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Interrelationship Between Serum Iron Concentration and Pregnancy-induced Hypertension and Chronic Hypertension in Pregnancy

Sungwal Rugpao MD,*
Theera Tongsong MD,*
Theera Lao-kul-dilok MD,#
Jarunee Lao-kul-dilok MD,#
Ratanaporn Sekhornrit MD.*

*Department of Obstetrics and Gynaecology, Faculty of Medicine, Chiang Mai University, Chiang Mai, Thailand
#The Research Institute for Health Sciences, Faculty of Medicine, Chiang Mai University, Chiang Mai, Thailand

Abstract : *It is important to distinguish pregnancy-induced hypertension(PIH) from pregnancy complicated by chronic hypertension(CHT). Retrospective case-control studies demonstrated a correlation between serum iron concentration and PIH. This study is a cross-sectional study to compare the serum iron concentration among three groups of pregnant women i.e. normotensive (control), CHT and PIH. Of 180 pregnant women recruited, there were 45 CHT and 45 PIH. 90 controls were selected by matching to CHT and PIH for age group, gestational age, hemoglobin and history of iron supplementation. The serum iron was determined in three phases i.e. antepartum, intrapartum and postpartum. It was shown that serum iron was significantly higher in delivery phase of PIH group both comparing to its own control or in pooled data and PIH group itself also demonstrated a peak of mean serum iron concentration during intrapartum when comparing to antepartum and postpartum phases. (Thai J Obstet Gynaecol 1991;2: 59-65.)*

Key words : serum iron concentration, pregnancy-induced hypertension, chronic hypertension

It is practically important to make an early diagnosis of pregnancy-induced hypertension (PIH) and to distinguish it from underlying chronic hypertension (CHT) due to their different management. In severe PIH, pregnancy must be rapidly terminated, while those of CHT could usually safely go on to term. This is of special importance since some patients attend the antenatal clinic very late in their pregnancy. It may be very difficult to differentiate between CHT and PIH, especially those first seen in late

pregnancy presenting with hypertension without any previous information on early pregnancy blood pressure and no definite sign of PIH. Many laboratory measurements, therefore, have been developed to differentiate these two diseases, i.e. determining the level of uric acid, antithrombin III, platelets, or liver enzymes[1]. There is, however, no laboratory technique able to effectively differentiate the two entities.

In 1981, Entman and associates[2] reported a retrospective case-control study to evaluate the clinical course and mean serum iron concentrations among the patient groups of PIH, CHT and normotensive pregnant women. The study demonstrated that mean serum iron concentrations in the antepartum and intrapartum phases of PIH group were significantly higher than in CHT and normotensive controls and the concentrations in the PIH group were highest at the intrapartum phase. For postpartum phase, there was no significant difference among the three groups. In addition, it was demonstrated that the peak of serum iron concentration at intrapartum phase was well-related to the severity of the disease. In 1982, Entman and associates[3] reported another study whose results confirmed the previous findings. They, furthermore, found that serum iron was sensitive and specific parameter for PIH, and the predictive value was high exceeding any other test so far employed for this disease. They, therefore, concluded that the serum iron has transient but striking changes during the course of PIH, and that in their opinion this test was the most sensitive and specific for diagnosis and predicting the severity of the disease. So far, this finding has not been substantiated by any other group of investigators, especially in subjects who have different racial and nutritional characteristics from those of the American counterpart. It is highly desirable, therefore, to conduct a similar study to document whether or not the above observation could be reproduced in a pregnant PIH population of northern Thailand.

Materials and Methods

A cross sectional case-control study was conducted at Maharaj Nakorn Chiang Mai Hospital, Department of Obstetrics and Gynaecology, Faculty of Medicine, Chiang Mai University, from September 1, 1985 to August 31, 1990. The study population i.e. PIH, CHT and normotensive pregnant controls were recruited from the antenatal clinic and obstetrical wards. Of the 180 singleton and nonanemic pregnant women recruited, there were 45 CHT, 45 PIH and 90 controls. PIH group consisted of pregnant women who met the criteria of PIH[1]. Again,CHT patients were those diagnosed before pregnancy, and who met the criteria of CHT[1]. Controls were healthy, normotensive pregnant women having no other signs and symptoms of PIH. 90 controls were selected, case by case, by matching CHT or PIH for age group, trimester

of gestational age at delivery and first antenatal clinic visit, hemoglobin concentrations (10-12, 12-14 gm %), and history of iron supplementation.

For PIH and CHT patients, blood samplings were taken the first time that PIH or CHT was diagnosed, which might be during the antepartum, intrapartum or postpartum periods. If the antepartum specimen had been obtained, the next specimen would be taken serially at the following conditions:1) the time that PIH was considered to become worse i.e. from mild to severe and/or, 2) immediatedly before induction of labor and/or, 3) during the active phase of intrapartum and/or, 4) 72 hours postpartum. If the first specimen obtained was the intrapartum one, the next specimen would be taken during 72 hours postpartum.

In controls, antepartum specimens were obtained during trimester of gestation matching to the cases. Intrapartum and postpartum specimens were obtained as they were in the cases.

Total serum iron determination was based on the extraction of iron by using precipitating agent and then treated with chormogenic reagent bathophenanthroline sulfonate gives pink color solution which could be absorbed at 535 mm[4].

Calculation of the mean value and standard deviation of serum iron concentration of each study group was done. The statistical significance for mean difference was tested by analysis of variance. If there was statistically significant difference in the mean values among the three groups. The fluctuation of serum iron concentrations was compared between cases and controls.

Results

The important characteristics of each pair of control and study group are described in Table 1. In comparision, the PIH group was not significantly different from its control in mean age, parity, gestational age at first antenatal visit, number of visits, percentage of iron supplemetation, gestational age at delivery, mode of delivery, except for fetal birthweight which was significantly lower in the PIH group. For the pair CHT group and its control, there was no difference in many characteristics except that the CHT group had a significantly higher parity.

When comparing the mean serum iron concentration for each pair of control and study group it was found that there was statistical difference ($p<0.05$) only between PIH and its control during the delivery phase. The mean(± 1 SD) serum iron concentration of PIH and controls during intrapartum phase were 115.98 ± 78.08 and 77.11 ± 35.20 μg% respectively.

When pooling the data of controls for either CHT or PIH groups into one control group and comparing the mean serum iron by analysis of variance, the statistically significant difference was only for the intrapartum phase. The mean serum concentration of controls, CHT and PIH dur-

ing intrapartum phase was 77.89± μg% respectively.
38.17, 83.49±38.17 and 115.98±78

Table 1 Characteristics of study population

Study groups	n	Mean age (years)	Parity O (%)	Parity 1 (%)	Parity>1 (%)	GA at 1st ANC	No.of ANC
CHT	45	28.2±5.2	46.7	31.1	22.2	20.8±8.8	7.2±3.4
Control	45	27.3±4.7	60.0	37.8	2.2	20.6±8.5	7.3±3.1
p value	-	0.365	<----------0.015---------->			0.894	0.974
PIH	45	26.5±5.6	62.2	26.7	11.1	21.9±7.8	6.2±3.2
Control	45	25.2±5.6	75.	22.2	2.2	21.1±7.5	6.9±3.4
p value	-	0.231	<----------0.18---------->			0.621	0.267

Table 1 Characteristics of study population (continued)

Study groups	Hb (g %)	% Iron supplement	GA(wks) at delivery	Vaginal delivery	Cesarean delivery	Birth weight (g)
CHT	12.14±1.15	97.4	37.47±3.96	38(84.4%)	7(15.6%)	2778.00±521.68
Control	11.73±0.96	84.4	37.60±3.22	41(91.1%)	4(8.90%)	2917.33±22.17
p value	0.069	0.064	0.140	<--------0.218------->		0.209
PIH	11.82±1.13	95.6	36.24±3.56	35(77.8%)	10(22.2%)	2525.78±656.72
Control	12.14±1.15	100.0	37.47±3.96	41(91.1%)	4(8.90%)	2778.00±521.68
p value	0.199	0.475	0.127	<--------0.146------->		0.047

Table 2 Mean serum iron of CHT and controls

Phase of iron taken	CHT	Control	p value
Antepartum	73.39±30.49(n=18)	86.85±35.41(n=13)	0.266
Intrapartum	83.49±38.17(n=45)	78.67±41.72(n=45)	0.569
Postpartum	75.32±36.27(n=44)	65.89±35.89(n=44)	0.223

Table 3 Mean serum iron of PIH group and controls

Phase of iron taken	PIH	Control	p value
Antepartum	88.00±34.41(n=26)	78.92±34.70(n=26)	0.078
Intrapartum	115.98±78.08(n=43)	77.11±35.20(n=45)	0.004*
Postpartum	69.10±42.33(n=42)	63.60±25.10(n=45)	0.468

*Statistically significant

Table 4 Mean serum iron by study groups and pooled controls

Phase	Control	CHT	Control	p value
Antepartum	84.42±34.30(n=26)	73.39±30.49(n=18)	88.00±34.41(n=26)	0.076
Intrapartum	77.89±38.38*(n=90)	83.49±38.17*(n=45)	115.98±78.08*(n=43)	0.003**
Postpartum	64.73±30.74(n=89)	75.32±36.27(n=44)	69.10±42.33(n=42)	0.264

* Statistically significant for Scheffe's test
**Statistically significant for analysis of variance

Table 5 Mean serum iron by phase of blood samplings

	Antepartum	Intrapartum	Postpartum	p value
Control	84.42±34.30*(n=26)	77.89±38.38*(n=90)	64.73±30.74*(n=89)	0.009**
CHT	73.39±30.49(n=18)	83.49±38.17(n=45)	75.32±36.27(n=44)	0.463
PIH	88.00±34.41*(n=26)	115.98±78.08*(n=43)	69.10±42.33*(n=42)	0.008**

* Statistically significant by Scheeffe's test
**Statistically significant by analysis of variance

The PIH group also demonstrated a peak of the mean serum iron con centration during the intrapartum phase. The mean serum iron in the PIH group during ante-, intra-and postpartum phases were 88.00±34.41, 115.92 ±78.08 and 69.42 ± 42.33 μg% respectively.

Discussion

The results of this case-control study indicate that there is a transient but significant increase in the level of serum iron concentrations during intrapartum period of pregnancy-induced hypertensive patients, as documented by Entman et al[1]. The mean serum iron concentrations for the control and chronic hypertension groups, however, do not significantly change at the time of delivery. This finding is consistent with the value documented by Kaneshige[5], who also showed that mean serum iron concentrations in late pregnancy, intrapartum and

postpartum were not significantly different.

Iron metabolism of pregnancy has been studied extensively, it has been generally related only to anemia[6-9]. There have only been reports demonstrating the relationship between ferrokinetic changes and PIH[1,2].

In order to control the variables, 90 controls of this study were selected by matching to CHT or PIH patients for hemoglobin concentrations, history of iron supplementation, age group, and trimester of gestational age. It is well documented that hemoconcentration occurs commonly in PIH patients, especially in severe cases, and concern could be raised that the iron concentration changes are a reflection of the hemoconcentration. Among the patients in this study, hemoconcentration was, however, corrected by adequate hydration during the delivery phase, and clinical parameters of hemoconcentration, i.e. hemoglobin and hematocrit during labour did not show marked hemoconcentration. The hemoglobin, of course, was influenced by both hemoconcentration and blood loss.

Ferrokinetic changes in PIH group may be explained by the possible mechanism of increasing red cell destruction associated with either intravascular or extravascular hemolysis. There was evidence of erythrocyte destruction characterized by hemolysis, schizocytosis, spherocytosis, reticulocytosis, hemoglobinuria and occasionally hemoglobinemia[10,11]. These dearrangements result in part from microangiopathic hemolysis, which is the characteristic of PIH. It is likely that plasma erythrocyte membrane lipid changes that accompany pre-eclampsia are magnified by decreased serum albumin concentration and these serve to intensify fragmentation hemolysis. Hemolysis may be the explanation of ferrokinetic changes in PIH but the definite mechanism requires further ivestigation.

Serum iron concentration is influenced by biologic and laboratory variation on serial samplings. Although samples were drawn at various times, effectively randomizing the data, the degree to which diurnal variation might have an impact on the data should be considered. Winkel and associates[12] reported a 12.9% variation with higher levels in the afternoon, and they also noted an average 29% day-to-day variation for individuals[13]. Long and coworkers[14] reported that 18 of 25 subjects showed an average 21% decrease in iron levels in the afternoon, and 7 of 25 individuals showed an average of 20% higher levels in the afternoon, and of 25 individuals showed an average of 20% higher levels in the afternoon. These reports suggest that the impact of biological variation should be of minimal magnitude on the data presented.

These data suggest an acute and significant increase in serum iron concentrations associated with PIH, but not in CHT and normotensive pregnant women. The findings confirm those of Entman's studies[2,3]. The mean serum iron concentration in the antepartum phase was, however, not significantly different among the three groups, this result did not support the findings in

another Entman's report[3]. It may be possible that the population for the antepartum phase was too small to show the difference. The increase in serum iron concentration during delivery may not only serve as an adjunct to distinguish PIH from underlying CHT but might also be one of the parameters to reflect the severity of the disease.

The investigators concluded that the serum iron concentration increased during the delivery phase of pregnant women complicated with PIH compared with CHT and normotensive pregnant women and it might serve as adjunct to differentiate between PIH and CHT.

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Factors Associated with Term Infant's Birthweight of ≥ 3000 g at Ramathibodi Hospital

Sompol Pongthai MD, MPH,*
Kulsuda Jiamsuchon MSc.#

*Department of Obstetrics and Gynaecology,
#Division of Medical Statistics,

Faculty of Medicine, Ramathibodi Hospital,
Mahidol University, Bangkok 10400, Thailand

Abstract : *The aim of the National Economic and Social Development Plan (Phase VI) is to have at least 60% of infants born with a birthweight of ≥ 3000 g throughout the country. Biological, socio-economic and medical factors are all well known to be associated with infant's birthweight. This retrospective study, carried out during the first two years of the National Plan, was to find out the incidence and determine the association of maternal age, gravidity, weight at the time of labour, height, educational level, occupation, and complications during pregnancy with single liveborn infant weighing ≥ 3000 g at 37 weeks of gestation or more. The incidence of infant's birthweight of ≥ 3000 g was 68.1% and was significantly associated with all mentioned factors. Other than medical factors i.e. socio-economic and biological factors were also strongly associated. Reduction of teenage pregnancy as well as improvement of nutritional status are highly recommended and of great priority in reaching the target set in the National Plan. (Thai J Obstet Gynaecol 1990;2:67-72.)*

Key words : birthweight, associated factors, term infant birthweight of ≥ 3000 g

The aim of the National Economic and Social Plan, Phase VI (NESP VI) concerning maternal and child health is to have at least 60% of infants born with a birthweight of equal or more than 3000 g for the whole of Thailand[1]. To implement this, associated factors with infant's birthweight of ≥ 3000 g and < 3000 g should be determined and then a strategy should be worked out to decrease the number of infant's weighing less than 3000 g at birth.

Many factors are well known to be associated with infant's birthweight, that is to say biological factors such as maternal age, parity, gravidity, weight, height, etc.; socio-econo mic factors such as maternal education, occupation, etc.; medical factors

such as diseases, complications during pregnancy, etc.[2-4]. According to infant with low birthweight, small for gestational age is the most frequent contributor[5], while little is known about associated factors of infants weighing ≥ 3000 g at birth.

