fetuses due to hypoxia. From the supervised collective, 105 children died within the perinatal period, that is the time which covers the last weeks ante partum, the labor itself and the first 7 days of extrauterine life. This is a percentage of 1.3%, a satisfactory result within the high-risk collective. This evaluation represents the largest mortality statistics in connection with amnioscopy published by far.

Besides amnioscopy, the cardiotokography has got some importance in the early diagnosis of imminent hypoxia due to placental insufficiency, especially the load test by physical exercise or — even more simple — after artificial inducing of contractions with oxytocin.

This type of diagnosis has by far not undergone enough testing as amnioscopy. The judgment about the effectiviness of this procedure therefore can not be called as definite.

Together with DUDENHAUSEN (5) we controlled 64 cases with amnioscopically detected meconium stained amniotic fluid by cardiotokography. The condition was that in all these cases uterine contractions were present, induced either by the previous performed amnioscopy or artificially induced by small dosis of oxytocin. The results are presented in Fig. 5. It seems to be true that in fetuses with both pathological symptoms a) meconium passage and b) late decelerations the incidence of cases with marked acidosis — this means group A II and AI — is higher than in cases in which only meconium passage could be observed, but no late decelerations. On the other hand we found, as it can be seen in the lower part of the table, in the group without late decelerations — This means no reactions of heart-rate to the contractions — three cases, thus 6%, with marked acidosis.

From these preliminary results we can draw the conclusion that cardiotokography as a single used method seems not to be more reliable than amnioscopy. Cardiotokography used in late pregnancy after induction of contractions gives additional informations or can be to a certain degree a compensatory method for cases in which neither amnioscopy nor amniocentesis is performable.

Besides the procedure for the diagnosis of intrauterine hypoxia, attention today is payed to the question of fetal malnutrition.

On one hand it is known that late damages in children may also result from fetal malnutrition. On the other hand through the working group of MANZANILLA and coworkers from Mexico (13) and from our own results —this work has been started independently (21)— new aspects of artificial intrauterine nutrition by injec-

		NUMBER OF CASES	FIRST FBA		STATE OF THE NEWBORN				DELIVERY	
					CLINICAL SCORE[1]		pH umb. art[2]			
			≥7.25	≤7.24	≥ 7	< 7	A V+IV	A III-I	spont.	operat
N = 64	WITH ALARM DIPS	13	13	Ø	11	2	10	3 (1=A III, 1=A II, 1=AI)	10	3
	WITHOUT	51	51	Ø	42	9	43	8 (5=AIII, 3=AII, 0=AI)	37	14

(1) In our modified scoring system 0-6 points are representing a depression
(2) A V - IV = pH ≥7.2, A III = pH 7.19 - 7.10, A II = pH 7.09 - 7.0, AI = pH < 7.0

Cases with amnioscopically detected meconium stained amniotic fluid dependent from presence or absence of alarm dips (= dip II, late or variable deceleration), the results of first fetal blood analysis, state of the newborn immediately after delivery and kind of delivery.

Fig. 5

tion of nourishing solutions into the amnion have been shown.
For the diagnosis of fetal malnutrition, the determination of Oestriol excretion as well as the cephalometry by ultra-sound are useful.

Supervision of the fetus after the onset of labor.

A correct supervision of the high-risk fetus has to begin within the first few minutes after the admission of the parturient in the hospital. Here, at this special point of the admission-procedure it comes to a loss of time in many hospitals: time consuming routine preparations, for instance shaving, enema, bathing and the usual preliminary examinations as questioning of the history, general status and the external as well as the rectal or vaginal examination. In the meantime the most important measure, the reliable evaluation of the fetal condition, remains undone until the patient is brought to the prelabor ward or into the delivery room. The exclusive ausculation and counting of the fetal heart rate with the stethoscope as a random test when the patient is admitted is insufficient and does not correspond anymore with modern aspects. Even high risk fetuses remain by this imperfect and quite common admission procedure 30 to 60 minutes practically unsupervised. This happens even in otherwise modern hospitals.
As a first measure, therefore, at least in every case at risk we suggest to perform, immediately after arrival of the patient in the hospital an "admission-amnioscopy". The main purpose of amnioscopy otherwise is the supervision of high-risk fetuses in late pregnancy. At the beginning of labor amnioscopy allows to bridge over if the amniotic fluid is clear - by far more safety than before the critical period of the admission and preparation procedure. If the admission-amnioscopy shows meconium-stained amniotic fluid the other methods for the intensive supervision have to be applied immediately. If there is no opportunity for the continuous recording of the fetal heart frequency, in these pathological cases fetal blood analysis should follow amnioscopy. Is a heart rate monitor available, provided that there are contractions, the fetal heart rate should be registered immediately. This, for instance, can take place during questioning the history. If there are no suspicious decelerations of the fetal heart frequency in connection with contractions (alarmdips) and if the baseline frequency (heart frequency between contractions) is normal, all further preparations and examinations can follow until the patient finally comes into the prelabor ward or the delivery room and the continuous monitoring begins. If the recording of the fetal heart-rate shows suspicious patterns, fetal blood analysis should follow without delay.
During labor, the most valuable techniques of fetal supervision are continuous monitoring of the heart frequency in combination with fetal blood analysis.
Continuous recording of the heart-rate has not, according to the comparisons with fetal blood pH-values proved itself as an exclusive monitoring technique. Admittedly it gives relatively early warning of intrauterine danger, but it does not provide a sufficient reliable diagnosis of hypoxia. The following heart rate patterns were considered in our department for several years as suspicious for hypoxia (Fig. 6):

1. The alarm-dip; this new term suggested by us in 1969 (19) should describe all variations of fetal heart-rate decelerations dependent on uterine contractions ("contraction reaction types"), which were regarded as suspicious. For example dip type II, late deceleration, variable deceleration.

