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Clinical value of fetal spontaneous movements in early pregnancy

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With the B-scan ultrasound technique the ultrasound waves of a certain wave-length emitted by an emitter are partially reflected in the body from the interfaces of media with different sound conductivity. These echoes are transformed into electrical impulses by a receiver and directed towards a cathode tube. A cross sectional picture through the body's interior is obtained on the luminescent screen. **It is possible with automatic and rapid picture formation to observe continuously movements in the body's interior.** They differ from glimmer and artefacts of the rapid picture formation. We paid special attention to spontaneous movements of the fetus within the amniotic fluid **during the first half of pregnancy.**

It has been possible to observe spontaneous movements of fetuses only in **aborted or surgically obtained** fetuses. Consistent studies have been mainly concerned with observations of reflex movement induced by external stimuli. Even under optimal conditions, the physiological circumstances of these studies were not conducive to an understanding of fetal behaviour in utero.

1. Experimental procedure

Ultrasound is being increasingly utilized in obstetrics. The technical basis and the significance of this kind of examination are summarized in monographs [2, 7, 13]. If the ultrasound emitter is automatically moved in the sectional plane, then by the so-called **parallel scan method**, a cross sectional picture is also formed automatically (VIDOSON-Gerät, Siemens) [2]. **15 to 16 cross sectional pictures per second** become visible on the screen. This is achieved automatically by rotation of the directional beam in front of a system of mirrors [8]. By using the so called "rapid picture

Curriculum vitae

EMIL REINOLD was born on June 24, 1931 in Vienna (Austria); at eighteen he began his studies at the Faculty of Medicine in the University of Vienna. He received his Dr. med. univ. in July 1958. For three years he worked in different hospitals to obtain his "ius practicandi". Since September 1961 he has been a member of the I. Universitätsklinik für Geburtshilfe und Gynäkologie in Vienna. In June 1966 he received his diploma as specialist in obstetrics and gynecology and was made a senior of the clinic. For years, he has been specially interested in perinatology, in particular the intensive supervision of the mother and child during pregnancy and labor, as well as ultrasound diagnostics.



formation" the movements in the body can be continuously observed [10]. By moving this applicator of ultrasound which contains the directional beam emitter and the mirror optical system in a water bag across the abdomen of the patient, one obtains a spatial image of organs within the body on the luminescent screen [2, 10].

2. Results

Spontaneous fetal movements in the amniotic cavity were observed on the luminescent screen using this method. It is possible to recognise the fetus from ultrasound echoes from about the eighth postmenstrual week. They are nearly always visible from the tenth week of pregnancy. **The form and shape of the fetus, however, cannot yet be distinguished at this point although spontaneous changes in position can already**

be observed. In the following weeks, the shape of the fetus is more distinguishable as it grows in size and so it is easier to study the type of movement, and its course [11]. **Up to about the twentieth week of pregnancy, this method makes it possible to scan the amniotic cavity and its contents, because the depth of visible outline using the ultrasonic technique is limited to 16 cm.**

2.1 Spontaneous movements

In these studies, passive movements could be excluded and hence the observed movements of the fetus were spontaneous and not due to external influences. Two types of movements could be distinguished. **The one type starts with a strong and sudden movement. The whole body of the fetus moves and changes position in the amniotic cavity.** The impression from the luminescent screen is that the body is kicked away from the wall of the amniotic cavity and then continues to swim and slowly resettles again into its original position. The touching of the amniotic wall may induce a new movement. The second type of movement is **slow and inert.** The strong movement impulse is absent. The position of the fetus is **changed either slightly or not at all.** It appears that **only parts** of the body e. g. the extremities are moved.

2.2 Induced movements

These movements are evidently not conducted in any characteristic sequence or frequency. In cases where no spontaneous movements were noticed, an attempt was made to move the fetus passively by palpating the uterus through the abdominal wall of the mother and thus, perhaps, to awaken it. This usually resulted in the spontaneous movements described above.

The ability of the fetus to perform the first type of movement was assessed highest and considered to be the most relevant. The time of observation was at least 5 min.

2.3 Significance and validity of the movements

The significance and validity of these spontaneous movements in the first half of pregnancy can be

assessed from the clinical diagnosis of the mother. Normal cases, cases with signs of early pre-eclampsia in the time before the ultrasound examination, imminent abortion (labor, eventually with hemorrhages) or hemorrhages out of the cervix (without discomfort to the patient) were compared (tab. 1). **In more than 75% of a group of mothers whose fetuses showed rapid spontaneous movement, no pathological signs were diagnosed.** In more than 50% of 61 mothers whose fetuses showed **only slow movements, no pathological findings were made.** Out of 21 mothers whose fetuses, in spite of palpation across the uterus showed **no spontaneous movement, only 6 had no pathological changes.**

Clinical Diagnosis	Spontaneous movement		
	Strong	Slow	Absent
No Pathology	182	32	6
Hemorrhage	18	11	5
Imminent Abortion	21	8	6
Pre-eclampsia	19	10	4
	n = 240	n = 61	n = 21

Tab. 1. Clinical diagnosis for different types of fetal spontaneous movements in early pregnancy.