The aim of this study is to find out the incidence and to determine the association of some biological, socio-economic as well as medical factors with infants weighing ≥ 3000 g at birth at 37 weeks of gestation or more at Ramathibodi Hospital. The factors under study were maternal age, gravidity, weight at labour, height, educational level, occupation, medical and obstetric complications during pregnancy.

Materials and Methods

This was a 2-year retrospective study of all parturients who delivered single liveborn infants with a gestational age of 37 weeks or more (calculated from last menstrual period) at the Department of Obstetrics and Gynaecology, Faculty of Medicine Ramathibodi Hospital, from January 1, 1988 to December 31, 1989. The data were extracted from labour and delivery records. Incidence was reported in percentage. Association of maternal age, gravidity, weight at labour, height, educational level, occupation, medical and obstetric complications during pregnancy were tested by using *Chi-square test* and the statistical significance was determined at $p < 0.05$.

Results

The total livebirths were 14922 with 63.9% weighing 3000 g or more. There were 13613 parturients who delivered single liveborn infants with a gestational age of ≥ 37 weeks (92.5% of total single livebirths) and 9271 (68.1%) infants were ≥ 3000 g and 486 (3.6%) were < 2500 g, mean (μ) birthweight ± 1 standard deviation (SD) was 3181 ± 401 g (range 1220-5420 g).

Maternal age ranged from 15 to 46 years with μ ± 1SD being 28.3 ± 4.5 years. Most of them were multigravidae (56.9%). Their mean weight at the time of labour ± 1SD was 63.2 ± 8.3 kg (range 36-120 kg). Their height was 136.5-177.5 cm range and 154.3 ± 5.1 cm (μ ± 1SD). Ninety one per cent stated their education, that is to say 0.1% had no formal education, 32.0% primary school level, 12.0% secondary school level, 24.1% high school level or professional school and 31.6% with higher professional education or university degree. Ninety nine per cent mentioned their occupation i.e. 27.3%t housewives, 8.7% traders, 26.5% office workers, managers, academicians and administrators, 37.2% labourers and farmers.

Maternal age

Table 1 shows the incidence of infant's birthweight of ≥ 3000 g among each maternal age group. The teenagers (≤ 19 years) gave an incidence of 55.5% while the other age

groups gave more than 60%. The difference was statistically significant (X^2 = 14728.38,df=5).

Table 1 Infant's birthweight and maternal age

Maternal age (years)	Birthweight (g)			
	< 3000		≥ 3000	
	n	(%)	n	(%)
≤ 19	114	(44.5)	114	(55.5)
20-24	493	(37.0)	1607	(63.0)
25-29	1762	(32.2)	3700	(67.8)
30-34	1161	(28.7)	2877	(71.3)
35-39	326	(27.4)	861	(72.6)
≥ 40	36	(30.5)	82	(69.5)

Gravidity

As seen in Table 2, all groups show an incidence of more than 60% with infant's birthweight of ≥ 3000 g. The difference of these occurrences was statistically significant (X^2 =7921.37,df=5).

Table 2 Infant's birthweight and gravidity

Gravidity	Birthweight (g)			
	< 3000		≥ 3000	
	n	(%)	n	(%)
1	2107	(35.8)	3769	(64.2)
2	1470	(30.8)	3299	(69.2)
3	540	(26.2)	1523	(73.8)
4	157	(25.3)	464	(74.7)
5	46	(23.3)	151	(76.7)
≥ 6	22	(25.3)	65	(74.7)

Weight at the time of labour

The incidence of infant's birthweight of ≥ 3000 g among all weight groups was significantly different (X^2 =14233.80,df=8). The incidence was 32.0, 34.3, 48.7, 58.9, 71.2, 77.1, 80.0, 86.9, and 85.4% for each weight group of ≤ 44, 45-49, 50-54, 55-59, 60-64, 65-69, 70-74, 75-79 and ≥ 80 kg, respectively (Table 3).

Table 3 Infant's birthweight and maternal weight at labour

Maternal weight (kg)	Birthweight (g)			
	< 3000		≥ 3000	
	n	(%)	n	(%)
≤ 44	36	(35.8)	17	(32.0)
45-49	230	(30.8)	120	(34.3)
50-54	777	(26.2)	739	(48.7)
55-59	1177	(25.3)	1681	(58.9)
60-64	1021	(23.3)	2527	(71.2)
65-69	597	(22.9)	2006	(77.1)
70-74	277	(20.0)	1109	(80.0)
75-79	82	(13.1)	542	(86.9)
≥ 80	73	(14.6)	426	(85.4)

Height

As seen in Table 4, the association of maternal height and incidence of infant's birthweight of ≥ 3000 g was statistically significant (X^2=15236.82, df=7). There were 37.6, X^2 50.1, 58.5, 65.9, 72.2, 77.6, 81.4 and 76.0% of mothers whose height was ≤ 139, 140-144, 145-149, 150-154, 155-159, 160-164, 165-169 and ≥

170 cm, respectively.

Educational levels

The educational level shows significant association with the incidence of infant's birthweight of ≥ 3000 g (X^2=18467.88, df=3). As seen in Table 5, infant's birthweight of ≥ 3000 g accounted for 65.8% among no formal education or at primary school level, secondary school level 66.3%, high school level and professional school 68.5%, higher professional education or university degree 70.2%.

Occupations

The incidences of infant's birthweight of ≥ 3000 g among each occupational group (Table 6) i.e. labourers, housewives, traders and office workers were 66.8, 67.2, 68.3 and 70.7%, respectively. This difference was statistically significant (X^2= 10330.46, df=3).

Table 4 Infant's birthweight and maternal height

Maternal height (cm)	Birthweight (g)			
	< 3000		≥ 3000	
	n	(%)	n	(%)
135-139	10	(62.4)	6	(37.6)
140-144	159	(49.9)	160	(50.1)
145-149	805	(41.5)	1130	(58.5)
150-154	1678	(34.1)	3237	(65.9)
155-159	1188	(27.8)	3077	(72.2)
160-164	375	(22.4)	1300	(77.6)
165-169	54	(18.6)	236	(81.4)
≥170	10	(27.1)	27	(72.9)

Table 5 Infant's birthweight and maternal education

Maternal education	Birthweight (g)			
	< 3000		≥ 3000	
	n	(%)	n	(%)
None and Primary school	1366	(34.2)	2638	(65.8)
Secondary school	504	(33.7)	971	(66.3)
High school and professional school	947	(31.5)	2055	(68.5)
Higher professional education and university	1172	(29.8)	2765	(70.2)

Table 6 Infant's birthweight and maternal occupation

Occupation	Birthweight (g)			
	< 3000		≥ 3000	
	n	(%)	n	(%)
Labourers	1680	(33.2)	3385	(66.8)
Housewives	1219	(32.8)	2495	(67.2)
Traders	379	(31.7)	815	(68.3)
Office workers	1054	(29.3)	2552	(70.7)

Medical and obstetric complications during pregnancy

Table 7 shows that 65.2% of those who had complications had infant's birthweight of ≥ 3000 g while those without complications had 68.6%. The difference was statistically significant (X^2 = 9.75, df=1).

Table 7 Infant's birthweight and complications during pregnancy

Complications during pregnancy	Birthweight (g)			
	< 3000		≥ 3000	
	n	(%)	n	(%)
No	3593	(31.4)	7866	(68.6)
Yes	749	(34.8)	1405	(65.2)

Discussion

As aimed by the National Health Plan, 60% of infant's birthweight throughout the country should be ≥ 3000 g by the end of the 5-year NESDP VI in 1992, the Ramathibodi figure was found to be 68.1% for infants born at ≥ 37 weeks of gestation during the first two years of this plan. Since Ramathibodi Hospital is a University Hospital in Bangkok, the maternal characteritics are so typical and are much different from the general parturients of the country[6] i.e. mean age was 28.3 years, 50.1% was of second and third gravidae, mean weight at labour was 63.2 kg, mean height was 154.3 cm, 55.7% finished high school, 62% were housewives, traders and office workers, 83% had no complications during preg-nancy. All these factors can contribute to the higher proportion of infant's birthweight of ≥ 3000 g at this institute. Furthermore, when these factors were divided into subgroups, increased incidence of birthweight of ≥ 3000 g was also clearly demonstrated. Maternal age of 30-39 years, gravidity of ≥ 3, weight at labour of ≥ 60 kg, and height of ≥ 155 cm gave an incidence of more than 70%.

It is interesting to note that teenage mothers, those who weighed less than 60 kg at labour and whose height was less than 150 cm, not more than 60% could significantly deliver infants with a birthweight of ≥ 3000 g. These factors, although specifically biological, are still under socio-economic influence. The maternal height is mainly determined by nutrition at the time of the growth spurt period as well as genetic, inadequate nutrition or malnourish can result in a low height. The adequacy of nutrition is the result of combining influences from politics and socio-ecnomics. Maternal weight at the time of labour depends on adequate nutrition prior to and during pregnancy. This is also under the influence of politics, socio-economics and good antenatal care. Teenage pregnancy, meanwhile, can be one indicator of the country's social development. The higher the education is, the fewer the teenage marriages and pregnancy.

It can be concluded that factors beyond medical care play an important role in increasing the rate of infant's birthweight of ≥ 3000 g at 37 weeks of gestation or more. Reducing teenage pregnancy and improving nutritional status of the population are the major needs to accomplish this aim set in the National Development Plan.

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Ultrasonic Measurements of Fetal Biparietal Diameter in Normal Pregnant Northern Thai Women

Theera Tongsong MD,
Chanane Wanapirak MD,
Acharawan Yampochai BSc.

Department of Obstetrics and Gynaecology,
Faculty of Medicine, Chiang Mai University,
Chiang Mai, Thailand

Abstract : *Fetal biparietal diameters (BPD) were measured by two perinatologists, who were well-trained for obstetric ultrasound, using Aloka models SSD 630 and 650. The measurements were performed on 1230 occasions in 452 women during normal pregnancies between 14 - 40 weeks (ages range 17-38 years), 205 of whom having had one examination while the remaining 247 had 1025 examinations. For each week of gestational age, the measurements were done at least on 35 occasions. The gestational ages were based on the history of the last menstrual period, first trimester antenatal care clinic, and consistent with Dubowitz scores in every case. The mean increase in BPD between 14 - 30 weeks, 31 - 36 weeks and 37 - 40 weeks were 3.1, 1.9 and 1.3 mm/week respectively. The values of BPD for each gestational week in this study are baseline data for evaluation of fetal BPD growth in the northern part of Thailand. (Thai J Obstet Gynaecol 1990; 2: 73-79.)*

Key words : biparietal diameter, gestational age, normal pregnant northern Thai women

Accurate assessment of gestational age is one of the most important roles in diagnostic ultrasound. Measurement of the crown-rump length in the first trimester[1,2] or fetal biparietal diameter in the second trimester[2-4] is a precise method of determining gestational age.

BPD could be determined by ultrasound from 14 weeks through pregnancy and serial measurements give information for evaluation of fetal growth.

Results of BPD measurements in other, mostly European and American population have been published by several workers[2-4]. Jordaan[5] reported that the BPD measurements at term for a given weight showed biological variation in different population, although Dobowitz and Goldberg[6] advocated that racial origin did not influence the BPD measurement.

It was demonstrated that birth-

weight of Thai newborns was less than those of western newborns[7,8], therefore, it may not be suitable to use standard BPD growth of western data to evaluate pregnant Thai women. Little comparable information has been published from developing countries especially southeast Asia. The study of BPD growth in the central part of Thailand, but not in the north, has been reported[9]. We, therefore, decided to measure the fetal BPD with ultrasound in pregnant northern Thai women to create a normal fetal BPD growth curve for our population.

Subjects and Methods

The study included 452 pregnant northern Thai women attending the antenatal clinic at Maharaj Nakorn Chiang Mai Hospital. The subjects had to meet the following criteria : 1) history of regular menstruation and the exact date of the last menstrual period was known, 2) singleton pregnancy without medical or obstetrical complication, no evidence of intrauterine growth retardation and congenital anomalies, 3) attending antenatal clinic within first trimester of pregnancy and menstrual age consistent with clinical examination, 4) Dubowitz scores must be assessed and the scores confirm LMP (gestational age by Dubowitz scores must not be different from menstrual age by more than 2 weeks), 5) labour occured spontaneously within 2 weeks of predicted date of delivery.

The study was conducted between April 1989 and December 1990. The fetal BPD was measured on 1230 occasions in 452 pregnancies.

All scanning was done with Aloka models SSD 630 and SSD 650 scanner with a transducer frequency of 3.5 MHz. At each measurement, the midline echo of fetal skull, cavum septum pellucidum and thalamus were clearly visible on the scan display, and measurement of the BPD is made with electronic calipers (calibration based on a speed of sound in tissue of 1540 mm/second) from the outer margin of the proximal skull table to the inner margin of the distal skull table (leading edge to leading edge).

All examinations were performed by two of the authors (T.T, C.W.) who did not know the menstrual age of the patients. Dubowitz scores were assessed by only one pediatrician who had no information about the obstetric data of the patients.