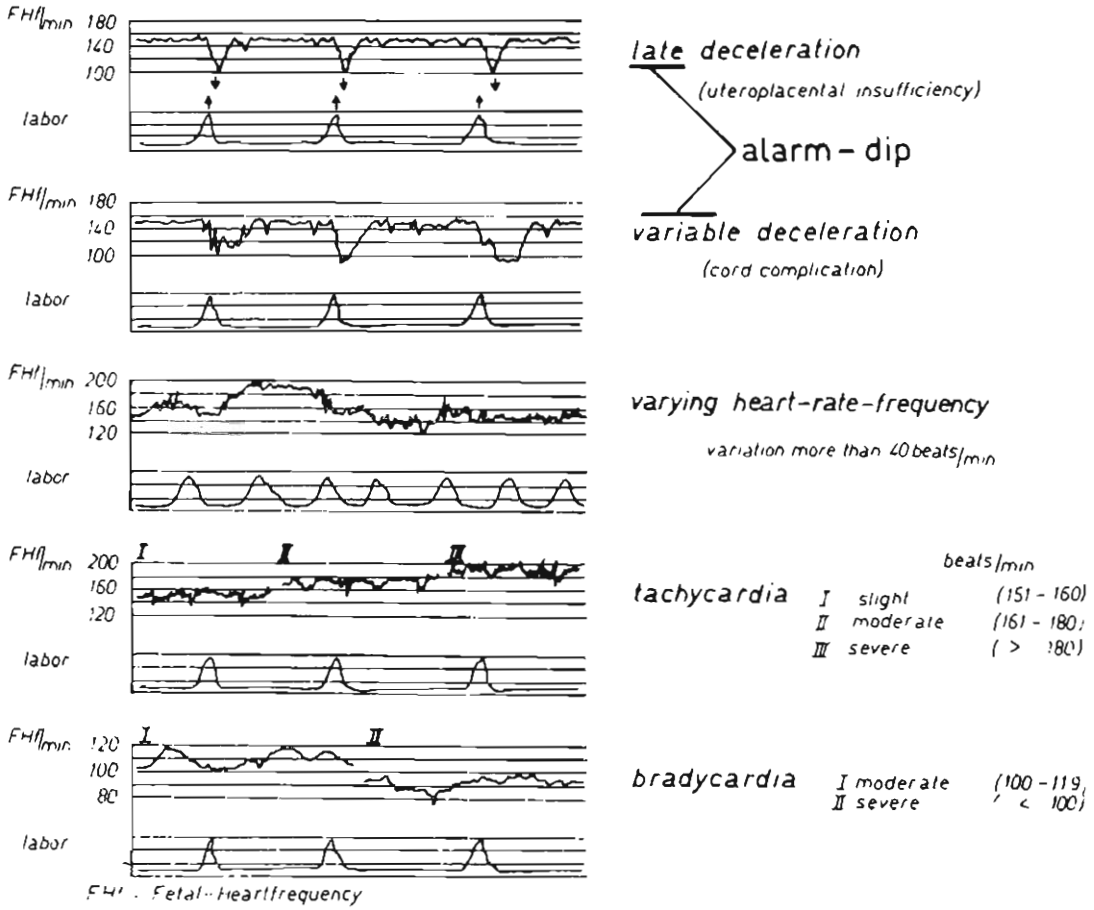


Fig. 6

2. Bradycardia, heart-frequency between contractions: 120/min.

3. Tachycardia, heart-frequency between contractions: 160/min., during: 10 min. or 150/min., duration: 30 min.

4. Alarm-dips and tachycardia.

5. Alarm-dips and bradycardia.

6. The varying heart frequency, independent from contractions. (Variations more than 40 beats/min.)

Of particular interest is a comparison between the acidity and heart-rate patterns. Such an evaluation has been performed together with IMHOF and RUDOLPH (10) on 498 fetuses at risk.
Concerning acidity we evaluated the following groups:

1. Normal acidity with pH over 7.25

2. Preacidosis pH 7.24 to 7.20 (prepathological values)

3. Acidosis pH less than 7.20 (pathological values).

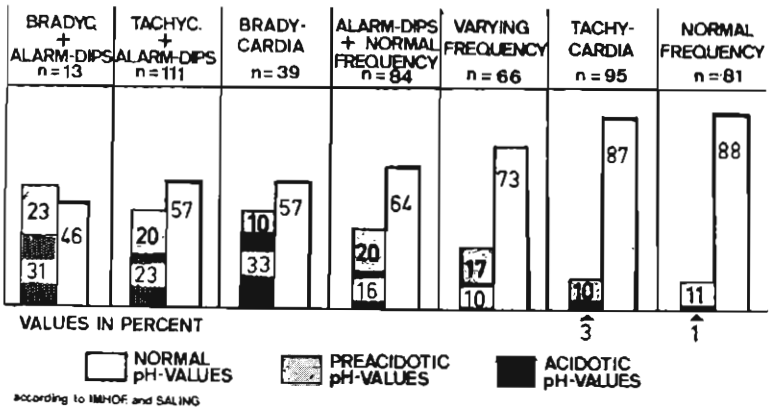


Fig. 7

From this evaluation —the results can be seen in Fig. 7— It is evident that most cases of preacidosis and acidosis, i. e. hypoxic conditions of the fetus, are to be expected when both heart frequency patterns, bradycardia and alarm-dips were present. Surprisingly high is the rate of fetuses with normal acidity in cases of suspicious heart-rate patterns, ranging from 46% to 87%. We found the lowest incidence of increased acidity when there was tachycardia without alarm-dips. So it is quite open whether it is advisable or not to perform fetal blood analysis in a case with tachycardia without alarm-dips. We have the intention to cancel this indication for fetal blood sampling.