It might also be possible to assess the significance of the different types of spontaneous movement by comparing the further course of pregnancy as a retrospective analysis. **94% of the first group of mothers whose fetuses showed strong movements delivered a live child weighing more than 2,500 grams.** Nearly threequarters of the mothers in the second group with **fetuses with slow movements delivered a live child weighing more than 2,500 grams.** In the third

Course of Pregnancy	Spontaneous Movements		
	Strong	Slow	Absent
Live child	227	46	0
< 2,500 g			
Premature	6	6	1
Abortion	5	7	13
Intrauterine death	2	2	7
	n = 240	n = 61	n = 21

Tab. 2. The course of pregnancy in fetuses that show different types of spontaneous movements in early pregnancy.

group, where **no** spontaneous movements were observed, only **one mother delivered a pre-mature but live child** (tab. 2).

3. Discussion

Spontaneous fetal movements have been reported only for aborted or surgically obtained fetuses [1]. The first studies concerning the ability of the fetus to move were performed by MINKOWSKI who induced movements by external stimuli [9]. He distinguished different forms of responses depending on the age of the fetus and corresponding to the development of centers that begin to function. Extensive studies have been described by HOOKER and these were then continued by HUMPHREY [3, 4]. These studies were performed on fresh fetuses obtained by Caesarean section. Immediately after cutting the umbilical cord, they were brought into an environment that corresponded to intrauterine conditions. The type and extent of movements evoked by touching different parts of the body with the so-called Hair-estesiometer were examined. Movements that appeared without any evident stimulation were observed in some cases but they were evidently not considered to be important [6].

A completely new approach is now possible in the study of the life and behaviour of the fetus in utero since it is possible to observe spontaneous fetal movements **within** the uterus. It is clinically interesting to know whether fetal movements can indicate the state of the fetus and whether they make it possible to recognise pathological changes. Objective judgments are difficult to come by here since we have no relevant parameters for early pregnancy that would characterise the state of the fetus. A comparison of the clinical state of the mother is only conditionally useful since the pathological state of the pregnant woman need not always be reflected in a similar state in the fetus. Perhaps a **better assessment is possible by following the further clinical course of pregnancy**. Disturbances in development can occur slowly and thus change or limit the

behaviour of the fetus until eventually it dies or is aborted.

3.1 The value of movements

Until recently it was not possible to compare fetal behaviour in utero with the clinical diagnosis and the course of pregnancy, and hence our experiments are the first attempt to do so. Most of the pregnant women were examined in the out-patient department. Not all of them were treated in our clinic. Hence it was often not possible to influence the clinical treatment of the pregnancies. The way the pregnancies ended however, was always known. It must also be taken into consideration that the number of cases with slow movements, particularly those with no movements at all, was not very great. Hence, this observation seems to be rare. Nevertheless, we feel justified **in concluding from our observations that in normal fetal development, lively movements are performed which start with a strong impulse and move the whole body of the fetus within the amniotic cavity. Inert and slow movements are performed either in conjunction with the strong movements, or in isolation.** It appears that this type of movement occurs when the normal state of the fetus is impaired, but this has not been demonstrated conclusively. The absence of movements, even when attempts are made to interrupt the resting period of the fetus by passive movements, also indicates an inability to perform spontaneous movements. Further work should throw some light on the physiological behaviour of the fetus. Once such knowledge has been obtained, one can study the possibilities of affecting the fetal state, e. g. with therapeutic measures.

3.2 Biological effects of ultrasound

The biological effect of ultrasound has been tested by numerous investigators both in animals and in clinical studies and no harmful or altering effects could be demonstrated for doses used for diagnostic purposes [2, 7].