Results

A total of 1230 measurements were obtained from 452 pregnant northern Thai women, 205 patients had one measurement each and 1025 measurements were obtained from the remaining 247 patients. The measurements were done from the gestational age of 14 weeks to 40 weeks, at least 35 measurements for each gestational week. The mean and 2 standard deviations (2SD) of BPD for each gestational week are shown in Table 1. The linear quadratic function was the best model for describing the relation be-

Table 1 Mean fetal BPD with 2 SD, 5th, 50th and 95th percentile for GA

GA week	No. of exam. (n)	Mean (cm)	2 SD (cm)	5th percentile	50th percentile	95th percentile
14	37	2.53	0.48	2.1	2.5	3.0
15	41	2.83	0.40	2.5	2.8	3.1
16	40	3.08	0.68	2.4	3.0	3.6
17	43	3.61	0.58	3.1	3.6	4.1
18	43	3.94	0.66	3.5	3.9	4.4
19	49	4.34	0.68	3.7	4.2	4.9
20	51	4.44	0.70	3.8	4.4	4.9
21	48	4.84	0.62	4.3	4.8	5.4
22	41	5.10	0.62	4.4	5.1	5.5
23	39	5.55	0.66	4.8	5.5	6.2
24	44	5.70	0.68	5.0	5.7	6.1
25	42	6.09	0.64	5.5	6.1	6.5
26	43	6.32	0.68	5.7	6.3	6.9
27	45	6.68	0.76	5.7	6.7	7.2
28	47	6.93	0.60	6.1	6.9	7.8
29	46	7.25	0.78	6.6	7.2	7.8
30	47	7.43	0.60	6.7	7.4	7.8
31	56	7.76	0.78	7.0	7.7	8.4
32	49	7.86	0.66	7.2	7.8	8.4
33	48	8.07	0.72	7.3	8.1	8.6
34	50	8.31	0.72	7.6	8.2	8.8
35	49	8.44	0.72	7.6	8.4	9.0
36	47	8.59	0.62	8.0	8.5	9.1
37	54	8.71	0.60	8.0	8.7	9.1
38	48	8.82	0.66	8.2	8.8	9.3
39	42	8.90	0.72	8.1	8.9	9.4
40	41	9.10	0.66	8.4	9.1	9.5

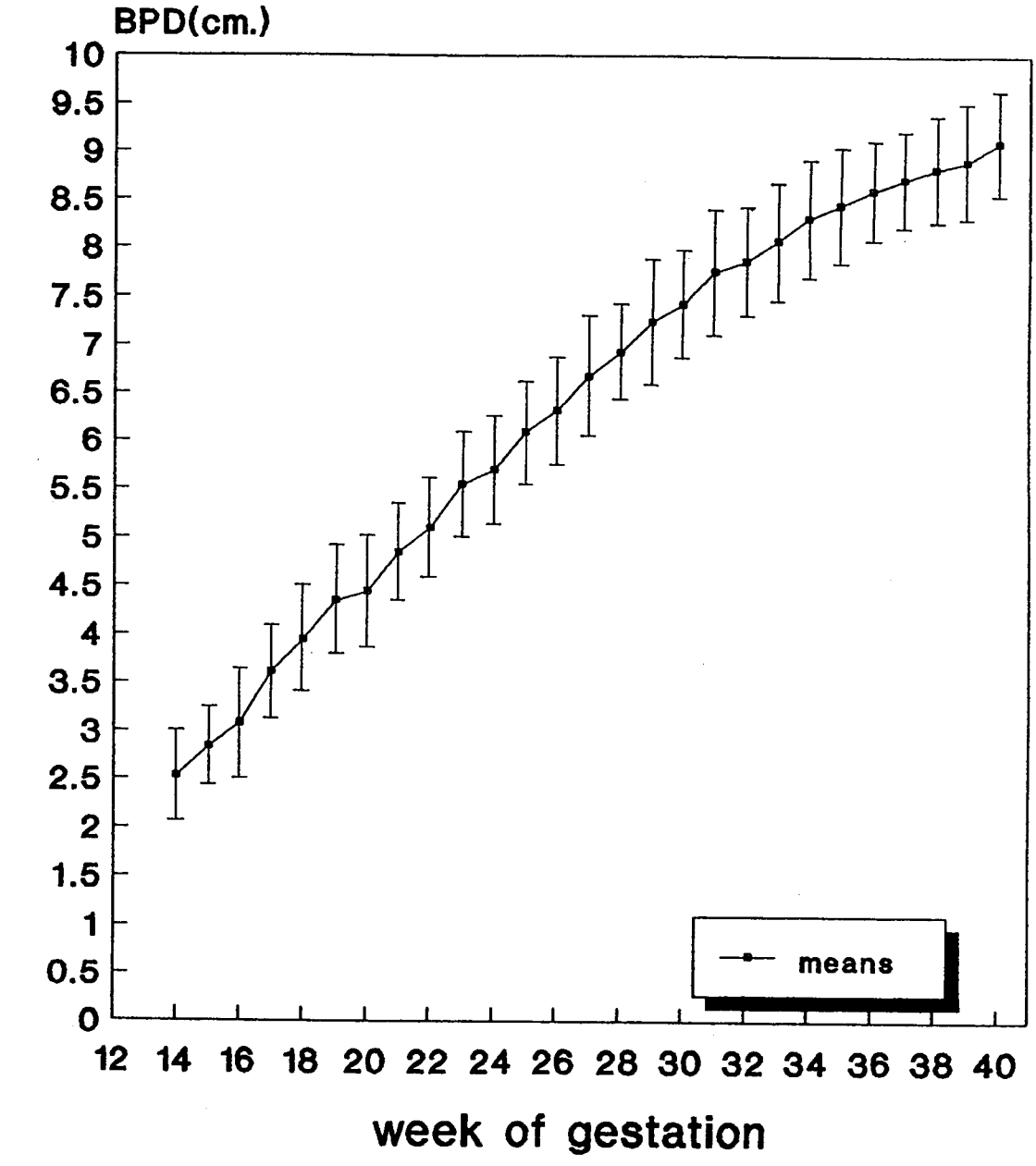

Fig. 1 Correlation between BPD and GA in normal pregnant northern Thai women.

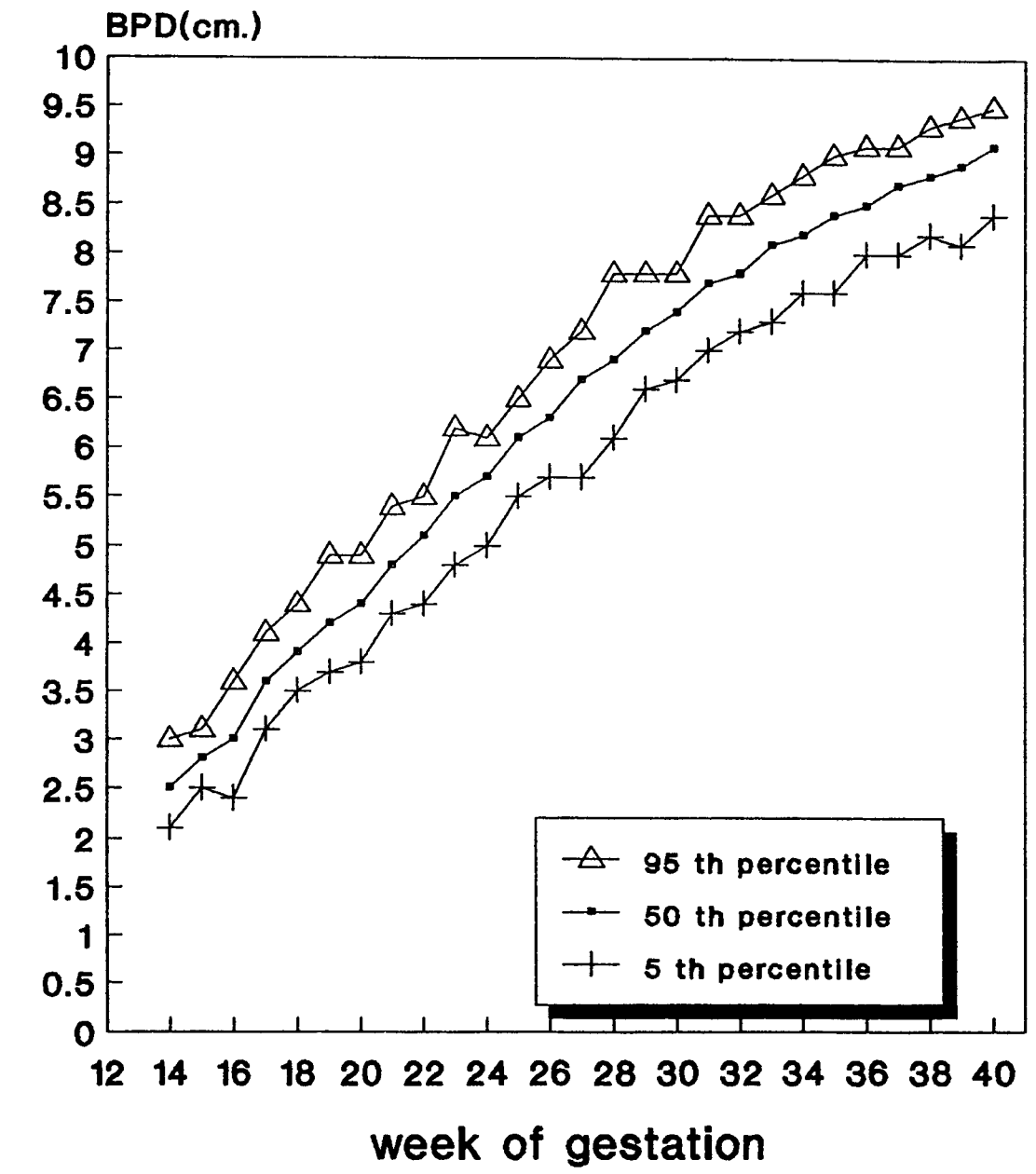

Fig. 2 Percentile chart of BPD in normal pregnant northern Thai women

tween BPD and gestational age (r = 0.98). The correlation was formulated, BPD = -4.25089 + 0.54998(GA) - 0.0 053847(GA2) [GA = gestational week]. Mean BPD values, 2 standard deviations, 5th, 50th and 95th percentile were calculated and are shown in Table 1.

From the tables, the means of weekly increase of BPD were 3.1, 1.9 and 1.3 mm/wk for 14 - 30 weeks, 31 - 36 weeks and 37 - 40 weeks respectively (Figs. 1,2).

Discussion

Two basic factors influence the fetal growth rate, intrinsic growth potential of the fetus which is genetically determined and the growth support it receives from mother and placenta.

Growth of fetal BPD in pregnant northern Thai population in this study shows an asymptotic curve like that of Caucasians as reported by other investigators[10-15]. In the second trimester, the BPD value of this study and that of the west are not too different, however, the values from pregnant northern Thai women are apparently lower in the third trimester. Comparison between the present study and another one at Chulalongkorn Hospital[9], mostly is not statistically significant different. Although our values are somewhat lower than those reported by western investigators, they, however, are consistent with those of the study in the central part of Thailand, the study at Chulalongkorn Hospital[9]. These findings suggest that the racial factor may be the important role in fetal BPD growth.

Our BPD growth curve does not show great variability of the standard deviation toward term, contrary to the western study[15], the growth curve of which shows a widening of the variability toward term.

Our results agree with the study of Jordaan[5] who found a biological variation in different populations for BPD measurements and emphasized the need for each institution to accumulate its own data to define the characteristics of the population it serves. Although our values were not so different from western studies during the second trimester, they were lower in our series than the others in late pregnancy[10-14].

The values from this study are important baseline data for evaluation of fetal BPD growth in our population and can be used as standard values of BPD growth of northern Thai population because they are created from various unselected socioeconomic status and adequate sample size. This growth curve is more appropriate for application with pregnant northern Thai women than the Caucacian standard curves[11-15].

Acknowledgements

The authors wish to thank the ultrasound unit staffs of the Radiology Department for their kind cooperation and valuable help. We also wish to thank Associate Professor Kamjad Swasdi-O and Associate Professor Suri Simarak for their encouragement.

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Ultrasonographic Fetal Abdominal Circumference in Normal Pregnant Northern Thai Women

Theera Tongsong MD,
Chanane Wanapirak MD,
Apiradee Takapijitra Bsc.

Department of Obstetrics and Gynaecology,
Faculty of Medicine, Chiang Mai University,
Chiang Mai, Thailand

Abstract : *The relationship between fetal abdominal circumference (AC) and menstrual age was determined from 14 to 40 weeks of gestation by analysis of 1193 measurements examined with linear array real-time ultrasound scanner. Mathematical modeling of the data demonstrated that the lincar quadratic function was optimal model (r=0.96). The correlation was formulated, AC = -8.89584 + 1.268717 (GA) - 0.00444334 (GA)^2 (GA=gestational weeks). Predicted abdominal circumference values for a given gestational week were determined and presented in tabular form. This measurement may be useful as an adjunct in predicting menstrual age in cases in which the BPD is technically inadequate or impossible to obtain due to unusual position. Additionally, fetal abdominal circumferences are useful as adjuncts to evaluate fetal growth or fetal weight. (Thai J Obstet Gynaecol 1990;2: 81-86.)*

Key words : abdominal circumference, gestational age, normal pregnant northern Thai women

It is possible to evaluate fetal growth or gestational age by sonographic measurements of biparietal diameter, femur length or abdominal circumference. The sonographic measurement of fetal abdominal circumference (AC) at the level of umbilical vein was described since 1975 for use in predicting fetal weight[1,2]. More recent reports have emphasized the usefulness of this measurement in monitoring normal growth, and in detecting intrauterine growth retardation. There is considerable evidence that the abdominal circumference is the most sensitive indicator of fetal size and that if the gestational age is reasonably known it will be equivalent to ultrasound measurement prior to 20 weeks. A low abdominal circumference is the most sensitive indicator for a small for gestational age fetus, especially asymmetrical intrauterine growth retardation[3]. Although the AC may be

no more accurate than head measurement in establishing fetal age, it may be useful as an adjunct to predict menstrual age with biparietal diameter(BPD) or femur length. The relationship between gestational age and AC in pregnant northern Thai women has not yet been reported. Because each institution should have its own data to apply to its population, we decided to perform this study.

Patients and Methods

Ultrasonographic AC measurements were prospectively obatined in normal pregnant northern Thai women attending the antenatal clinic at Maharaj Nakorn Chiang Mai Hospital at least 30 times per gestational week. The patients had to meet the following criteria : 1) history of regular menstruation and exact date of the last menstrual period known, 2) singleton pregnancy without medical or obstetrical complication; no evidence of intrauterine growth retardation or any congenital anomalies, 3) attending antenatal clinic within first trimester of pregnancy and clinical estimation of gestational age agrees with menstrual age calculated from dates and, 4) Dubowitz scores were confirmatory of this age. All scanning was done with Aloka models SSD 630 and 650 scanner with a transducer frequency of 3.5 MHz. The plane of section chosen for AC measurement was the axial plane at the level of the umbilical vein-ductus venosus complex. All measurements were performed by electronic elipse caliper, which is a new, more accurate technique. The measurements were made along the outer perimeter of the abdomen. The mean abdominal circumference values and their standard deviation, 5th, 50th, 95th percentile rank weekly intervals using standard method, each interval was centered on the week (e.g. 16 weeks interval, 15.5-16.49 weeks). Mathematical modeling of the relation of AC and menstrual age was carried out using the linear, linear quadratic and linear cubic models. Predicted abdominal circumference values for each gestational week were calculated, using the optimal models.

All examinations were performed by two of the authors (T.T, C.W.) who did not know the menstrual age of the patients. Dubowitz scores were assessed by only one pediatrician who had no obstetric data of the patients.

Results

A total of 1193 measurements of AC from 14 to 40 weeks were performed in 421 patients, 205 patients were measured only once in gestation while the remaining 216 patients were serially measured at least twice, with at least 35 measurements for each gestational week. The mean and 2 standard deviations (2SD) of AC for each gestational week were calculated and are shown in Table 1 and Fig.1. There was progressive linear increase from the first trimester toward term. Additionally, 5th, 50th, 95th percentile

Table 1 Mean fetal AC with 2 SD, 5th, 50th, and 95th percentile for gestational age

GA weeks	No. of exam. (n)	Mean (cm)	2 SD (cm)	5th percentile	50th percentile	95th percentile
14	35	8.58	1.78	7.4	8.5	9.7
15	39	9.21	1.56	8.0	9.2	10.0
16	36	9.91	2.34	8.1	9.9	12.0
17	43	11.52	2.16	8.9	11.5	13.2
18	41	12.49	2.00	10.9	12.2	14.0
19	49	13.84	2.36	11.8	13.4	16.7
20	50	14.60	2.56	12.2	14.5	16.0
21	49	15.80	2.61	13.9	15.6	18.0
22	40	16.83	2.12	15.0	16.8	18.4
23	39	18.12	2.90	15.8	17.8	20.4
24	43	18.74	2.42	16.7	18.7	20.6
25	43	19.95	2.52	17.2	19.8	21.5
26	42	20.74	3.24	18.0	20.6	23.3
27	47	22.27	2.82	19.8	22.3	24.3
28	47	22.76	3.66	19.7	22.8	26.0
29	49	24.34	3.86	21.5	24.1	27.7
30	47	25.16	3.56	22.1	25.0	27.7
31	57	26.48	3.50	23.6	26.3	29.3
32	49	26.84	3.18	24.2	27.0	29.3
33	50	28.60	3.64	25.7	28.7	31.8
34	50	29.16	3.12	26.5	29.1	32.4
35	49	30.51	3.60	27.4	30.3	34.9
36	48	31.03	3.42	27.8	31.2	33.5
37	55	31.88	3.72	28.5	32.0	34.5
38	48	32.83	3.38	30.4	32.8	36.0
39	42	33.78	3.38	30.4	33.8	36.0
40	41	34.38	3.58	31.0	34.6	37.0

are also shown in Table 1 and Fig. 2. The linear quardratic function was an optimal model for describing the relationship between AC and gestational age (r=0.96). The correlation was formulated, AC = -8.89584 + 1.26817 (GA) - 0.00444334(GA^2) (GA = gestational age in week).