KUBLI, HON and coworkers (12) reported 2 years ago on the results obtained in 85 fetuses: a good correlation exists between heart rate patterns (late deceleration) and fetal acidosis. If we had calculated correlation coefficient for our series, the results might have been similar. However even with a good correlation coefficient the clinical decision in the individual case is not satisfying. In the paper by KUBLI and coworkers, it is stated that acidosis was present in approximately half the cases, which means that the suspicion of hypoxia was not confirmed in the other half. These results show, as ours do, that continuous recording of the fetal heart-rate alone is not the best solution to the problem.

The cesarean section presents, today as in the past, a mortality rate for the mother approximately 10-15 times higher than spontaneous delivery. So it does not seem to be justified that labor should be terminated on principle by an operation in all cases of suspicious heart-rate patterns even if there is no hypoxia. At least one can speak of an optimal solution to the problem in this case.

Other fetal heart-rate patterns that have been discussed recently and are considered to give further information about the state of the fetus are the various types of baseline oscillation, which are classified according to their maximum amplitude during 1 min. (Fig. 8).

They were first described by the working group of CALDEYRO-BARCIA and coworkers (14), but these authors did not ascribe much importance to these patterns. HAMMACHER argued against the opinion (8) that certain oscilation types, especia-

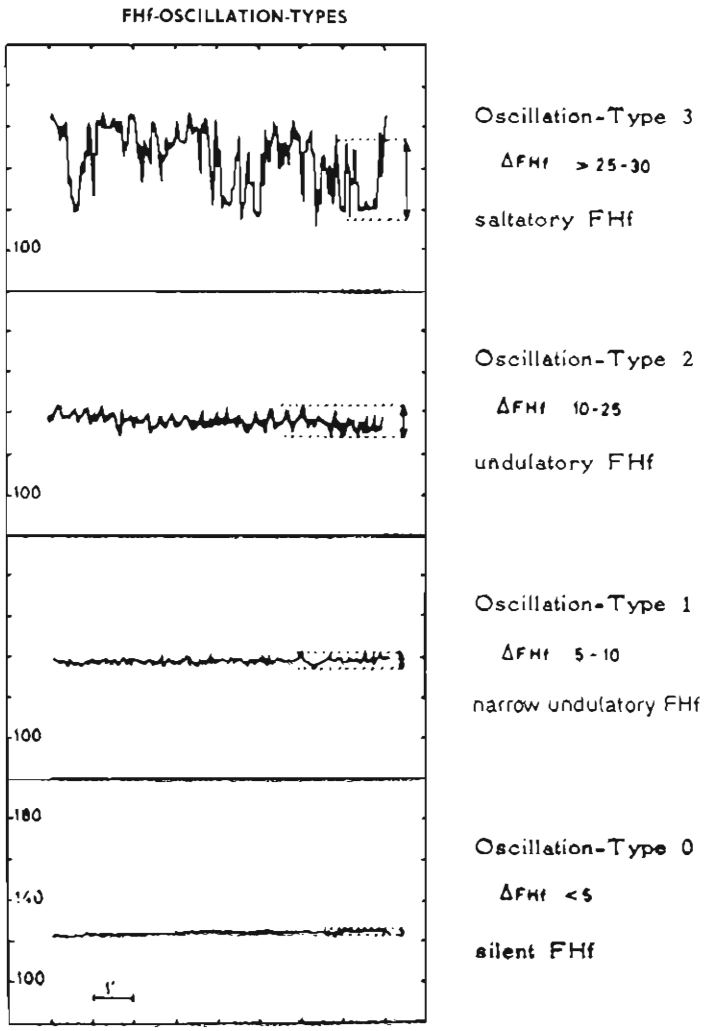


Fig 8

lly the silent and the saltatoric type, provided evidence of intrauterine danger, except when the fetus was asleep or when the autonomic nervous system was under the influence of medication. We also investigated this question (11) and compared the different oscilation types with the fetal pH. The results were the following. During alarm-dips (Fig. 9) superimposed on the various oscilation types, it was not possible to determine whether the alarm-dips were harmful or not. Even the silent oscilation type occured more often with a normal pH than with acidosis. Between contractions (Fig. 10) the various oscilation types were distributed evenly amongst the different groups according to pH, so that it was impossible to draw important conclusions concerning the state of the fetus.

Only one exception seems to be given in cases with severe bradycardia and a silent oscilation type. A recent not yet published evaluation prepared together with B. MULLER shows as it can be seen in Fig. 11 that in 26 such fetuses in 18 cases there

B. DURING ALARM-DIPS

PATTERNS OF OSCILLATION TYPES	NORMAL pH ≥ 7,25	PREACIDOSIS 7,24 - 7,20	ACIDOSIS < 7,20
SALTATORIC 5 (4 %)	5	0	0
UNDULATORIC 58 (50 %)	47 (81 %)	8 (14 %)	3 (5 %)
REDUCED UNDULATORIC 36 (31 %)	24 (67 %)	8 (22 %)	4 (11 %)
SILENT 18 (15 %)	7 (39 %)	6 (33 %)	5 (28 %)
Σ 117			

IMHOF and SALING

Fig. 9

A. BETWEEN CONTRACTIONS

PATTERNS OF OSCILLATION TYPES	NORMAL pH ≥ 7,25	PREACIDOSIS 7,24 - 7,20	ACIDOSIS < 7,20
SALTATORIC 155 (18 %)	126 (81 %)	12 (8 %)	17 (11 %)
UNDULATORIC 622 (71 %)	481 (77 %)	88 (14 %)	53 (9 %)
REDUCED UNDULATORIC 86 (10 %)	65 (76 %)	12 (14 %)	9 (10 %)
SILENT 5 (1 %)	4 (80 %)	0	1 (20 %)
Σ 868			

