

# ULTRASONIC PARAMETERS FOR THE CONTROL OF EMBRYONAL GROWTH

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The monitoring of pregnancy has hitherto been considered as a study of the growth of the foetus, and the importance of the development of the embryo has been neglected (1). Obstetricians, moreover, have not previously had available any effective parameter for the verification of embryonal growth, and have had to base this exclusively upon objective examination and on analysis of the chorionic gonadotrophins (2, 3, 4, 5). We have therefore suggested associating with the already existing parameters an assessment by ultrasound, for the rapid, complementary detection of embryonal eutrophy or dystrophy, by evaluating the growth of the ovular chamber together with its possible variations.

## MATERIAL AND METHODS

In reviewing our case-histories from 1971 to 1976, we took into consideration practically all the following clinical situations, which can be checked during the first trimester of pregnancy: diagnosis of pregnancy, habitual abortion, threatened abortion, suspected internal retained abortion, suspected extra-uterine pregnancy, minor asymptomatic metrorrhagia, abdomino-pelvic colic and acute abdominal syndromes, cervical incompetence, vaginal and abdominal cerclage, suspected hypofunctional hydatidiform moles, suspected twin pregnancy, suspected fibromatosis of pregnancy, suspected ovarian cyst during pregnancy, induced pregnancy, acute and chronic urogenital inflammation during pregnancy: all of these being conditions in which clinical examination and analysis of the HCG have not and do not permit the obstetrician to make a certain diagnosis of a healthy ovum.

## CONSTRUCTION OF THE GROWTH CURVE OF THE OVULAR CHAMBER

1,051 scannings were made and taken into consideration in patients with a regular menstrual cycle and whose last menstruation could definitely be confirmed, i.e., cases in which it was possible to approximate fairly closely to the date of conception. These were also patients in whom no suspicion of any pathological condition had been raised on the basis of the clinical and laboratory findings and

## SUMMARY

The Authors report their own experience on the monitoring of embryonal growth by ultrasounds, and conclude that, the evaluation of ultrasound parameters during the first 12 weeks of pregnancy, enable to make a real assessment of the state of health of the embryo.

of the satisfactory progress of the pregnancy.

The parameters that can be investigated in an ovular chamber are described in table 1:

Table 1. Possible ultrasonic parameters of the ovular chamber.

Area of sac	} ———→	from internal or	
Perimeter of sac		external contours	
Volume of sac			
In longitudinal scanning	Ø	Longitudinal	dia.
		Ø Ant.-Post.	dia.
In transverse scanning	Ø	Ant.-Post.	dia.
		Ø Lat.-Lat.	dia.
Zone of insertion:	anterior		
	posterior		
	fundus		
	low insertions		
Morphology:	thickness of contours		
	regularity of contours		

tronic scale was set at 1580msec, this being the mean velocity in human tissues (excluding bone tissue: 4050 msec).

The scanning results, week by week, were as follows:

	Age of pregnancy	Scanning nos.	Mathematical Ø in cm
6- 5 weeks	196		
6-12 weeks	855	6	1.30
		7	2.00
		8	2.70
		9	3.30
		10	4.00
		11	4.67
		12	5.35

The method used for working out the data needed for constructing the curve was that of « minimum squares » (10, 11).

Comparison between rates of growth at various periods of gestation.

Week of preg.	Rate of growth per week (cm)
5 → 12	0.700
12 → 18	0.440
18 → 31	0.278
31 → 42	0.143

From the 5th to the 12th week of pregnancy the values refer to the diameter of the ovular chamber; from the 12th week, onwards, to the DBPF.

Standardization of the morphological characters of the ovular chamber followed from the mathematical values:

5th week of amenorrhoea. — Before this stage it is not possible to measure the ovular chamber with the apparatus at present available commercially, because its diameter is less than one centimetre; only the presence or absence of the primitive embryonal node can be diagnosed. The ovum has a rounded appearance and is surrounded by chorion frondosum, which inspissates the image of the walls.

No echo of embryonal origin can be detected. In 196 cases examined, the site of implant and its form were described;

These are all valid in a selective study of a restricted circle of patients, and especially with medical staff who are prepared to give up some part of each day to ultrasonic diagnosis. In our ultrasonic diagnosis department, attached to the Obstetric and Gynaecological Clinic of the University of Padua, 3,700 scanings were performed in 1976 alone in patients admitted to hospital as well as in out-patients, which would make such selective work impossible except with detriment to the correct monitoring of pregnancy. For this reason we assessed only the mean of three readings taken in median longitudinal, right oblique longitudinal and left oblique longitudinal scanning (7, 8). On working out these data statistically we were able to construct a growth curve for the ovular chamber (fig. 1).