Discussion

In this report, we defined the percentile ranks and variability for each gestational week of fetal abdominal circumference values from 14 to 40 weeks gestation. We have experienced some problems in the evaluation

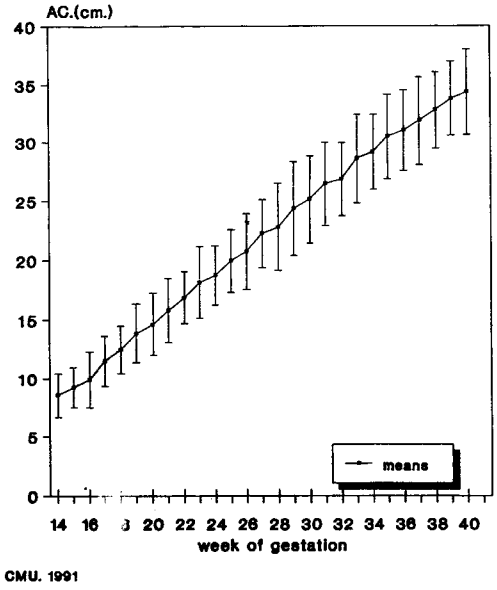

Fig. 1 Abdominal circumference and GA in normal pregnant northern Thai women.

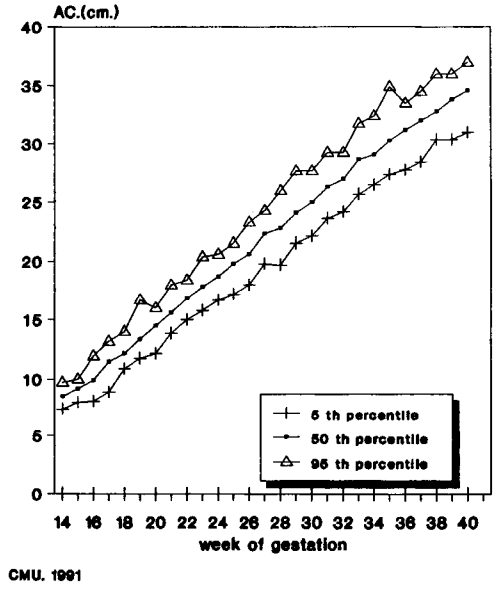

Fig. 2 Abdominal circumference and GA in normal pregnant northern Thai women.

of Thai fetus by using western standard data. Some evidences have shown that the birth weight of a neonatal Thai baby is lower than the Caucasian ones[4,5]. Because of this racial factor, we need our own data of AC to apply with our population. From our study, surprisingly, the values are not so different from those of western studies, so the racial factor may not influence the fetal abdominal growth. The variability of abdominal circumference for each gestational week is broader than that of that observed with BPD, nevertheless, this measurement can be useful as an adjunct to BPD or femur length to predict gestational age. Even with proper imaging and technique in normal fetus, the AC is not as accurate an age predictor as BPD or femur length. Although this could represent actual biological variability in AC size, it is more likely to be due to the poorly defined margins or the abdomen in comparison with bright margins of the fetal femur or skull[6].

In comparison, mean AC value of each week in a pregnant northern Thai population is not significantly different from those in western reports[7-10].

To create a normogram like this, the sample size calculated from the variabilty of the previous study[7-10], requires about 20 measurements for each gestational week, so we believe that this large series can be effectively used as a standard one for application with northern Thai women.

Potential sources of error in

using the AC to predict menstrual age are as follows : 1) imaging from a plane that is due to too low or too high in the fetal abdomen which generally results in underestimating age, 2) measuring from a section that is taken obliquely through the abdomen (which is usually characterized by an oval-shaped abdomen with a long segment of the umbilical vein) which will artificially increase the AC and, 3) using this measurement to predict age in pathological conditions such as growth retardation or macrosomia when the fetal abdomen is disproportionately small or large for age respectively.

We hope that this baseline data of AC in normal pregnant northern Thai population is significant for these reasons. First, the measurement may be useful as an adjunct in predicting menstrual age in case where the BPD or femur length is technically inadequate or impossible to obtain. Second, it is useful as an adjunct to evaluate fetal growth or fetal size in women who, for obstetric reasons, have to be delivered either in the late 2nd or early 3rd trimesters. In these women, the AC may be helpful in defining the chance for fetal survival because it is a relatively close predictor of fetal weight. Finally, fetal AC is useful as an adjunct in the diagnosis of some abnormalities. For example, when hydrocephalus is suspected, the presence or absence of disproportion between the fetal head and body, ascertained by comparing BPD and AC percentile rank is important not only in establishing the diagnosis, but also in delineating the severity of the condition. The severity and progression of fetal ascites can also be assessed by serial AC measurement.

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Genetic Amniocentesis : Five Years Experience

Sauwakon Ajjimakorn MD,*
Mayuree Jirapinyo MD,*
Chalermsri Thanuntaseth MD,*
Tongtis Tongyai MD,*
Daoroong Kangwanpong Dr rer nat.#

*Ultrasound and Prenatal Diagnosis Unit,
Department of Obstetrics and Gynaecology,
#Human Cytogenetic Unit, Department of Pathology,

Faculty of Medicine, Ramathibodi Hospital,
Mahidol University,
Bangkok 10400, Thailand

Abstract : *Three hundred and eighty-three women underwent genetic amniocentesis (A/C) for chromosome diagnosis. Two hundred and eighty-two were observed throughout their pregnancies and deliveries. Almost all A/C were performed by obstetricians who had been trained in prenatal diagnosis and genetic A/C. The risks of the procedure were minimal and the results were reliable. Three women had spontaneous abortions and eight pregnancies were induced. Two hundred and seventy-one were delivered after 28 weeks gestation. Only fifteen women had premature deliveries. The caesarean section rate in the series was 44%. There was one stillbirth and two neonatal deaths. (Thai J Obstet Gynaecol 1990; 2: 87-93.)*

Key words : genetic amniocentesis, karyotyping, outcomes of pregnancy

Genetic amniocentesis (A/C) permits possibilities in the diagnosis of serious genetic disorders prenatally. It plays an important role in clinical genetic practice and thus promotes the standard of modern obstetric care.

The prenatal diagnosis unit in the Obstetrics and Gynaecology Department, Ramathibodi Hospital has been operating since 1983. At the beginning, the karyotyping was performed at the Human Cytogenetic Unit, Anatomy Department, Chulalongkorn University until June 1985, thereafter, it was done at the Human Cytogenetic Unit, Pathology Department, Ramathibodi Hospital.

We report a five-year experience in genetic A/C performing and karyotyping at Ramathibodi Hosspital. This report analyzed the indications for A/C, the gestational age, the results of karyotyping, the follow-up and the outcome of the pregnancies.

Materials and Methods

A total of 383 cases of genetic A/C were performed from June 1985 to May 1990 using the technique described by Ajjimakorn et al[1]. In twin pregnancy, each sac was tapped. To distinguish between the two sacs indigocarmine solution was injected into the first after amniotic fluid was aspirated[2-4].

Results

The number of cases increased dramatically from 8 and 9 cases in 1985 and 1986 to 166 cases in 1989 respectively (Table 1). The mean age of the patients was 36 years (ranging from 15 to 47 years). Forty-nine per cent were between 35 and 39 years of age (Table 2). Thirty-five per cent were primiparae, 39% had only one child and 18% had two children. The mean gestational age at the time of A/C was 18 weeks (ranging from 15 to 32 weeks). Eighty-nine per cent of A/C were done under 20 weeks of gestation and only 2% after 26 weeks.

Table 1 Number of amniocentesis each year

Years	Number
1985 (from June)	8
1986	9
1987	45
1988	78
1989	166
1990 (until May)	77
Total	383

Table 2 Age of women at amniocentesis

Age	Number	Per cent
≤ 19	1	0.3
20 - 24	13	3.4
25 - 29	34	8.9
30 - 34	50	13.1
35 - 39	188	49.1
40 - 44	92	24.0
≥ 45	5	1.3
Mean age = 36 years		

Four cases were performed between 30 and 32 weeks following the clinical diagnosis of polyhydramnios and ultrasound scan was requested to exclude congenital anomalies. Symmetrical intrauterine growth retardation (IUGR)was diagnosed in two cases, one with two weeks and the other four weeks smaller than dates. Two congenital anomalies were detected, one had hydrops as well as cystic hygroma and the other had omphalocele. In all cases polyhydramnios was confirmed by ultrasound. Genetic A/C was recommended in every case to rule out genetic disorders. The karyotyping of both cases with IUGR showed that the fetuses were affected with trisomy-18, and that of hydrops fetalis and cystic hygroma was trisomy-21. The karyotyping in omphalocele was normal and the infant was delivered abdominally at term with a pediatric-surgeon standing by. Operative correction of the defect was performed on the following day and the baby survived for 210 days postoperatively. One case of trisomy-18 was terminated outside the hospital. The other cases of trisomy-18

and trisomy-21 were terminated in this hospital and the karyotyping were confirmed using blood and tissue from the fetuses.

The most common indication for A/C was maternal age (68.7%). Ten per cent previously gave birth to Down's syndrome children and an equal number of 5% each had either children with congenital abnormalities or a family history of chromosomal disorders (Table 3). The success rate in performing A/C with the first puncture was 98%. Most of the fluid was clear (95%),4% was blood-stained and 1% had meconium-stained.

There were two sets of twin pregnancy in this series, one was diagnosed and the other was not. Of the undiagnosed twins, the karyotyping was 46,XX while the infants were born at term of different sexes.

Table 3 Indications of amniocentesis

Indications	No.	Per cent
Maternal age	263	68.7
Previous Down's syndrome	41	10.7
Preivous Trisomy-18	3	0.8
Previous Trisomy-13	2	0.5
Unidentified chromosome disorder	2	0.5
Family chromosome disorder	19	5.0
Previous malformed fetus	22	5.7
X- linked disease	3	0.8
Miscellaneous	28	7.3
Total	383	100.0

Karyotyping results

The culture time ranged from 7 to 43 days, mean average 15 days. Culture failure occurred in 10 cases (2.6%) but all except one case who refused repeat A/C were successful in the second culture. One had fetal skin with lanugo hair contamination. There were thirteen cases (3.4%) of abnormal karyotypings as follows, three trisomy-18, three trisomy-21, three balanced translocations, two deletion X and one of which was trisomy-18, one Kleinefelter syndrome, one mosaicism and one inversion Y (Table 4).

Table 4 Abnormal karyotyping results and pregnancy outcomes

Karyotyping results	No.	Pregnancy outcomes
Trisomy-18	3	TOP
Trisomy-21	3	TOP
Balanced translocation	3	CP
Deletion X (1 had trisomy-18)	2	1 CP, 1 TOP
Kleinefelter syndrome	1	TOP
Mosaicism	1	CP
Inversion Y	1	CP
Total	13	

TOP = Termination of pregnancy
CP = Continuing pregnancy

Follow-up

Only 282 out of 383 women (73%) were known pregnancy outcomes (Table 5). Three cases (1%)

Table 5 Pregnancy outcomes

Pregnancy outcomes	No.	Per cent
Spontaneous abortion	3	1.1
Induced abortion	8	2.8
Premature delivery	15	5.3
Term delivery	256	90.8
Total	282	100.0

aborted spontaneously at 16, 18 and 20 weeks gestation. Eight women had pregnancies terminated for the following indications : three with abnormal karyotypings, one fetal anomalies, one maternal Down's syndrome, one maternal mental retardation and two for social reasons. Three pregnancies were terminated before term. One stillbirth and two neonatal deaths were noted. Stillbirth was due to rupture of the varicose vein of the uterus at 30 weeks gestation. Two neonatal deaths were infants affected with trisomy-18 and trisomy-21 and were induced prematurely. The trisomy-18 with IUGR fetus was induced at 35 weeks gestation and the infant weight was 1220 g. The hydrops fetus affected with trisomy-21 was induced at 32 weeks and the infant weighed 2220 g.

Fifteen infants(5%) were delivered prematurely including three cases of affected fetuses who had preterm induction. Three weighed less than 1500 g, three weighed between 1500 and 1999 g and nine weighed between 2000 and 2499 g. Two hundred and fifty six cases (90.8%) were delivered at term. The mean infant's weight was 3061 g.

Sex prediction was correct in all except one at the beginning of the series where the expected female infant was a male.

Forty-six per cent had normal vaginal deliveries, 44% caesarean section, 5% vacuum extraction, 4% forceps extraction and 1% of breech assisting(Table 6). The common indi-

Table 6 Types of delivery

Types of delivery	No.	Per cent
Normal vaginal delivery	124	45.8
Caesarean section	119	43.9
Vacuum extraction	14	5.2
Forceps extraction	10	3.7
Breech assisting	4	1.4
Total	271	100.0

cations of caesarean sections were previouss caesarean section and elderly primigravida, 37.8% and 18% respectively.

Discussion

The increased number of A/C performed in our institution was due to improved public knowledge and awareness of prenatal diagnosis[5,6]. This has been well exemplified in several reports[7-10]. The mean gestational age at A/C was 18 weeks while we scheduled to perform the procedure between 16 and 18 weeks. Almost all of the late cases were polyhydrammios clinically diagnosed in the third trimester and ultrasound scan showed either fetal congenital anomalies or symmetrical IUGR. Several authors

have suggested karyotyping on fetuses with congenital anomalies diagnosed by ultrasound[11-13]. Rizzo[13] reported a very high incidence of chromosomal disorders associated with cystic hygroma(76.9%). He also reported the incidence of abnormal karyotyping on omphalocele, 33% when discovered as an isolated finding and 83.3% when associated with other malformations. In this series, one case of hydrops fetalis with cystic hygroma the karyotyping was trisomy-21 while that of omphalocele fetus was normal. The omphalocele infant also had tracheoesophageal fistula which was diagnosed postnatally. The operative correction was very complicated and the baby died 210 days after the operation.

Both of our cases of symmetrical IUGR associated with polyhydramnios were affected with trisomy-18. The retrospective ultrasound scanning revealed clenched fists and rocker-bottom feet in both fetuses. These findings may signify the intrauterine diagnosis of trisomy-18 by ultrasound scan. Although trisomy-18 is a lethal condition with a fetal loss rate of about 70%[14], the knowledge of fetal chromosome constitution has important implications in the management of the pregnancy and in counseling the couples[15].