IMHOF and SALING

Fig. 10

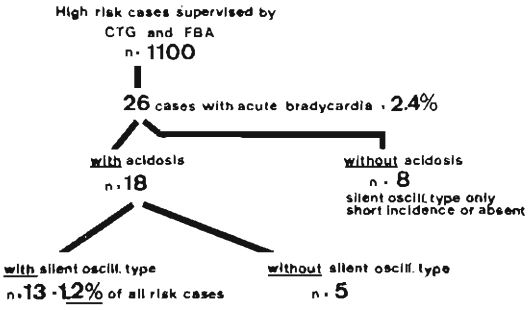


Fig. 11

could be detected a fetal acidosis and in 13 of them both, acidosis and silent oscilation type. From 8 cases without acidosis silent oscilatior was either in 5 cases only of a short incidence, or in 3 cases absent. Our clinical conclusion is, that in such cases with a combination of severe bradycardia and silent oscilation type, an operative termination of labor can be performed immediately without fetal blood-analysis. May I demonstrate you one such case in Fig. 12

The incidence of such cases is very low. We found in only 1.2% in a number of 1,100 high risk cases supervised by cardiotokography and by FBA. Of certain interest is also, the fact that there are sometimes cases (we found 5) with severe bradycardia, combined with acidosis but without silent oscilation type.

Another interesting question concerns the length of time required in the presence of a true hypoxic complication for fetal acidosis to occur after a suspicious heart-rate pattern has been observed (Fig. 13). These results enable us to outline the indications for fetal blood sampling when the fetal heart-rate is monitored.

Fetal blood analysis is indicated: 1. immediately after severe bradycardia (less than 100 beats/min.) occurs with or without alarmdips; 2. after 10 minutes with any other suspicious heart-rate patterns. At present the best way of a faultless recording for fetal heart rate relies on the electrocardiographic principle using a skin electrode placed on the presenting part. The pioneer for this type of registration is EDWARD HON. He is the first to have developed a scalp electrode which has become popular and which has formerly been a wound-clip (9). In the meantime HON has also developed a monitor which can be used in clinical routine. Shortly before the introduction of HON'S appa-

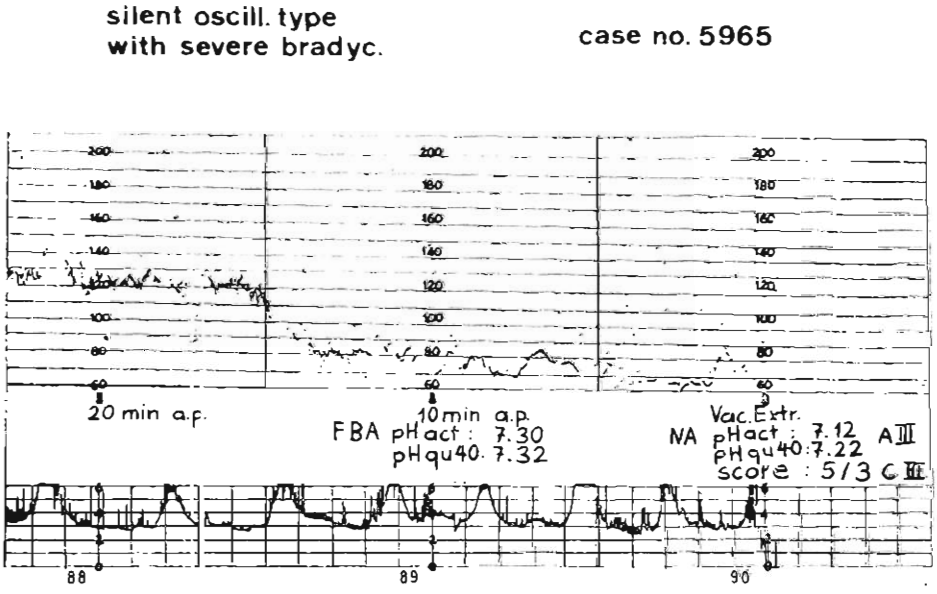


Fig. 12

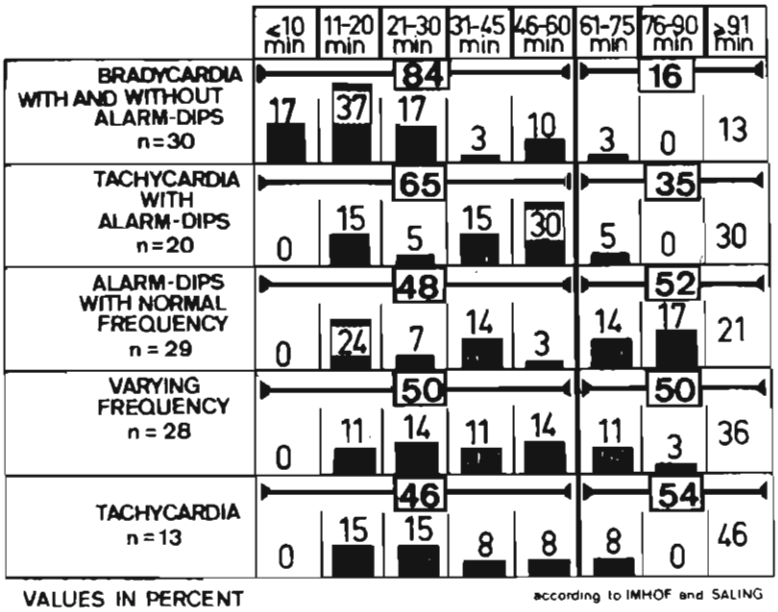


Fig. 13

ratus the cardiotokograph of HAMMACHER became available for routine clinical use. Its original concept was a phonocardiograph; thus it was based on external registration. Today it is possible to register with the cardiotokograph externally by phonocardiography and by ultrasonics as well as internally by electrocardiography. So, this apparatus form Hewlett & Packard is presently the most versatile of those tested by us and the most suitable for use in the daily clinical routine because it can be applied in every situation: externally when the membranes are still unruptured and internally after rupture of the membranes. An interesting protocol of an optimal simultaneous registration with all 3 principles on one patient can be seen in Fig. 14.