The echographic evaluations were made with an impulse device supplied by the firm Kretz-Technic (Ecografo A series 4100 MG an Ecografo B series 4100 MGS), furnished with emitting and receiving crystals of barium titanate; they were interchangeable and of frequency varying between 1 and 2 MHz. The elec-

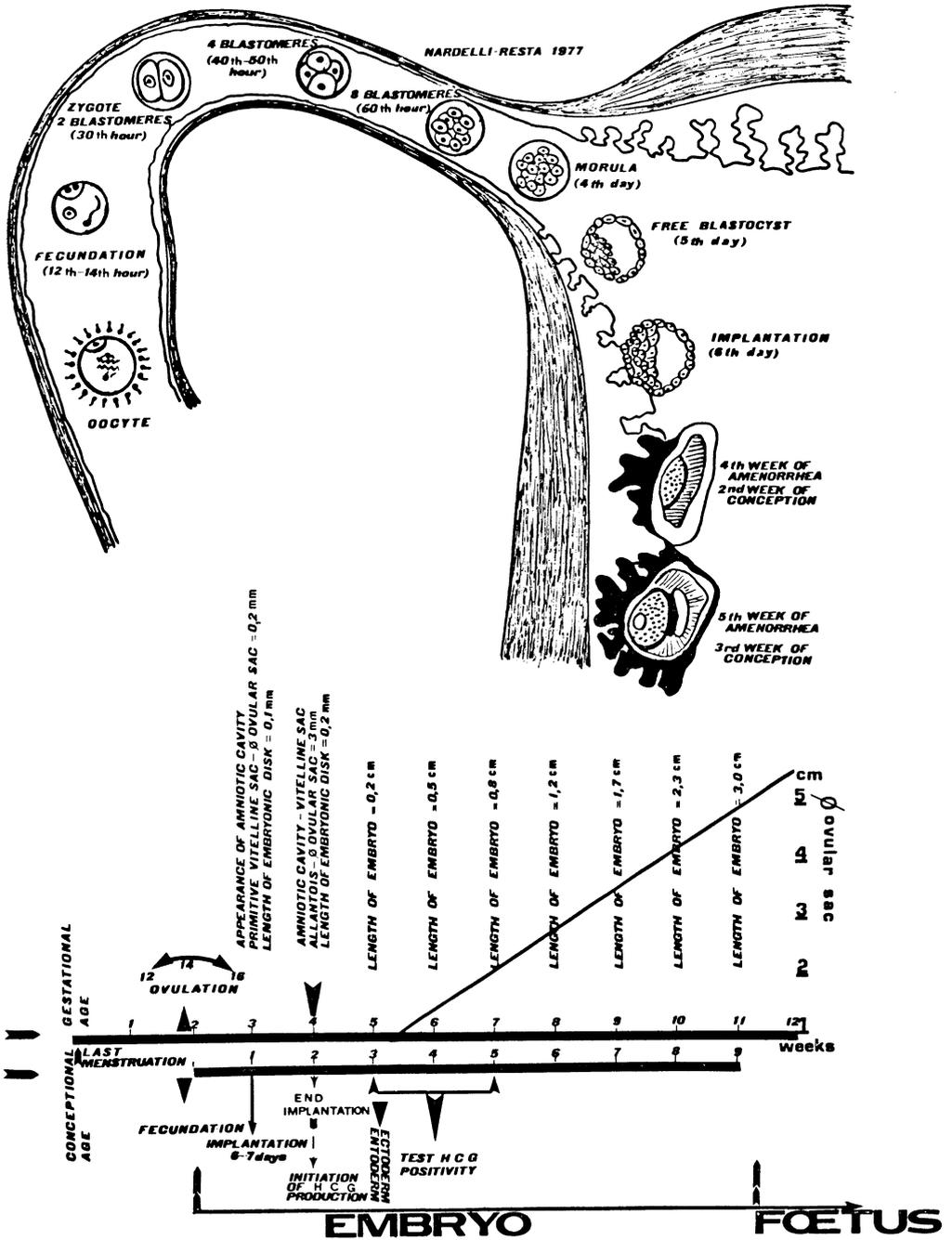


FIG. GROWTH CURVE OF OVULAR SAC

but it was not possible to provide any data on the vitality of the embryo.