Maternal age indication increased from 40 to 68%, whilst history of a previous child with chromosomal disorders decreased from 52 to 12%[1]. This change was similar to the Oxford series of eight years surveillance in which maternal age indication rose from 68 to 92% and the history of a previous child with chromosomal disorders decreased from 32 to 6 %[7].

The amniotic fluid was successfully obtained at first attempt (98%) and most were clear (95%). Ten cases required second A/C because of culture failure. Nearly all A/C were performed by one of the authors (SA, MJ, CT, TT) who had been trained in genetic A/C. One case of fetal injury in this series as shown by the presence of fetal skin and lanugo hair in the cultured cells was performed by an obstetrician who was not in the genetic A/C team. It has been concluded by working group all over the world that genetic A/C is a safe, accurate, reliable and of minimal risk only if it is performed by a team that provides the necessary expertise [16-18]. Gerbie and Elias[19] recommended that A/C should be performed by obstetricians and gynaecologists 1) experienced in this procedure, 2) with the availability of high quality ultrasonography and, 3) with access to a laboratory with experience in culturing and analyzing amniotic fluid cells.

The A/C in multiple pregnancy was simple, following identification of the number of fetuses and their sacs by careful ultrasound scan. We used indigocarmine solution injection into the first sac after fluid aspiration, the following sac could be easily distinguished. Diagnosis of twins can easily be missed especially at the beginning of the program[7,21,22] as we also found in this series.

Culture failure was found in ten cases (2.6%) and most of them occurred in the early stage of the program.

Thirteen cases in the series which comprised 3.4% had chromosomal aberration. Of these, eleven cases (2.9%) were between 35 and 47 years of age while Ferguson-Smith and Yate[23] in 1984 reported all chromosomal aberration in a maternal age 35 years and over was about 2.26%. Among thirteen cases of abnormal karyotypings, seven cases with serious chromosomal disorders were selected for pregnancy termination after post A/C counseling, three were terminated between 20 to 24 weeks (2 trisomy-21,1 Kleinefelter syndrome), four were terminated between 28 to 35 weeks (3 trisomy-18,1 trisomy-21). The prenatal diagnosis was confirmed in 4 cases by fetal blood and/or fetal tissue. Six continued pregnancy until term and the fetal outcomes were phenotypically normal.

We had 1% of spontaneous abortion which was the same as other reports[20-22], and 1% of stillbirth and neonatal death. Stillbirth was due to rupture of the varicose vein of the uterus and was unlikely to be related to the procedure. Trisomy-18 and trisomy-21 could have accounted for the two neonatal deaths.

The overall premature delivery rate at Ramathibodi Hospital is about 7% and in this series was 5%. Caesarean section rate was almost double compared with the hospital rate, 44% and 25% respectively. The reasons for higher caesarean section rate were history of previous caesarean section as well as advanced maternal age.

We conclude that genetic A/C is a great asset in modern obstetric care. It is safe, accurate, reliable and of low risk when performed by well-trained persons, preferably obstetricians. The diagnosis guides us to the proper management of pregnancy and, thus, prevents birth with serious chromosomal disorders.

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The Epidemiology of Ovarian Cancer in Khon Kaen 1985-1989

Prasit Pengsaa MD,*
Banchong Udomthavornsuk MD,*
Vitaya Titapan MD,*
Vanchai Vatanasapt MD,#

*Department of Obstetrics and Gynaecology,
Faculty of Medicine, Khon Kaen University, Thailand
#Cancer Unit, Faculty of Medicine,
Khon Kaen University, Thailand

Abstract : *The data were collected from the Khon Kaen population-based cancer registration which is one of two population-based cancer registrations of Thailand. It covers the population of about 1.5 million in 20 districts. The female population from 1985 to 1989 was about 750000 to 800000.*

There were 136 new cases of ovarian cancer recorded in this 5-year period. The aged-standardized rate from 1985 to 1989 was 4.49, 4.26, 4.42, 7.09 and 2.72 per 100000 population per year respectively. The age-standardized mortality rate was 1.95, 0.82, 0.95, 0.88 and 0.34 per 100000 population per year respectively. (Thai J Obstet Gynaecol 1990 ; 2: 95-101.)

Key words : ovarian cancer, epidemiology, cancer registry

In developed western countries, ovarian cancer is the sixth most common cancer in women, accounting for about 4% of all female cancers. It is the leading cause of death from cancer in women in the United States and results in about 5% of all deaths from cancers[1]. Up to now there has been no report concerning population-based statistics of ovarian cancer in Thailand. The National Cancer Institute of Thailand reported the cancer statistics collecting the data from several hospitals voluntarily with a few incentives in 1982 but the data seems to be underregistered[2]. This report is the first population-based data of ovarian cancer in Thailand.

Materials and Methods

All cancer cases diagnosed during the period from January 1985 to December 1989 in all hospitals in

Khon Kaen province were collected according to the technic described by Maclennan[3]. There were 22 governmental hospitals and 5 private hospitals. All the cancer deaths registered in the death certificates were reviewed and collected during the same period. The analysis of data for the incidence and mortality rates for 100000 population both crude rate and age-standardized to world population (Table 1) were done by direct method[4,5]. Case fatality rate was obtained from the number of deaths from ovarian cancer in each year divided by the number of new cases in the same year and expressed in per cent.

The female population data of Khon Kaen province was obtained from the office of the National Economic and Social Development Boards for the year 1986 to 1989[6]. Since the 1985 estimation was not available, the 1986 data was used for calculation (Table 2).

Table 1 Standard world population

Age	World population
0-4	12000
5-9	10000
10-14	9000
15-19	9000
20-24	8000
25-29	8000
30-34	6000
35-39	6000
40-44	6000
45-49	6000
50-54	5000
55-59	4000
60-64	4000
65-69	3000
70-74	2000
75+	2000
Total	100000

Results

Incidence rates

Between January 1, 1985 and December 31, 1989, there were 136 cases of ovarian cancer collected (Table 3). The crude incidence rates varied from 2.72 to 4.89 cases per 100000 population per year and the age-specific incidence rates varied from 3.88 to 7.01 cases per 100000 population per year.

The age distribution of ovarian cancer in Khon Kaen province was presented as biphasic distributions (Figure 1). The young age group with the peak of 20 to 24 years and the old age group with the peak of 45 to 49 years. Most patients were married and only 12.5% of them were single (Figure 2). Figure 3 shows the first hospitals record of those ovarian cancer cases, most of them were from big hospitals in town. Three-fourth of the cases were in the late stages by the time of registration (Figure 4), only 8.8% of the cases were in stageI. The sites of metastasis are shown in Figure 5, the most common sites were liver, lymphnodes, lung and pleura, and brain. Figure 6 shows the mode of diagnosis of those cancer cases 73.5% of which had histological diagnosis. Figure 7 shows the treatment modali-

Table 2 Khon Kaen female population in the years 1985-1989

Age groups	1985	1986	1987	1988	1989
0-4	97100	97100	96400	95700	94700
5-9	101900	101900	100200	98600	97200
10-14	103900	103900	103700	103400	102700
15-19	94600	94600	96800	98500	99700
20-24	73000	73000	77600	81900	85600
25-29	58200	58200	59900	61000	63100
30-34	50000	50000	51600	53200	54700
35-39	42100	42100	43400	44700	46100
40-44	34800	34800	36100	37400	38600
45-49	29800	29800	30300	31000	31800
50-54	25400	25400	26000	26700	27400
55-59	19900	19900	20900	21700	22500
60-64	14900	14900	15500	16200	16900
65-69	10600	10600	11000	11500	12000
70-74	7300	7300	7400	7600	8000
75+	7300	7300	7500	7800	8100
Total	770800	770800	783800	796900	809110

The population data in the year 1985 is not available, the figure of population of the year 1986 is used instead.

Table 3 Number of new cases of ovarian cancer in Khon Kaen province, Thailand, from 1985-1989

Years	No. of patients	CR	ASR
1985	23	2.98	4.49
1986	26	3.37	4.26
1987	23	2.93	4.42
1988	42	4.89	7.07
1989	22	2.72	3.88

CR = Crude rate
ASR = Age standardized rate

ties of ovarian cancer in Khon Kaen province, 75% of the cases had been operated on and about 40% of those had been treated by chemotherapy.

Mortality rate

Deaths from ovarian cancer for the population in Khon Kaen province from 1975 to 1989 are shown in Table 4 with crude and age-standard-

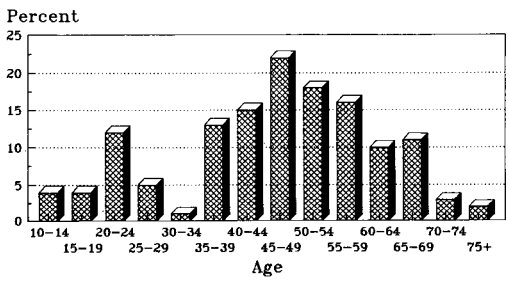

Fig. 1 Age distributions of ovarian cancer in Khon Kaen province 1985-1989.

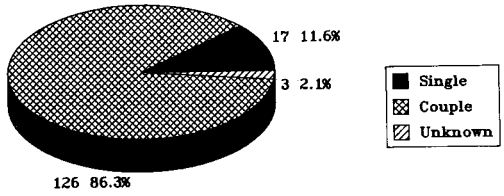

Fig. 2 Marital status of ovarian cancer in Khon Kaen province 1985-1989.

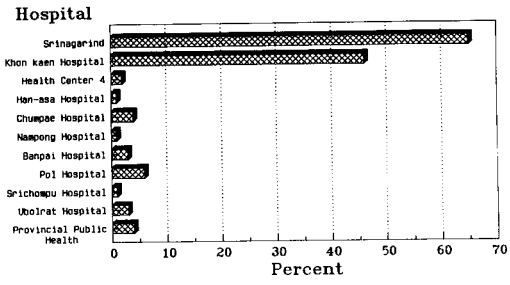

Fig. 3 First hospital registration of ovarian cancer in Khon Kaen province, 1985-1989.

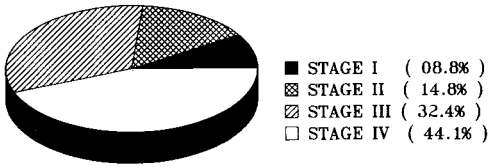

Fig. 4 Staging of ovarian cancer in Khon Kaen province 1985-1989.

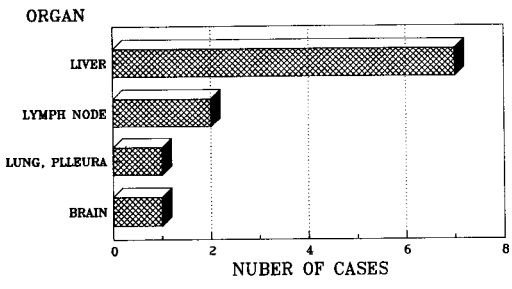

Fig. 5 Sites of metastasis of ovarian cancer patients in Khon Kaen province, 1985-1989.

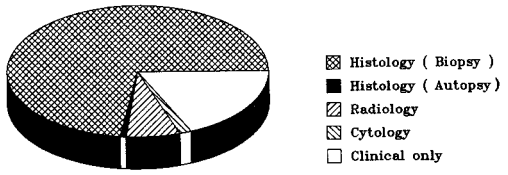

Fig. 6 Mode of diagnosis of ovarian cancer in Khon Kaen province 1985-1989.

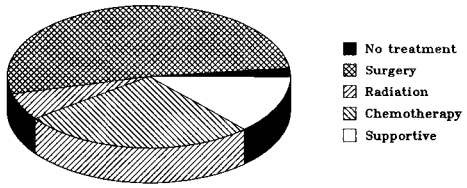

Fig. 7 Treatment of ovarian cancer in Khon Kaen province 1985-1989.

Table 4 Deaths from ovarain cancer 1985-1989

Years	No. of patients	CMR	ASMR
1985	5	0.64	1.95
1986	6	0.78	0.82
1987	4	0.51	0.95
1988	9	1.13	8.8
1989	2	0.25	3.4

CMR = Crude mortality rate
ASMR = Age-standardized mortality rate

ized mortality rate. The age-standardized mortality rate ranged from 0.82 to 8.8 cases per 100000 population per year. Case fatality rates of ovarian cancer in Khon Kaen province varied from 8.76% to 43.42% and the rates were decreased (Table 5).

Table 5 Incidence and mortality rates of ovarian cancer in Khon Kaen, Thailand, 1985-1989

Years	New cases	Incidence/100000		Mortality/100000		
		Crude incidence	Age-stardard-ized	Crude MR	Age-standard-ized	Case fatality rate (%)
1985	23	2.89	4.49	10	1.95	43.42
1986	26	3.37	4.26	5	0.82	19.25
1987	23	2.93	4.42	5	0.95	21.49
1988	39	4.89	7.07	5	0.88	12.44
1989	22	2.72	3.88	2	0.34	8.76

Table 6 Cancer of ovary, cervix and all cancers at Srinagarind Hospital, 1985-1989.

Years	Ovary	Cervix	Total Cancers
1985	64	329	2034
1986	64	416	2533
1987	96	451	3653
1988	94	483	3655
1989	91	605	4101
Total	409	2284	15976

Discussion

From the same registry, ovarian cancer is the second most common cancer for gynaecological cancers in Khon Kaen province next to cervical cancer of which the age-standarrdized incidence rate was 17.2 per 100000 population per year[7,8]. By the hospital-based registration, ovarian cancer ranged from 64 to 96 cases per year and comprised only one-sixth of cervical cancer (Table 6). Even though, ovarian cancer is low for the Thai population as a whole compared with some developed countries (Table 7), for a referral center like Srinagarind Hospital it is a problem. As Thailand is developing from an agricultural country to be an industrialized one, the risk of ovarian cancer is increasing. The high rate for ovarian cancer were from those who had an ovarian cancer-prone family, more than 40 ovulation years and mother or sisters with ovarian cancer. Those who were above 45 years old with nulliparity, or first pregnancy after age 30, late menopause and regular perineal exposure to talc are also significant risk of ovarian cancer. Other possible risk factors include a history of ionizing irradiation to the pelvis. It has also been linked with carcinoma of the breast, endometrium, and colon suggesting a common aetiology. There is no clear means of prevention of ovarian cancer and the treatment results reported are

Table 7 Incidence of ovarian cancer in some selected countries in the world[5]

Country	Registry	ASR*
Europe		
Norway	The Cancer Registry of Norway	15.3
Sweden	The Swedish Cancer Registry	15.2
Denmark	The Danish Cancer Registry	14.5
Iceland	The Icelandic Cancer Registry	13.9
Germany	Hamburg	12.8
U.K.	Oxford	12.6
Spain	Navarra	6.4
America		
California	Alameda, white	12.1
	Alameda, black	10.5
Connecticut	Connecticut, white	12.0
	Connecticut, black	7.3
Canada	National	11.5
	Alberta	11.1
	British Columbia	10.6
Asia		
China	Shanghai	5.0
Hong Kong	Hong Kong	5.8
India	Bangalore	5.9

Approved by International Agency for Research on Cancer, WHO
*ASR = Age-standardized incidence rate.

still poor. Comparing the case fatality rate of ovarian cancer to that of cervical cancer at the same registry it is twice as high. The problem of ovarian cancer to referral centers is increasing, both the treatment and the result. Surgery is considered to be the first choice, followed by adjuvant chemotherapy. The cost of chemotherapy is increasing and without satistactory results[9]. In the next few years ovarian cancer will be the main problem for gynaecologists in Thailand.