For the combined fetal surveillance by apparative heart-rate registration after rupturing of the membranes and fetal blood analysis, there was the need of a scalp electrode which did not hinder fetal blood sampling and could be removed quickly in the case of cesarean section. Two years ago we have developed a new electrode which fulfills these qualifications (17).

The needle electrode is placed simultaneously with the cathether for measuring the intrauterine pressure. This is done with the help of a funnel inserted into the endoscope for fetal blood sampling (Fig. 15). Whereas about 40% of the cases that were registered with the external cardiotokograph showed not quite sufficient results (17) the registration wtih the

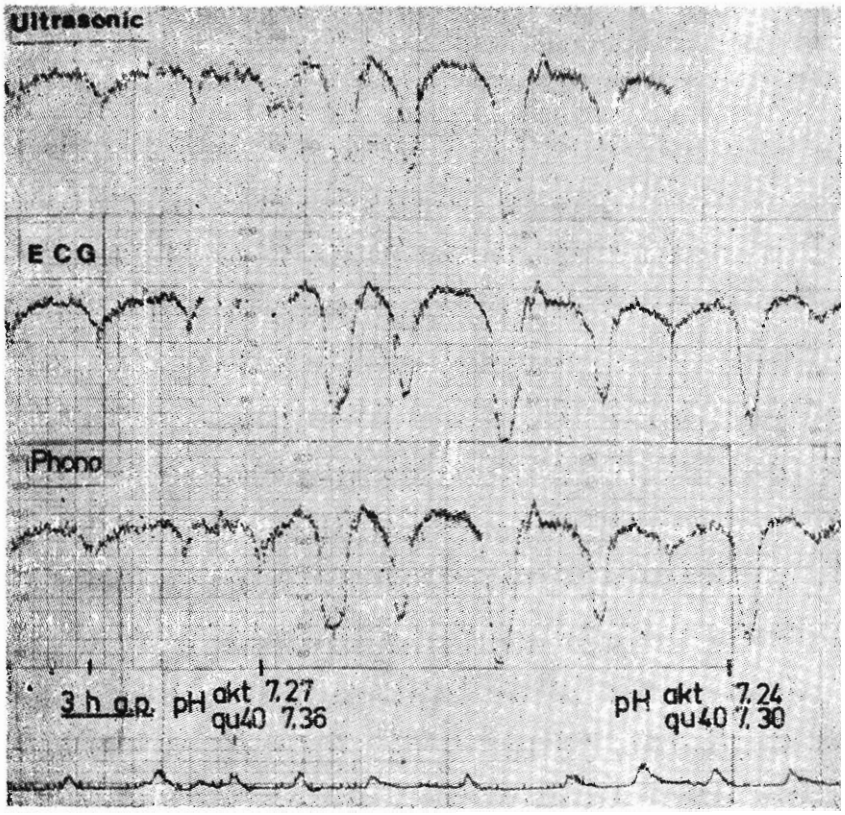

Ultrasonic
E C G
Phono
3 h a.p.
pH akt 7.27
qu40 7.36
pH akt 7.24
qu40 7.30

Fig. 14

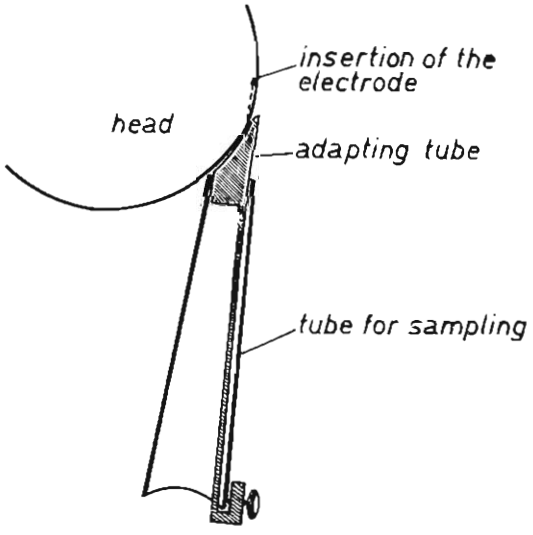

insertion of the electrode
head
adapting tube
tube for sampling

Fig. 15

help of the scalp needle-electrode is in more than 90% sufficient.
The advantages of fetal heart-rate monitoring and fetal blood analysis augment each other when used simultaneously (Fig. 16).

CRITERIA	APPARATIVE FETAL-HEART-RATE CONTROL	F B A
CONTINIOUS REGISTRATION	PHONOCARDIOGR. = + E C G = + +	−
EARLY SUSPICION OF INT. UTERINE HYPOXIA	+ TO + +	(+) TO +
RELIABILITY OF A DIAGNOSIS OF HYPOXIA	(+)	+ +
EVALUATION OF THE DEGREE OF HYPOXIA	(+) TO +	+ +
RESULTS; FREE OF INFLUENCE OF MEDICATION	(+) TO +	+ +