Summary

The ultrasound technique makes it possible to study changes in position of the fetus within the body on a luminescent screen. Using an automatic rapid picture building technique of 15–16 pictures per second, movements inside the body can be observed continuously. Spontaneous fetal movements within the amniotic cavity were examined between the 10th and 20th week of pregnancy. Two different types of movement were observed: one type begins with a strong movement which leads to a change of position of the whole fetal body within the amniotic cavity; the second type of movement is slow and inert; it is confined only to part of the body and the position of the fetus is altered slightly or not at all. Both types of movement showed no characteristic sequence or frequency. If no spontaneous movements were observed, an attempt was made to move the fetus passively by palpating the abdominal wall and the uterus and thus waking it from a possible state of sleep. This usually resulted in the types of movement described above. The significance and value of these spontaneous movements was evaluated by comparing them both with the clinical diagnosis at the time of observation (tab. 1) and the further course of pregnancy (tab. 2). In a group of 240 women whose

fetuses showed strong spontaneous movements (during a period of observation of 5 minutes), no pathological signs were found in more than 75%, and more than 94% of all pregnancies resulted in the birth of a live child weighing more than 2,500 grams. In 61 mothers whose fetuses during the 5 minute observation period showed only slow and inert movements, the clinical diagnosis indicated normal pregnancy in more than half the cases, and nearly three-quarters gave birth to a live child weighing more than 2,500 grams. In 21 mothers whose fetuses showed no spontaneous movement even if attempts were made to wake the fetuses, only 6 cases showed no pathological changes and only 1 pregnancy resulted in the birth of a live but premature baby. The investigative method makes it possible for the first time to study the intrauterine life and behaviour of the fetus. Our present knowledge concerning fetal movements is derived from studies on surgically obtained fetuses in whom movements in response to stimuli had been observed. This new method makes it possible to observe the fetus within the uterus and to conclude, at least when fetal spontaneous movements are absent, that the fetus is at risk.

Keywords: Fetus, Fetus-(movements of the), ultrasound, pregnancy.

Zusammenfassung

Klinische Bedeutung der fetalen Spontanbewegungen in der Frühgravidität.

Durch eine Ultraschalltechnik mit automatischem schnellem Bildaufbau von 15–16 Bilder pro Sekunde können Bewegungsabläufe im Körperinneren auf einem Leuchtschirm kontinuierlich verfolgt werden. Untersucht wurden die Bewegungen, die der Embryo bzw. Fet zwischen der 10. und 20. Schwangerschaftswoche in der Amnionhöhle spontan ausführt. Es konnten dabei zwei verschiedene Arten von Bewegungen beobachtet werden: die eine Art beginnt mit einem kräftigen Bewegungsimpuls, wobei der ganze fetale Körper in der Amnionhöhle bewegt wird und seine Lage ändert. Die zweite Art der zu beobachtenden Bewegung ist eine langsame und träge, die oft nur einen Teil des Körpers erfaßt, wobei die Lage des Feten nicht oder nur unwesentlich verändert wird. Diese beiden Arten werden in uncharakteristischer Folge und Häufigkeit ausgeführt. Wenn keine Spontanaktivität zu beobachten war, wurde versucht, durch Stoßpalpation den Fet passiv zu bewegen, um ihn aus einem eventuellen Schlafzustand zu wecken. Im Anschluß daran traten für gewöhnlich die beschriebenen Bewegungen auf. Um Aufschluß über die Bedeutung und Wertigkeit dieser Spontanbewegungen zu erhalten, wurden sie einerseits mit der klinischen Diagnose in der Frühschwangerschaft (Tab. 1) und andererseits mit dem weiteren

Schwangerschaftsverlauf (Tab. 2) verglichen. In einem Kollektiv von Müttern ($n = 240$), deren Feten bei einer Beobachtungsdauer von 5 Minuten lebhaft Spontanbewegungen zeigten, war die klinische Diagnose in über 75% unauffällig und über 94% der Schwangerschaften endeten mit der Geburt eines lebenden Kindes über 2500 g. In einem Kollektiv von Müttern ($n = 61$), deren Feten bei einer Beobachtungsdauer von 5 Minuten nur langsame und träge Bewegungen zeigten, war die klinische Diagnose in etwas mehr als der Hälfte der Fälle unauffällig und knapp mehr als $\frac{3}{4}$ endete mit der Geburt eines lebenden Kindes über 2500 g. In einem Kollektiv von Müttern ($n = 21$), deren Feten trotz Aufweckversuchen keine Spontanbewegungen zeigten, konnten nur in 6 Fällen kein pathologischer Befund erhoben werden und nur eine Schwangerschaft endete mit der Geburt eines lebenden aber unreifen Kindes. Mit dieser Untersuchungsmethode ist es erstmals möglich, das intrauterine Leben und Verhalten zu studieren; das bisherige Wissen über die Bewegungen des Feten stammte von Untersuchungen an operativ gewonnenen Früchten, bei denen Bewegungsreflexe als Reizbeantwortung beobachtet wurden. Diese Untersuchungsmöglichkeit erlaubt aber den Fet intrauterin zu beobachten, und zumindest aus dem Fehlen von Spontanbewegungen ist offenbar eine Gefährdung abzuleiten.

Schlüsselwörter: Fet, Bewegungen, Frühschwangerschaft, Ultraschall.

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