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Consumer Preference Study of the Female Condom in a Sexually Active Population at Risk of Contracting AIDS

Chuanchom Sakondhavat MD,*
Yuthapong Werawatakul MD,*
Arawan Borkam MD,*
Pattamavadee Pinitsoontorn BSc,#
Chusri Kuchaisit MS,*
Soontorn Sakammai BSc,*
Punnee Kukieattikool BSc.*

*Department of Obstetrics and Gynaecology,
Faculty of Medicine, Khon Kaen University,
#Family Planning Unit,
Faculty of Medicine, Khon Kaen University,
Khon Kaen 40002, Thailand

Abstract : *During February 1989, in Khon Kaen, northeast Thailand,20 women at high risk of contracting sexually transmitted deseases were trained in the use of the female condom. Each voluntary participant in this trial was given a supply of 20 condoms and 4 bottles of lubricant. After two weeks, each of the women was interviewed by researchers. The 20 volunteers reported having 247 episodes of vaginal intercourse in the two weeks and used the female condom in 78, or 32%, of episodes. The female condom was tolerated well by the women users but was not popular with male partners. Men found the female condom unattractive and complained that it reduced sensation. Users reported that the (US manufactured) female condom was too long and wide and did not stay in place. The users generally expressed the view that, if the male partner did not object, the women would willingly use a female condom. The conclusion of the author is that the female condom will be acceptable to highly sexually active women in Thailand if (1) the partner does not object to the use of the female condom and (2) the design of the condom is appropriate for the Thai anatomy. (Thai J Obstet Gynaecol 1990; 2:103-109.)*

Key words : female condom, AIDS

HIV infection in Thailand is increasing most rapidly among intravenous drug users in Bangkok. Now it appears that AIDS is beginning to spread rapidly among female commercial sex workers who populate every province in Thailand.

This study was conducted in anticipation of the eventual spread of AIDS into the large population of

commercial sex workers (CSWs). The need for a method to help the women protect themselves from AIDS infection was clearly indicated by a previous study conducted by the authors in 1987[1]. In that study it was found that only half of the customers of female CSWs in Khon Kaen used condoms during vaginal intercourse. All the women in the study wanted complete protection from contracting AIDS and other sexually transmitted diseases (STDs) but were not always able to convince their partners to wear condom.

A vaginal sponge to prevent STDs and conception has already been tested in a Bangkok high-risk population with limited success[2]. However, to prevent STDs and HIV infection it is clear that a more comprehensive barrier method is needed. The invention of the female condom by a Danish gynaecologist offered the first opportunity to place effective STDs prevention in the hands of women themselves[3].

The manufacture of this condom was adapted by Wisconsin Pharmacal in the United States. Through Family Health International a supply of 400 female condoms were shipped to Khon Kaen, Thailand, in February, 1989 for a field trial among twenty highly sexually active women with multiple partners.

Objectives

The objective of this study is to determine the use-effectiveness of female condoms in Thai rural CSWs.

The goal of the study is to help the development of a greater variety of methods that can be used to prevent the contract and spread of AIDS.

Methodology

Twenty sexually active women who had multiple sexual partners were the subjects. These women were selected because they were at high risk of contracting STDs and because their profession enabled the collection of a variety of male partners' reactions to the female condom in a short period of time. Only women currently using contraception were eligible to participate.

As a pre-test, four CSWs who were not the 20 subjects were trained in the use of female condoms and given a supply of ten pieces plus two bottles of lubricant each and told to try using the condom for one week. The purpose of this pre-test was to gather practical information to enhance the content of the training instructions. In addition the pre-test was an exploratory step to determine that the female condom could, in fact, be used by this high-risk group.

The 20 subjects, all worked in the same establishment, volunteered to participate in a two-week trial of the female condom. Their employers gave full support and cooperation for the field trial.

During a period of three hours before they began to work, the 20 vol-

unteers were given an overview of AIDS by an experienced gynaecologist and how AIDS can be prevented. Next, the female condom was described to them. Then the 20 participants split into four groups of five to learn more about the female condom and practice inserting the condom by using a full scale pelvic model. Four nurses conducted these small group sessions.

At the end of the small group sessions, each participant was given a Thai-language pamphlet on how to insert and to remove the condom, a supply of ten unlubricated, female condoms and two bottles of lubricant supplied by the condom manufacturer. The participants were informed that they would be interviewed on their experiences after the first and second weeks. They were told how to obtain resupplies of condoms and lubricant and all women were instructed not to reuse the condoms and to return any unused supply.

To conserve time, the 20 women were interviewed at their place of employment by the same four nurses, who were split in conducting in-depth interviews and who also conducted the group training.

The questionnaire was developed through collaboration with FHI and went through a number of revisions before attaining the final version. Because of the small number of respondents and the use of some open-ended questions the data were hand-tabulated.

All subjects were offered free blood tests to screen for HIV infection and syphilis. Pelvic examination was perfomed once a week as a regular check up.

Results

A total of 17 of the 20 subjects were interviewed twice. Three were interviewed after one week but were not available at the end of two weeks. Similarly, three were not available at the end of one week but were interviewed at the end of the second week. For the 17 women who were interviewed twice, the results of the second interview were presented.

Patient characteristics

The twenty volunteers in this feasibility trial of the female condom have the following characteristics:

Age : ranged from 16 to 35 with a mean of 27.2 years.

Education : ranged from none to junior college; 14 had primary education (equivalent to sixth grade).

Fertility : 17 had been pregnant before, 11 had given livebirths, while 15 had a history of abortion. Mean gravida was 2.6, mean number of abortions was 2.3, and mean fertility was 0.7 livebirths.

STDs : 13 have had gonorrhea. The results of the blood tests did not find any HIV infection while 6 have had syphilis.

Contraceptions : 18 used the pills, 2 used the injectables.

Product used and women's perceptions

During the two weeks of the trial, the 20 volunteers had 247 acts of vaginal intercourse. The female condom was used in 78 (31.6%). All 20 participants tried to continue using the condom throughout the two weeks of the trial. The most common reason for discontinuing the use of the condom was the male client's objection. However, the general assessment of the condom from the female perspective was positive. Two–thirds of the volunteers had no aversion to the female condom although one-third said they disliked it.

Mechanically, the female condom performed well. No rips or tears during intercourse were reported, and no woman reported severe pain. The most uniform woman's objection to the condom was its large size. The US manufactured condom was reported to be too long and too wide for the Thai women in this trial. Virtually all women felt they had received adequate training in the insertion of the female condom but more than one-third found the process of inserting the condom to be a nuisance.

Male partner's reaction

In contrast to the women in this study, the man's reaction to the condom was negative (as reported by the women). No male partners were interviewed in this study. Ten out of the twenty volunteers reported that all their partners disliked the condom. Eight said some of their partners disliked the condom, while some liked it. Two of the twenty women reported that all of their partners liked the female condom.

Discussion

This study demonstrated that high-risk women for AIDS and other STDs can be rapidly and effectively trained in the use of a female condom. All twenty volunteers in this two weeks study were promiscuous and were compensated for their labour in proportion to their partner's sexual satisfaction. Yet, all the women were able to convince some of their partners to allow them to wear the female condom which is visible to the man and takes several minutes for the women to insert.

The least surprising finding of this feasibility trial of the female condom was the partner's objection. The men objected on aesthetic and sensual grounds. It is more noteworthy, perhaps, that the women were able to use the condom at all and that some reported that all their partners liked the female condom. All female participants were of the attitude that if the partner did not object, they would gladly use the female condom during each episode of intercourse. The major constraint to female condom acceptability is clearly partner's objection.

An unexpected finding of the study was that the US manufactured

Table 1 Product used

	No.	%
Using the female condom	*78*	*32*
Male condom was used	*82*	*33*
None	*87*	*35*
Total	*247*	*100*

Table 2 Overall assessment (15/65)

		No.
1. Did you like FC?	*no opinion*	*3*
	a great deal	*2*
	a little	*8*
	disliked	*7*
2. Did you use the FC throughout the weeks?		
	discontinued	*20*
	entire 2 weeks	*0*
3. If you stopped using it, what was the main reason?		
		No.
	caused discomfort to me	*6*
	caused discomfort to my partner (s)	*10*
	inconvenient	*11*
	sexual satisfaction	*6*
	partner (s) objected	*15*
	other reasons	*13*
4. Was it hard to insert properly?		
		No.
	No	*10*
	Yes, sometimes	*7*
	Yes, often	*3*
5. Did it bother you to insert the condom by yourself?		
		No.
	No	*8*
	Yes	*12*
6. Did the FC tear or rip during intercourse?		
		No.
	No	*20*
	Yes, how many?	*0*
7. Did your partner (s) know that you were using the FC?		
		No.
	No	*0*
	some did	*0*
	all did	*20*
	don't know	*0*
8. Did they like or dislike the condom?		
		No.
	all liked	*2*
	some disliked, some liked	*8*
	all disliked	*10*
	don't know	*0*
9. How convenient is the FC compared to the MC?		
		No.
	less convenient	*19*
	about the same	*0*
	more convenient	*1*
10. Did you have enough education/information to use this condom correctly?		
		No.
	No	*1*
	Yes	*19*
11. Would you advise others to use the FC?		
		No.
	No	*2*
	Yes	*18*
12. Do you think other women will use it?		
		No.
	No	*2*
	Yes, a few	*17*
	Yes, many	*1*
13. Would you like to use the FC in the future?		
		No.
	No	*7*
	Yes	*13*
14. Do you have any final comments about the FC?		
		No.
	No	*3*
	Yes, (specify)	*17*
	- new and interesting	
	- STDs prevention	
	- the woman is in control	
	- need a FC that the man cannot see	
	- hard to convince partner to agree to use it	
	- too long and wide	
	- take times to insert	
	- moves around in the vagina	
	- inconvenient to carry around, etc.	
15. Female condom versus male condom		

- *harder to put on*
- *more steps to follow*
- *must inspect the condom first to see if condition is good*
- *partner must be careful not to insert out side the condom*
- *must hold on the ring during intercourse and this spoils the mood*
- *partner objection*

condoms were too large for the Thai women in this study. The oversized length and diameter caused problems of insertion, lack of snug fit, too much mobility of the condom and slippage.

The high-risk women in this study fear venereal diseases and fear AIDS the most among STDs. The women also recognized the importance and effectiveness of the condom in STDs prevention. However, they are prevented from protecting themselves and their partners because the nature of their sexual relationships dictate that the man's pleasure and desires take priority over their own health.

When one volunteer was asked if she would agree to have unprotected intercourse with a man she knew had gonorrhea, she said she would not. Thus, when the danger of contracting STDs is visible and immediate the women make a rapid cost-benefit decision and become the assertive partner. Although the women might fear AIDS most, and realize that it can be spread by someone without symptoms, the threat of AIDS may still be too remote to motivate them to insist on using condoms or no sex. Thus, another volunteer suggested that the female condom should be promoted for prevention of syphilis and not AIDS because syphilis is a disease which they fear and which 6 out of the 20 volunteers have contracted before.

It is the conclusion of the investigators that the female condom will only become a viable alternative to high-risk women when their proximity to AIDS increases or if the male partners can be motivated to accept the female condom. Steps toward promoting increased acceptability of the condom would be 1) prelubrication of the condom to reduce insertion time and nuisance, 2) redesign of the condom to suit the Thai female anatomy and, ideally, 3) development of a new barrier technology for females that cannot be seen or felt by the man.

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VIth Scientific and Annual Meeting

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Informations : Chongruk Nipavong, MD
C/O Department of Obstetrics and Gynaecology
Siriraj Hospital
Bangkok 10700

Non-suture Conization with Monsel's Solution Pack:A Preliminary Report of 3 Cases

Somsak Tangtrakul MD,*
Orapin Panijayanusondhi BSc in Pharm.#

*Department of Obstetrics and Gynaecology,
#Division of Pharmacy, Faculty of Medicine,
Ramathibodi Hospital, Mahidol University,
Bangkok 10400, Thailand

Abstract : *Cervical conization is a common gynaecologic operation with adventitious serious complications. The major complication is hemorrhage. Traditionally, hemostasis is done by suture technique. In this report, cold knife conization followed by vaginal pack soaked with Monsel's solution was done in 3 cases with CIN and unsatisfactory colposcopy. The operative time was less than 6 minutes and the intraoperative blood loss was 100 ml or less. There was no immediate or delayed bleeding that required further treatment and also no other complication after 6 weeks of follow-up. This method is quite simple and effective. A further study involving a large series of patients to assess the short and long-term effects of this method is recommended.(Thai J Obstet Gynaecol 1990;2: 111-115.)*

Key words : conization, Monsel's solution

Cervical conization has for long been an accepted method for both diagnosis and treatment of cervical intraepithelial neoplasia (CIN)[1-3]. Most gynaecologists consider this operation as a minor operation, but it has been called "a formidable operation" with considerable and serious complications especially bleeding[3-6]. The suture technique is traditionally used for hemostasis. The use of a vaginal pack soaked with Monsel's solution (Ferric subsulfate) was reported to be an effective method in controlling hemorrhage and it was easier and quicker to perform than the suture technique[7]. This report presents the experience of the first 3 cases of conization using vaginal pack with this styptic agent.

Materials and Methods

Three cases of CIN with unsat-

isfactory colposcopy were further investigated with cold knife conization between January 9, 1990 and February 13, 1990. They were routinely admitted one day before the operation. Perineal shaving, enema and fasting over night were ordered.

In the operating room, the patient was placed in a lithotomy position. The vaginal toilet was done with surgical soak scrub and antiseptic paint. The conization was performed with a No.11 blade without any local vasoconstrictor. The size of the cone base depended on the non-stained area after a Schiller test. The apex of the cone was aimed to include majority of the cervical canal, followed by endometrial curettage. The hemostasis was done by packing the cone bed and upper vagina firmly with a 3cm wide gauze roll with its tip previously dipped in Monsel's solution. The use of Monsel's solution was restricted as much as possible to the cone bed rather than the vagina. An indwelling catheter was not used since packing was limited only to the upper vagina. There was no urinary problem postoperatively in all three cases.

The Monsel's solution was prepared and supplied from the Division of Pharmacy of this institution[8].

The operative time was recorded. The blood loss during the operation was determined by weighing swabs. The cone size was measured before fixation of the specimen.

The pack was removed on the following morning. After discharge, the patients were given an appointment for the follow-up at 2 and 6 weeks. They were assessed according to the vaginal discharge or bleeding and infection.

Results

The clinical data of the patients are presented in Table 1. Their ages were 32, 36 and 47 years and parity of 2, 1 and 8. All practised no contraception. The conization was done on days 16, 20 and 22 of the cycle. General anaesthesia was used in two cases. The other was done under epidural nerve block.