− AT PRESENT NOT POSSIBLE
(+) INSUFFICIENT
+ SUFFICIENT
+ + VERY GOOD

Fig. 16

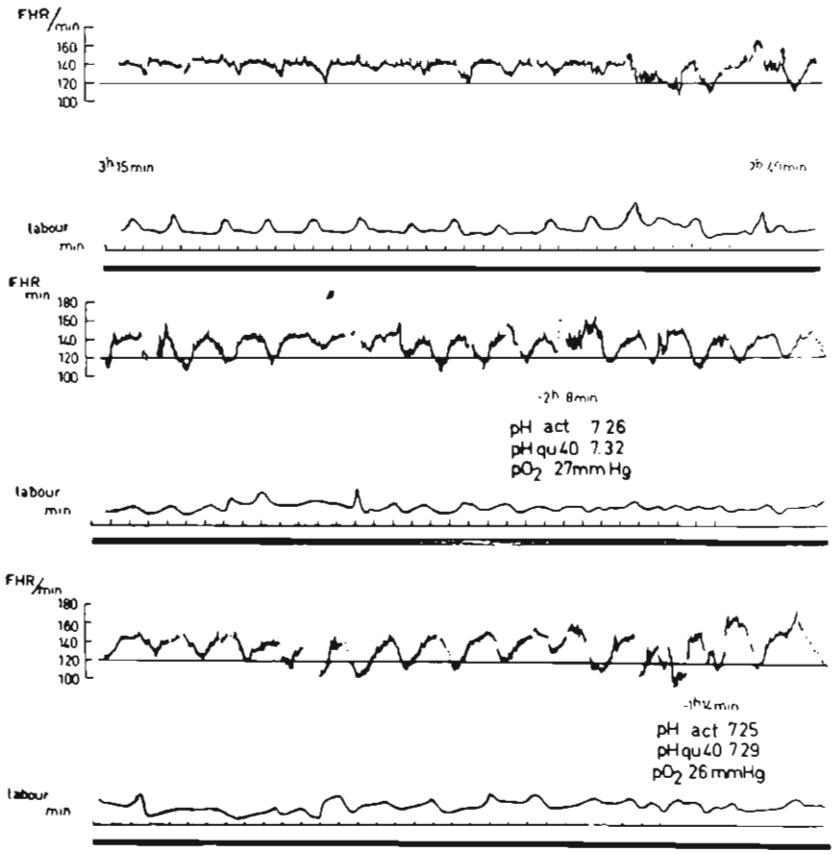
1. The fetal heart-rate can be recorded continuously, but fetal blood analysis can only be carried out intermittently. It may be that this will change when pH-electrodes for continuous registration are developed. However, as approximately 80% of the complications that occur during labour are only slowly-progressive, samples taken at intervals of 15-30 minutes give sufficient warning.

2. When there is a suspicion of hypoxia, fetal heart-rate monitoring is an advantage because in most cases suspicious patterns occur before biochemical changes can be recognized.

3. The severity of intrauterine complications can be determined much more accurately with the aid of biochemical analysis of fetal blood than by relying solely on the pattern of fetal heart-rate.

4. One can usually say that the greater the degree of hypoxia the greater is the degree of acidosis. But, deep alarm-dips may be present when the pH is normal or only slight reduced (Fig. 17), and only shallow alarm-dips may be seen with advanced acidosis (Fig. 18).

5. The reaction of the autonomic nervous system can be influenced by medication, i.e. atropine reduces vagal tone, thereby partially eliminating alarm-dips and causing tachycardia. Atropine can also produce a silent type of oscilation. All other drugs that influence the autonomic nervous system also influence the heart-rate patterns, i.e. Rauwolfia drugs, B-mimetics etc. This disadvantage is not shared by fetal blood analysis.
The indication to terminate labor operatively for fetal reasons can be deduced from the results of fetal blood analysis. In this connection we emphasize that one



late deceleration for
last 3hrs with
normal blood findings
Case No. 3236

spont-deliv

score 11/4

umb-art pH act 7.36
pH qu40 7.33

Fig. 17

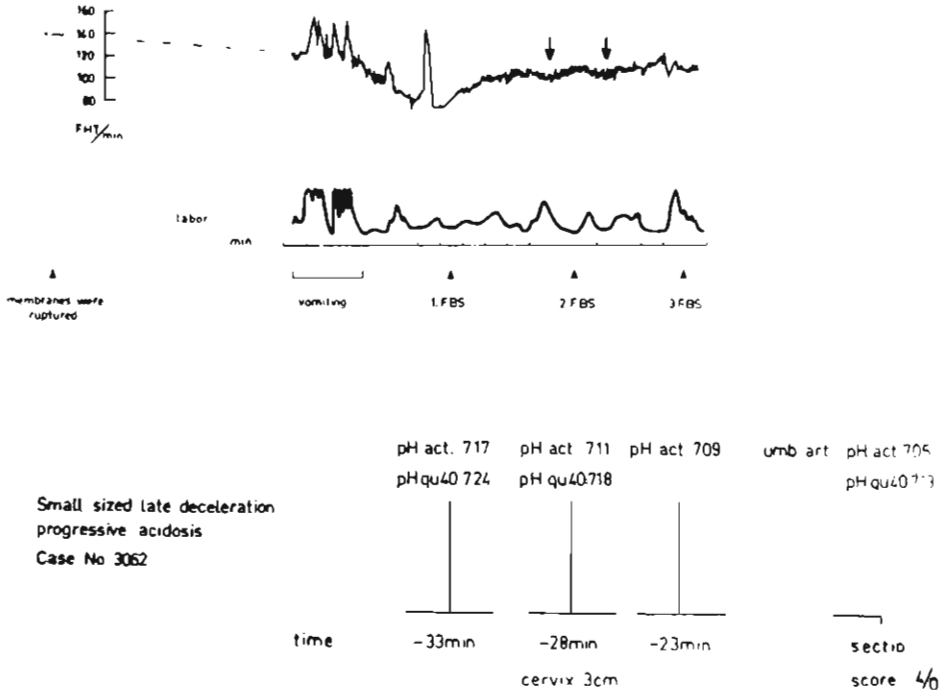


Fig. 18

must always be aware of the complete clinical obstetric situation and must not rely only on the pH-values. The scheme we use at present is shown in Fig. 19.

Explanation of our indication scheme:

1. pH 7.25 and higher represents normal values; also if suspicious clinical signs of the fetus (i.e. heart-rate alterations, passage of meconium) are present one can wait.