*6th week of amenorrhoea.* — The ovular chamber appears to be enfolded by the chorion frondosum, but it already possesses sufficient acoustic differentiation for a reading to be taken, and thus from this moment ultrasound can differentiate normal from pathological pregnancies. The mean value of the diameter is found to be 1.30 cm. From the statistical calculation it is discovered that the measurement may in theory be done from 5½ weeks, with a value of 1.00 cm for the diameter. The measurement is made from one internal margin to the other (excluding the chorion). No embryonal echoes are heard, and only very rarely was it possible to perceive the foetal heart beat, using the T.M. method; in all these cases it was found from careful examination of the past history that there was a slight divergence between the last menstruation and the date of conception, that is, the foetal heart beat was noticed very early (6th - 7th week), which leads to the supposition that the date of conception was very close to the last menstruation.

*7th week of amenorrhoea.* — The sac seems enlarged as compared to previous checks; its volume was about 2 cc; diameter 2.00 cm; the foetal heart beat was not definitely perceptible, as for the 6th week. Embryonal echoes may be heard and thus also occasional movements referred to arhythmic contractions approximating to the cephalic and caudal extremities.

*8th week of amenorrhoea.* — The ovular chamber has passed the threshold of 2 cc in volume and its diameter is 2.70 cm. The primitive embryonal node is in evidence; the chamber with the chorion frondosum now occupies about two-thirds of the uterine cavity and a certain rarefaction and flattening of the chorion frondosum can be appreciated

beyond the point of contact with the maternal decidua. The crown-rump diameter of the embryo can be measured (1.20 cm). The foetal heart rate is perceptible due to the formation of the outline of the foetal cardiovascular apparatus, which is starting to pulsate rhythmically at around 160 beats per minute. The first embryonal movements appear, localized in the upper limbs, due to the establishment of reflex arcs. The foetal heart beat, assessed at this time by the A+B+TM method, may give 4 results:

- positive;
- false positive: very rare because the possibility of synchronism with the maternal heart is always checked;
- false negative: three explanations:
  - obese patients,
  - retroverted uterus,
  - conception date a long way from last menstruation, so that the time of gestation considerably precedes the time of conception; in these cases the result often becomes positive after one week;
- negative: to exclude any doubt, morphological assessment of the outlines of the ovular chamber is very important and should be done before the hormonal tests become negative.

*9th week of amenorrhoea.* — The ovular chamber was found to increase in volume by 75 % per week; its diameter was about 3.30 cm and the embryo was easily identified.

*10th week of amenorrhoea.* — The image of the embryo is occupying a progressively larger space in the ovular chamber, which is diminishing due to the transformation of the chorion frondosum into chorion laeve. The chorion frondosum is also more restricted in size and is organized at one pole of the gestational ring, increasing still more its relation to the decidua. Its diameter is 4.00 cm.

*11th week of amenorrhoea.* — The transformation of the chorion frondosum into chorion laeve may now be considered complete, in that the line limiting the sac appears thin, shap, well-defined, smooth and regular. The chorion frondosum is now organized in a polarized placental structure. The embryo is quite evident and mobile; the ovular chamber has a diameter of 4.65 cm.

*12th week of amenorrhoea.* — The placenta is complete as regards implant and organization; from this time onwards only functional enlargement occurs, proportional to the stage of pregnancy. The sac can only be measured with difficulty, since the contours adhere to the walls of the uterus (<sup>6</sup>). For this reason the ovular growth parameters, from this time onwards, will be the foetal diameters. The diameter of the chamber measures 5.35 cm; its volume (<sup>9</sup>) is now such as to make possible the aspiration of sufficient amniotic fluid for the required investigations, without inducing any danger of decompression within the chamber itself, and without any need for volumetric replacement with sterile physiological solution.

#### CONCLUSIONS

The examination of the ovular chamber by ultrasound during the first 12 weeks of pregnancy enables us to make a real assessment of the state of health (or otherwise) of the embryo. The obstetrician should remember two parameters: measurement of the ovular chamber and its morphological characteristics, both of which are dependent upon intrinsic factors (foetal distress, etc.) and/or on extrinsic factors (mass compression, etc.). This is because the mathematical value of

the diameter cannot be dissociated from morphological verification; each parameter, in fact, gives us only the information that the other does not allows us to analyse. Obviously, ecography of the ovular chamber, while being a very good method for assessing embryonal health, cannot be separated from evaluation of ovular function, though it can in a concrete fashion improve the diagnostic and thus the therapeutic possibilities.

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