Table1 Clinical findings of the patients

	Case I	Case II	Case III
Age	32	36	47
Parity	2	1	8
Contraceptions	no	no	no
Operative days of cycle	16	20	22
Anaesthesia	general	epidural	general
Cone width (mm)	30	20	20
Cone length (mm)	10	20	10
Operative time (minutes)	5	5	5.40
Intraoperative blood loss (ml)	100	50	30
Hospital stay (days)	3	2	2
Early and delayed bleeding	no	no	no

The cone width was between 20 and 30 mm, and the cone length between 10 and 20 mm. The operations were finished within 6 minutes in all cases. The blood loss varied

from 30 to 100 ml. Two cases were allowed to return home on the first postoperative day. The first case stayed one more day for observation to make sure there was no untoward effects in our first experience.

No early or late hemorrhage was found in all cases. But all had experienced vaginal discharge sometimes with blood staining or tiny pieces of dark brown material for one to two weeks. At 6 weeks review, all portio vaginalis were found short, but completely epithelialized. No febrile morbidity or re-admission for other complication was noted.

Discussion

Although the general acceptance of colposcopy has decreased the need for diagnostic conization and CIN was also treated effectively by local ablative methods such as the carbon dioxide laser, electrodiatherapy, cold coagulator or cryosurgery[9-12]. The technique of colposcopy requires a competent colposcopist who required a rigorous period of training and significant experience, while the local ablative methods require competent colposcopists and special instruments which can be very expensive. Cold knife conization is still one of the more commonly performed gynaecologic operations for both diagnostic and therapeutic purposes. Because of its major complication is hemorrhage intraoperatively and postoperatively, several techniques of hemostasis have been described, these include variation of suture techniques and/or cryosurgery, use of vasoconstrictor, antifibrinolytic agent, Surgicel gauze and Monsel's solution[7,13-16].

The hemostatic technique used in this series was the Monsel's solution pack as described by Gilbert et al[7]. The hemostasis was all satisfactory. The advantage of this technique is that it needs no suturing and packing is easy to be performed. So it can be done quickly, it took less than 6 minutes to accomplish the operation in this series. And the blood loss during the operation was 100 ml or less. The secondary hemorrhage usually occurred on the 6 to 7 days after conization[4,5]. The inflammatory reaction associated with the presence of suture material in the healing cone bed was suggested to have caused this problem[7]. None of the cases in this series developed secondary hemorrhage.

Monsel's solution is a styptic or topical hemostatic agent widely used following skin or mucosal biopsies[8]. When applied to the cervix, it penetrated denuded mucosa and produced coagulation necrosis to a maximum depth of 0.6 mm. Foci of surface necrotic tissue persisted up to two weeks post Monsel's and impeded rapid re-epithelialization[17]. Because the cervix is a highly vascular organ, bleeding usually occurs following cutting of the cone. The application of Monsel's solution alone could not stop the bleeding. Pressure effect on the cone bed by the gauze pack reduced or stopped the hemorrhage and this styptic agent could be absorbed into

the denuded area and caused coagulation necrosis.

In addition, this technique is an "open" method of conization, which is another advantage. An "open" cone had less long-term effects i.e. menstrual symptoms, cervical stenosis and the follow-up with colposcopy or cytological study was more satisfactory than the "closed" one[7,16]. So it is beneficial for conservative treatment of CIN in women who need further fertility.

In conclusion, the hemostasis used in this series is a simple and effective method. However, a prospective randomized trial involving a large series of patients should be studied to assess the short and long-term effects.

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SPECIAL ARTICLE

Transvaginal Ultrasound in Obstetric Practice

Yuen Tannirandorn MD.

Department of Obstetrics and Gynaecology,
Faculty of Medicine, Chulalongkorn Hospital,
Chulalongkorn University,
Bangkok, Thailand

Ultrasound is an important diagnostic aid in modern obstetrics and has contributed greatly to the improvement in perinatal outcome over recent decades. Initially, ultrasound was looked upon in obstetrics with skepticism because the quality of the information was dubious, and there were some concerns regarding its safety for the fetus. Gradually these concerns were muted as detrimental effects were not identified, and thus ultrasound could be used whenever clinically indicated. Conventional transabdominal sonography is frequently used in pregnant patients. However, technological advances in sonographic imaging are continuing, the most recent being the application of intracavitary scanning, particularly transvaginal sonography. The use of "high frequency" transvaginal probes result in improving resolving capacities to allow earlier and more difinite diagnosis than the conventional transabdominal techniques.

Instrumentation and scanning technique

Many munufacturers now offer high resolution dedicated transvaginal transducers, with frequencies in the 5 to 7.5 MHz range, for use with their standard equipment. The preferable transducer is 6.5 MHz[1]. The depth of field used in conventional transabdominal sonography necessitated the use of low frequency transducers with their inherent less detailed resolving capacities. The proximity of the organs in the region of interest with the transvaginal technique allows the use of a higher resolution and shorter focal zone transducer. The focal properties as well as the lateral and axial resolution of the 3.5, 5.0, and 6.5 MHz sector vaginal probes are compared in Figure 1[2].

The technique of performing a transvaginal scan is relatively simple. The patient is examined in the lithotomy position using a simple gynaecological examination table with stirrups (Figure 2). The reverse Trendelenburg position may be advantageous due to the pooling of pelvic fluid in the cul-de-sac. The examination is better performed with an empty bladder, as a full bladder may a) displace most of the pelvic organs beyoud the reach of the focal zone of the transducer

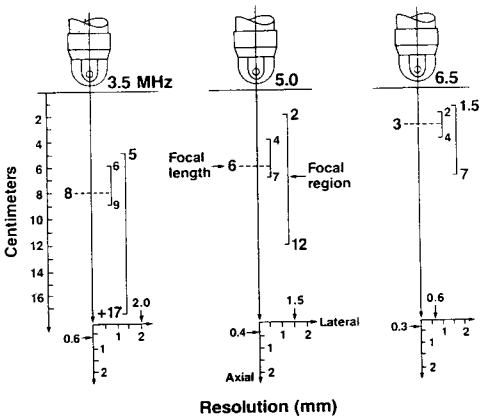

Fig. 1, Comparative figure showing the focal region, focal length as well as the lateral and the axial resolution of the 3.5, 5.0, and 6.5MHz probes.

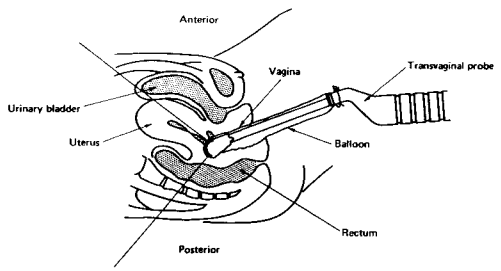

Fig. 2 The relationship between transvaginal probe and pelvic organs.

(within 7 cm), b) produce a disturbing enhancement effect and, c) distort pelvic anatomy[3]. The only exception may be the imaging of a low lying placenta because a half-full bladder will help in outlining the anterior aspect of the cervix and the internal os. The transducer/probe is covered with a condom or a rubber glove containing coupling gel. This is then lubricated with more gel on the outside of the cover and inserted into the vagina. Scans can be obtained in the sagittal and semicoronal planes.

A systematic approach with transvaginal scanning is recommended. First, on the way in, scan the cervix, then the uterus is evaluated and followed by evaluation of adnexae. After this, the cul-de-sac is scrutinized for fluid or abnormal structures. Finally, other places, structures and additional pathologies are studied.

Pelvic structures may be brought closer to the end of the transducer by placing a hand on the patient's abdomen similar to that of a bimanual examination. Similarly, the mobility of the pelvic organs can be assessed by gentle manipulation of the probe into and out of the vaginal fornices and in case of pelvic pain the probe can be used to find the exact place of the maximum tenderness, similar to that used for a pelvic examination but this time under direct vision.

At the completion of the scan, the screen should be observed during withdrawal of the transducer so as to detect cervical or vaginal pathology which may be evident.

Major limitations of the transvaginal scan are limitations in the field of view and difficulties with orientation.

The display of transvaginal image was not standardized, until Bernaschek and Deutinger[4] recently suggested a standardized image display defined according to anatomical principles. The contact surface of the transvaginal probe should be projected to the bottom of the screen. For the

sagittal section, the left side the screen should correspond with dorsal and the right side with ventral (Figure 3). For the transverse section, the bottom of the screen corresponds with dorsal and the top with ventral; the right side of the patient is imaged on the left of the screen, and the left side of patient is imaged on the right (Figure 4).

Embryology

Early embryonic development can be studied in detail with high frequency transvaginal probe (6.5 MHz). This facilitates insight into first trimester perinatology[5-9]. In this review, gestational age is expressed in menstrual weeks and days from a certain and reliable LMP or 14 days added to presumed day of conception.

The first sign of an intrauterine pregnancy on transvaginal scan is an intrauterine gestational sac (Figure 5) which can be detected as early as four weeks and 1 day. At this time, its diameter is about 2-3 mm. The discriminatory zone, i.e. the level of quantitative serum β–hCG at which a gestational sac should be sonographically visible, has been found to be in the range of 500-800 mIU (The First International Reference Preparation)[5] with trasvaginal sonography, in contrast to the zone reported for conventional transabdominal sonography (1800-3000 mIU/ml)[10].

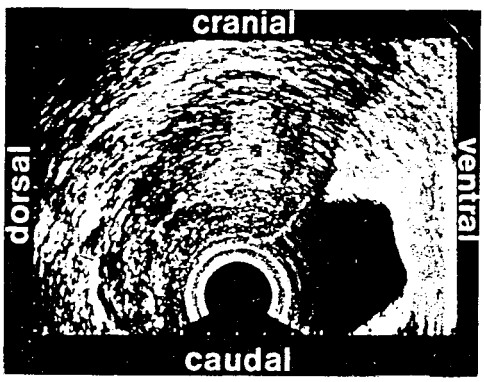

Fig. 3 Transvaginal sonography : correct image of the longitudinal section of an anteverted uterus using a frontally radiating sector scanner.

Fig. 4 Transvaginal sonography : classification of left and right in cases of cross-section of the uterus.

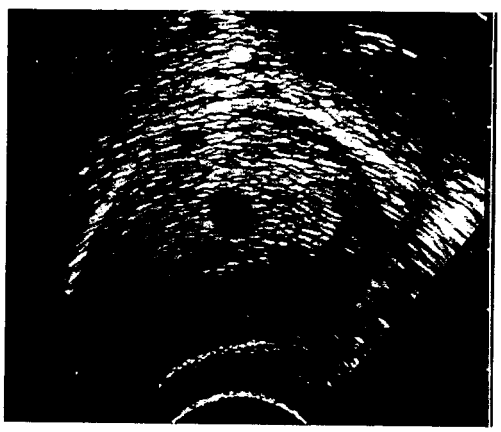

Fig. 5 Transvaginal sonography clearly demonstrates a hypoechoic gestational sac surrounded by an achogenic trophoblastic ring at five menstrual weeks.

The yolk sac (Figure 6) may be detected within the gestational sac at 5 weeks. The yolk sac at this time measures 2.5-3 mm. The structure to appear next is the embryo itself. At around six weeks, the crown-rump length (CRL) is about 3-4 mm, the heart beat is also seen within the tiny fetal embryonic pole. During week seven, when the CRL is about 12-14 mm, the small embryo assumes a curled-up position within the amnion. At this stage of gestation, it becomes apparent that the yolk sac lies within the extraembryonic coelom between the amnion and the chorion which lines the endometrial cavity.

The fetal heart beat can be first detected at five weeks and four days. By the sixth week, the majority of embryos have visible heart beats. During the ninth week, the septum within the ventricle can be recorded on the M-mode. After 14 weeks, a clear four-chamber view becomes visible.

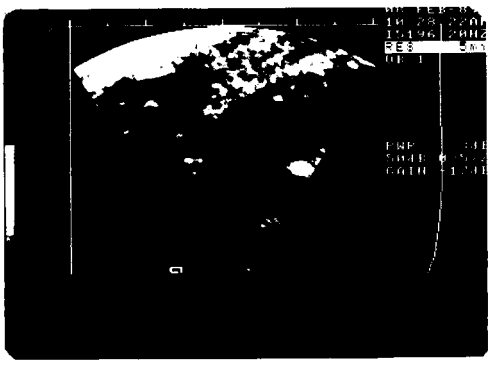

Fig. 6 The yolk sac appears as a 3-4 mm hypoechoic structure within the well-defined gestational sac.

The limbs

The arms and the forearms can be studied from week ten (Figure7). The lower limbs can be studied starting at eleven weeks. The fingers can be counted reliably after week eleven and quite easily after week twelve.

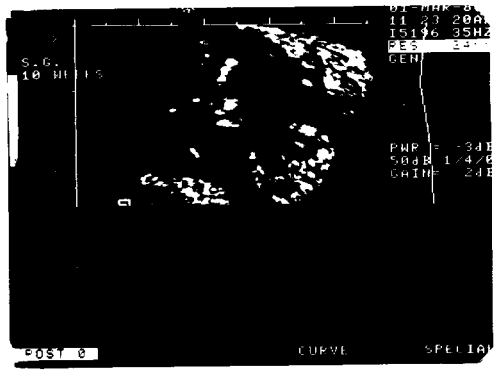

Fig. 7 Transvaginal sonography shows a clear picture of both arms at 10 weeks gestation.

The face

The face can be identified from eleven weeks. Bony structures are evident earlier, sometimes at 9 or 10 weeks, and soft tissue, such as the nose and the lips, somewhat later (12-13 weeks, Figure 8).

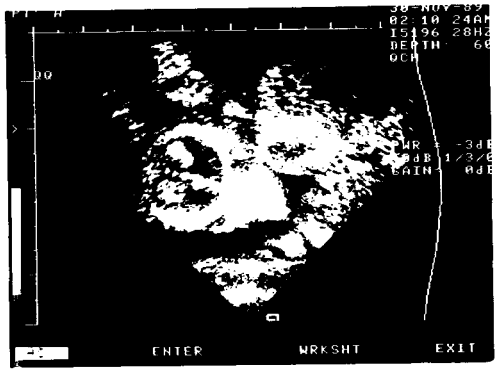

Fig. 8 Transvaginal sonography demonstrates choroid plexus and details of fetal face at 11 weeks gestation.

Physiologic herniation of the midgut

The midgut herniation can be recognised starting week 8 (Figure 9), when it becomes obvious, eventually disappearing completely during the eleventh week.

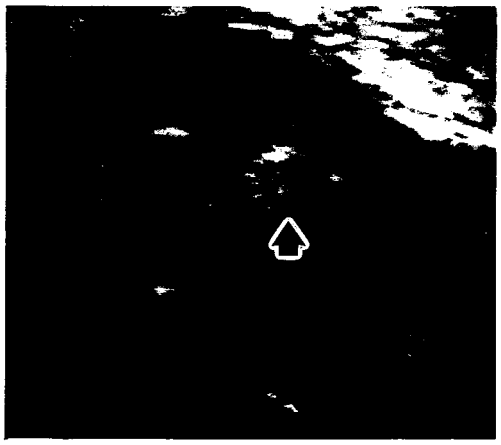

Fig. 9 Physiologic bowel herniation (arrow) within the umbilical cord may be more clearly seen transvaginally as shown in this 10 week fetus (magnified image).