2. pH 7.24 - 7.20 represents preacidosis:

   a) if the determination of pH shows a steep decrease, emergency operation is indicated. Fetus must be delivered within 10 minutes from the time of decision.

   b) if determination of pH shows a slight increasing preacidosis, the indication to terminate labor operatively is given.

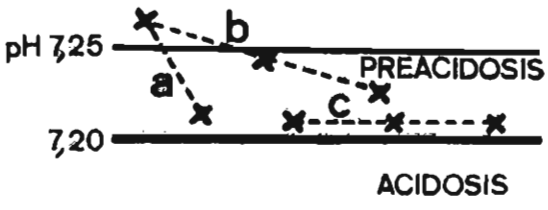


Fig. 19

c) repeated sampling p r e a c i d o s i s without a tendency of improvement, indication for operative termination of labor is also given with the exception that maternogenic acidity-increase (transference of organic acids from the mother to the fetus) must be excluded (18). If the difference in pHqu 40 between mother and fetus is 0.05 or less then the fetal condition is assumed to be the result of maternal acidity influence.

3. If the pH is below 7.20 (not shown in fig.) immediate delivery is indicated. Probably there is a too late detected hypoxia. Are peripheral blood samples —here taken from the skin of the presenting fetal part— representative of conditions in the rest of the circulation? This question can now be answered in the affirmative.

Significant correlations have been demonstrated between blood samples from the scalp and those from the central circulation; between the scalp and temporal artery (3); between the scalp and the umbilical vessels at cesarean section (24), as can be seen in Fig. 20; between scalp and carotid artery/jugular vein in primates (1), shown in Fig. 21, and between scalp and carotid/jugular vein in sheep fetuses (7). Nevertheless the possible influence on fetal blood values of caput succedaneum on the presenting part can not wholly be excluded (Fig. 22), especially when there is a severe caput succedaneum, as it is in about 2.4% of all newborns (2). However any discrepancy between values obtained from peripheral blood and conditions in the central circulation plays only a minor part in the routine application of fetal blood analysis.

Blood sugar determinations on the fetus during delivery can play a role in intrauterine diagnosis in certain cases: for instance, in diabetes mellitus or after a long spell of toxemia. Comparative studies of the mother and fetus offer interesting diagnostic and perhaps therapeutic possibilities. Thus we were able working with ZERNICKOW and PAKZAD (25), to establish in several fetuses that the rise in blood sugar normally associated with a complication during labor does not take place after a preceding spell of toxemia. The glycogen reserves appear to be exhausted, so that these newborn infants are especially exposed to hypoglycemia in the neonatal period. The determination of fetal blood sugar has become of more immediate value since a rapid electrochemical technique has become available for measurement of the so-called "true" glucose concentration. This gives results equally rapid and reliable as those from the technique for pH-determination.

Fetal blood analysis can also be of considerable help in the diagnosis and treatment of a fetus threatened by hemolytic disease. The severity of fetal anemia (Hb, Hk) and the infant's blood group can be determined before delivery and the COOMBS'test can also be carried out. In cases of severe erythroblastosis cross-matching between donor and fetal blood may, if necessary, be undertaken before delivery, so that exchange transfusion can be set up within minutes after delivery.

It is possible to carry out numerous other investigations on fetal blood samples. In theory, any test that requires only a small quantity of blood can be undertaken. Less, and less, since the introduction of fetal blood analysis, the unborn infant is an unknown patient; rather it is an increasingly familiar patient, for whom specific therapy can begin, if necessary, whithin seconds after delivery.

The results of intensive surveillance of the fetus are convincing (Fig. 23) Together with PAKZAD (15) we were able to de-

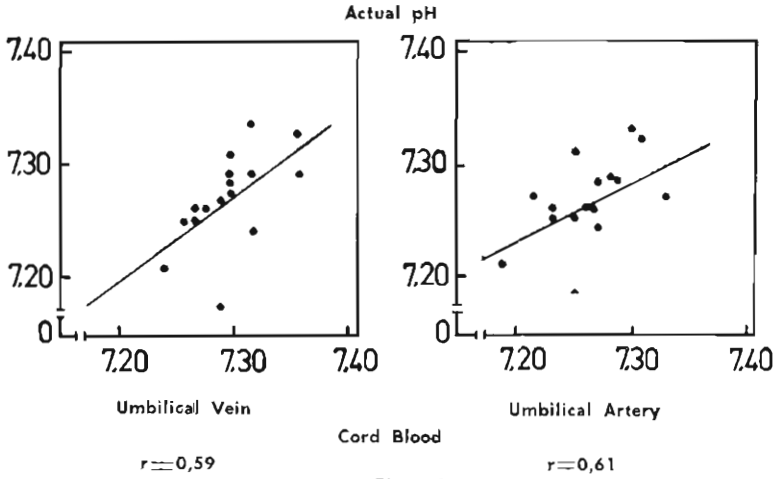


Fig. 20

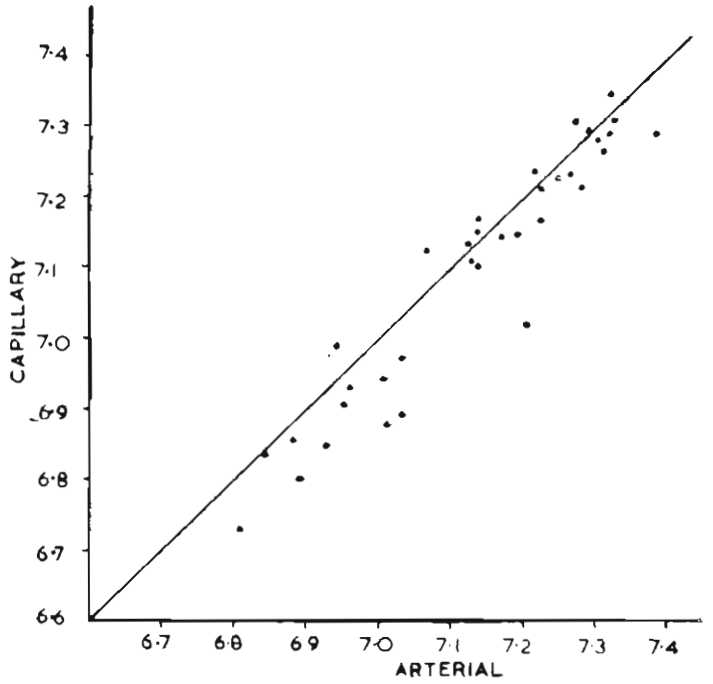


Fig. 21

CAPUT SUCCEDANEUM	NO	SLIGHT	MODERATE	SEVERE
n = 2100	1570	222	257	51
in %	74,8	10,6	12,2	2,43

COLEMAN and SALING

Fig. 22

MORTALITY OF INFANTS WITH INTENSIVE SUPERVISION DURING LABOR

Year	Total number of infants delivered	Fetuses supervised by FBA		Number of deaths in infants supervised by FBA	Mortality in cases supervised by FBA
		Total	%		
Supervision by auscultation and FBA					
1961 - 1967	18 363	3175	17.3%	64	2.0%
Transition period from auscultation to continuous monitoring of fetal heart rate combined with FBA					
1968 - 1969	5013	1400	27.9%	30	2.1%
Supervision by continuous monitoring of fetal heart rate (>80% of all labors) combined with FBA					
1970 – Sept. 1971	4 458	2025	45.4%	29	1.4%

Fig. 23

termine that in earlier years from 1955 till 1960 (when surveillance was only done with the stethoscope in our clinic) in our high risk group of 1.214 cases, 8.5% of the infants died during labor up to the 7th day post partum. The mortality rate in the corresponding collective in the later years when fetal blood analysis has been employed in combination with the auscultation by stethoscope, sunk to arrange between 1.5 till 2.8% in the mean to 2.1%. We considered the passage of meconium and/or alteration of fetal heart-rate as high risk symptoms. The year 1969 was a transition period from auscultation by stethoscope to continuous monitoring of the fetal heart-rate combined with fetal blood analysis and therefore not so much interesting. Of greater interest was last year, 1970, when continuous monitoring of fetal heart-rate has been used in more than 80% of all labors and, in indicated cases, also fetal blood analysis. The mortality sunk to 1.05% (11 of 1.043). From these 11 infants we lost only 2 fetuses during labor.

Finally a few words about the scoring of the newborn. The progresses in the supervisión of the fetus made necessary to improve also the scoring of the newborn immediately after delivery.

The scoring system primarily recommended 1953 by V. APGAR rapidly found a widespread use due to the large deficiency in the assessment of the newborn existing at that time. Because of some deficiency it has been partially modified, in our country by WULF and by ourselves. From a newer point of view it is insufficient to assess a newborn exclusively by a scoring system like these. The reason is that the most frequent and important danger to the infant, the intrauterine hypoxia can scarcely be differentiated from other causes of depression by such a simple scoring-system. Other reasons of depression are for instance drug application to the mother, anaesthesia, infection of the fetus, intrauterine stress etc.

Therefore we suggested in 1965 (16) to measure additionally the pH in the umbilical artery blood immediately after delivery. The combination: scoring of the clinical state and determination of the degree of acidity of the newborn is at present the most reliable and rapid assessment. It offers a sufficient method to distinguish whether hypoxia during labor was present or not. Together with WULF (20) we

submitted last year the formation of groups for both kinds of assessment to represent simply a general information about the newborn under consideration of acidity but also to enable one to use furthermore the 3 scoring systems used in our country (Fig. 24).

The condition of the child will then only be expressed by 2 letters and numbers; i.e. a newborn with APGAR 5, WULF 4, or 5 points in our system is to be found once in the group C III (C=Clinical) and, on the other hand, in the group A IV (A= Acidity) because the actual pH-value in the umbilical blood was 7.26. For a better understanding may I demonstrate 2 cases: An infant with a group-score of C IV and A III was very probably exposed to an intrauterine hypoxia for a short time immediately before delivery, but still without an depressive influence on the clinical state. An infant developed by cesarean section with a group-score of C II and A IV is very probably depressed by anaesthesia. Normal acidity is a proof that the fetus was not hypoxic during the last time of labor.

Ladies and Gentlemen: Let me close this lecture with the same words I closed the 2nd European Congress for Perinatal Medicine last year in London: More advances have been made in the last decade in monitoring the fetus at risk during labor than in any other period of Obstetrics. The two English pediatricians DOBBS and GAIRDNER established in 1966 in a provocative manner that man has been able to make enormous advances in space as well as with the atom, but in overseeing the most critical period of his own life he has not been able to advance further than relying on primitive manual manipulations (6). This clearly defined discrepancy shows how inadequately we were able to protect the fetus during labor. In the last few years this deficiency burdens only the obstetrician who continues to rely simply on his stethoscope; for the obstetrician who thinks and deals progressively the reproach of DOBBS and GAIRDNER is out of date and belongs to the history of medicine.

APGAR	WULF	SALING (main score)	clinical condition		symbol
9 - 10	8	9 - 12	optimal vigorous (infant)		K V
7 - 8	6 - 7	7 - 8	still vigorous (infant)		K IV
5 - 6	4 - 5	5 - 6	slight	depression	K III
3 - 4	2 - 3	3 - 4	moderate	depression	K II
0 - 2	0 - 1	0 - 2	severe	depression	K I

pH	state of acidity		symbol
≥ 7.30	normal acidity		A V
7.20-7.29	slight to moderate increased acidity		A IV
7.10-7.19	slight to moderate	acidosis	A III
7.00-7.09	advanced	acidosis	A II
< 7.00	severe	acidosis	A I

Fig. 24

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