The central nervous system

The central nervous system can be seen as early as the seventh week with the appearance of the unpartitioned single ventricle, while the spine can be reliably seen from week 9.

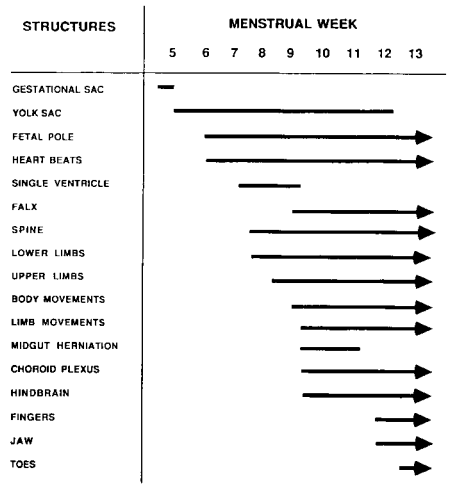

Fig. 10 Sequential appearance of embryonic structures/functions.

Table 1 Detection times for embryonic structures

Embryonic/Fetal structures	Gestational age at detection	
	TVS	TAS
Gestational sac	4 wk 1-3 d	5 wk
Yolk sac	5 wk	6-7 wk
Fetal heart beats	5 wk 6 d	6 wk 4-7 d
Limb buds	8 wk	9 wk
Head	8 wk	9 wk
Ventricles	8 wk 2-4 d	11 wk
Choroid plexus	9 wk	11-12 wk
Hands, Fingers	12 wk	17-20 wk

TVS = Transvaginal sonography, TAS = Transabdominal sonography

The genitalia

Since the phenotypic appearance of male and female genitalia become distinct only at around week 14, it is impractical to study the genitalia before this gestational age.

The sequential appearance of embryonic structures/functions detected by transvaginal sonograbhy is shown in Figure 10[5], and the comparison of detection times for embryological structures with transabdominal sonography is shown in Table 1[3].

Prenatal diagnosis

The clinical application of transvaginal sonography to prenatal diagnosis is outlined in Table 2.

Table 2 Transvaginal sonography in prenatal diagnosis

First trimester:
early detection of fetal anomalies
Second and third trimesters:
visualization of structures within focal zone
Diagnostic procedures:
early amniocentesis, transvaginal chorion villus biopsy, first trimester fetal blood sampling

Fetal anomalies

With the development of high-resolution transvaginal sonographic systems together with the knowledge of normal embryology as previously described, it has become possible to diagnose some major congenital abnormalities in the first trimester (Figures 11-15). The fetal abnormalities which can be definitely, probably or possibly diagnosed during the first trimester are shown in Table 3[11-16]. Two reasons for caution must be stressed. Firstly, every technical advance in ultrasound imaging has revealed structures not previously seen in the fetus and there is inevitably a lag period before their importance can be properly judged, this is especially true for first trimester diagnosis since our knowledge of the natural history of disorders at that stage is limited. Secondly, the main advantage of first trimester fetal diagnosis is that the pregnancy can be terminated (if indicated) by curettage or vacuum aspiration whereas prostaglandin-induced abortion is necessary during the second trimester. Whilst patients prefer first trimester termination, the technique of curettage or vacuum aspiration greatly limits the ability to confirm the pre-

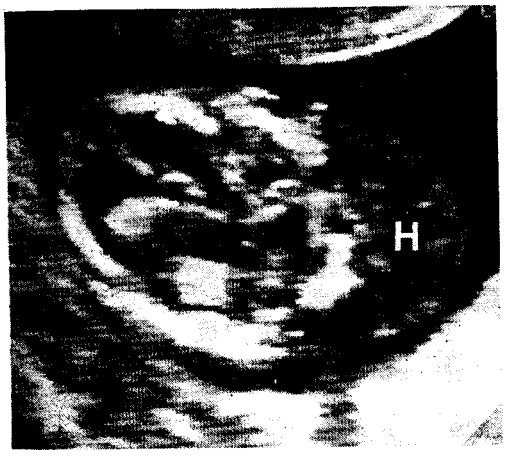

Fig. 11 Transvaginal sonography demonstrates a nuchal cystic hygroma (H) at 11.5 weeks from LMP.

operative diagnosis. It would be doubly tragic for a normal fetus to be aborted because of a mistaken diagnosis made with this new technique, and for the error to go undetected because of the nature of the abortion.

Fig. 12 Transvaginal sonography shows longitudinal scan of fetal spine at 11.5 weeks from LMP demonstrating a cervical spina bifida.

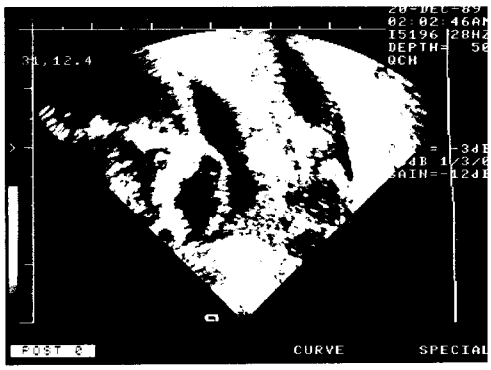

Fig. 13 Transvaginal sonography shows cross-sectional scan of a lumbar spina bifida which could not be seen by transabdominal scan at 6 weeks gestation.

Diagnostic procedures

Early amniocentesis

Transabdominal sampling of amniotic fluid has traditionally been

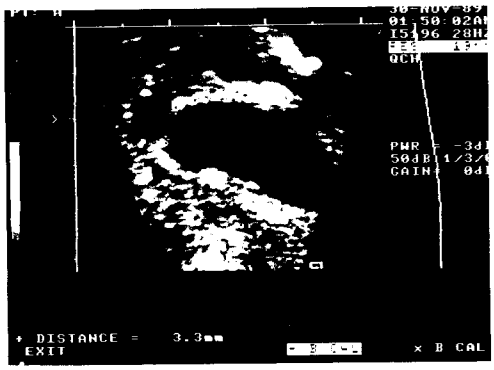

Fig.14 Transvaginal sonography demonstrates dilated posterior urethral valve and bladder due to posterior urethral valve obstruction at 11 weeks gestation.

Fig. 15 A) Transvaginal sonography shows fetal clubfoot at 13 weeks. Note foot and toes are visible in the same plane as lower leg.

B) The same clubfoot at 16 weeks.

Table 3 First trimester diagnosis of fetal abnormalities

Definite:	anencephaly
	cystic hygroma with or without hydrops
Probable:	neural tube defects
	renal agenesis
	infantile polycystic kidneys
	obstructive uropathy
	skeletal dysplasia
	congenital clubfoot
Possible:	cardiac malformations
	abdominal wall defects
	diaphragmatic hernias
	sacrococcygeal teratomas

performed at around 16 weeks, when the uterus is easily palpable, making it technically easy, however, such timing predates the now routine use of ultrasound-guided amniocentesis. Several studies in Europe and in the USA have reported the use of "early" amniocentesis in prenatal diagnosis[17,18], mainly in the 12-15 weeks range. Recently it has been reported that amniocentesis could be performed during 8-11 weeks with the culture success rate of 68.7%, whereas after 12 weeks there were no culture failures using standard cytogenetic techniques[19]. The preliminary experience at Queen Charlotte's and Chelsea Hospital with transvaginal ultrasound to guide transabdominal amniocentesis during the first trimester suggests that this may have some advantages. Before early amniocentesis becomes accepted into routine practice, it requires critical appraisal by controlled, preferably randomized, clinical trials.

Transvaginal chorionic villus sampling (CVS)

Transvaginal CVS was first reported by the groups in Italy and Germany using the technique shown in Figure16[20]. They suggested that transvaginal CVS can be performed in conditions where other sampling methods are contraindicated, the ideal gestation being from 8 to 11 weeks. However, due to limited data and experience, transvaginal CVS should not be employed in clinical practice at this moment. In addition, most contraindications of transcervical CVS can now be got around by transabdominal CVS.

First trimester fetal blood sampling

Due to advances in fetal me-

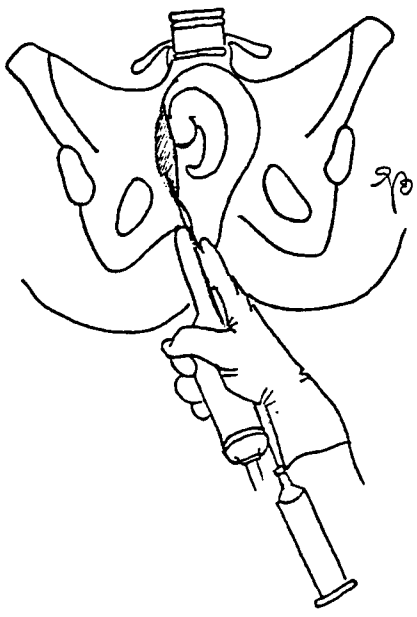

Fig. 16 Transvaginal chorionic villi sampling.

dicine, cordocentesis can now be performed as early as 13 weeks pregnancy under transabdominal ultrasound guidance[21]. However, the lower limit of gestation for this procedure is imposed by the operator's experience and the transabdominal ultrasound view. With high resolution transvaginal sonography, cordocentesis may, at least theoretically, be performed during the first trimester (especially between 12 and 14 weeks) under-transvaginal ultrasound-guided needling. This technique may offer new possibilities in the field of intrauterine transplantations, preventing, problably, the fetal immunocompetency.

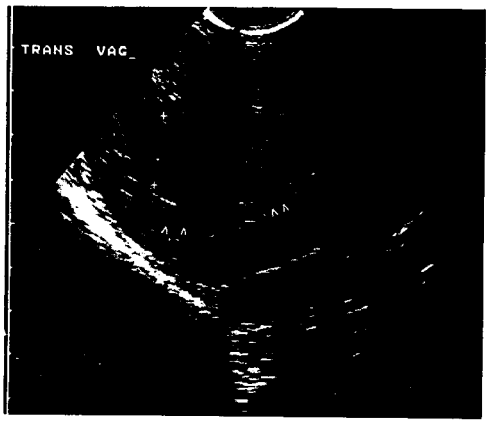

Fig. 17 Hypoechoic area (arrowheads) seen beneath the echogenic choriodecidua represent areas of subchorionic blood pooling which were not as readily visualized on transabdominal scan.

Complicated early intrauterine pregnancy

Threatened abortion

Spotting and/or pain are common in the first few weeks of pregnancy. In many instances, this is related to trophoblastic implantation within the decidualized endometrium. With development of the gestational sac, the small hypoechoic areas seen immediately beneath the echogenic choriodecidua are thought to be representative of areas of blood pooling (Figure 17). These are much better delineated on transvaginal than transabdominal scan.

Some patients with significant vaginal bleeding may have subchorionic hemorrhage. Subchorionic hemorrhage manifests as a crescentic, hypoechoic area between the chorion and myometrium. The subchorionic bleeding reflects some degree of chorio-myometrial separation, and with time the fluid collection may contain echogenic material representing clotted blood. The presence of subchorionic hemorrhage is an important prognostic indicator in a patient with vaginal bleeding. The relative size of the subchorionic hemorrhage can be quantitated and related to the size of the gestational sac itself. It has been shown that the relative size of the subchorionic hemorrhage has predictive value as to the outcome of the pregnancy. When the relative area of the subchorionic hemorrhage is less than 0.4 of the gestational sac or less than 60 ml, it is likely that the pregnancy will progress normally[22]. The sonographic detection of subchorionic hemorrhage usually necessitates a fol-

low-up sonographic examination to confirm fetal viability even if signs of fetal life are present on the initial examination.

Abnormal yolk sac

The yolk sac performs important functions for embryonic development during organogenesis and the remnant of the yolk sac (secondary yolk sac) seen on ultrasonography is often considered to be potential predictor of fetal outcome[23]. Growth of the yolk sac diameter has been found to have a curvilinear relationship with gestational age[24]. Although in general the size of the yolk sac does not appear to be a sensitive predictor of embryonic integrity and pregnancy outcome[24], total collapse of the yolk sac may be associated with chromosomal abnormalities. At present more information about this extremely rare condition is needed.

Non-viable early intrauterine pregnancies

Anembryonic pregnancy

A blighted ovum or anembryonic pregnancy implies cessation of embryonic development at a very early stage with continued development of the choriodecidua and membranes into gestational sac. The underlying abnormality is usually genetic (trisomy, triploidy, or monosomy).

Sonographically, an anembryonic pregnancy appears as a gestational sac which may be irregular in shape and surrounded by an irregular and thin decidua or interruped trophoblastic ring. No embryonic fetal pole or yolk sac are definable (Figure 18). When a gestational sac lacks an embryo, one must distinguish between a normal early intrauterine pregnancy and blighted ovum. The criteria established for transabdominal sonography include a distorted gestational sac with a mean linear dimension of greater than 25 mm without sonographic delineation of an embryo or a mean linear sac dimension of greater than 20 mm without sonographic delineation of a yolk sac[25]. The definite criteria will be forthcoming with transvaginal sonography.

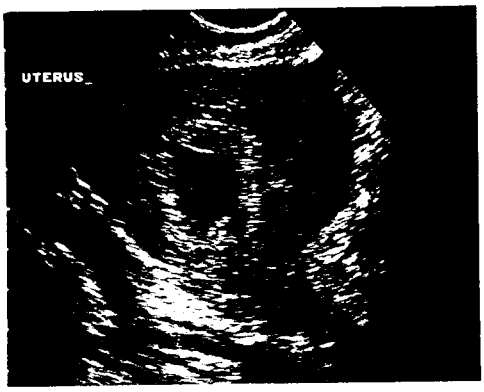

Fig. 18 Excellent delineation of an irregular empty sac with an interrupted choriodecidua consistent with an anembryonic pregnancy.

One should always emphasize that an abnormal-appearing gestation may develop normally. This seems to be the generally accepted clinical opinion. Therefore, caution must be

stressed, and it is advisable to give the suspected threatened abortion the benefit of the doubt when there is a normal-appearing or mildly atypical gestational sac without fetal pole or yolk sac. The patient should be re-examined in 1 or 2 weeks.

Incomplete abortion

An incomplete abortion implies vaginal bleeding associated with the passage of the fetus and/or products of conception with portions of the chorio-decidua and membranes remaining within the uterine lumen. Sonographically, the gestational sac appears irregular, partially collaped filled with inhomogeneous echogenic material. Subchorionic hemorrhage may be present. The sac may have an abnormally low position and the choriodecidua is significantly disrupted. These features can be easily appreciated on the transvaginal sonogram.

Complete abortion

Complete abortion implies spontaneous passage of the fetus and all choriodecidua and membranes. Sonographically, a thin (<4mm) central uterine interface arising from the coapted endometrial surfaces is apparent. No distention of the uterine lumen is present. While these findings could be delineated on the conventional transabdominal sonogram. They can be made with greater confidence with the transvaginal technique.

Fetal death

The sonographic features of fetal death vary with the period of time elapsed between fetal demise and sonographic examination. If the fetal death is recent, a fetus is identified without evidence of fetal cardiac activity. If the fetal death is remote from the examination, maceration of the placenta and fetus may limit their sonographic delineation. The transvaginal sonography improves delineation of fetal cardiac motion, therefore, absence of detectable fetal heart motion with this techinque confirms fetal demise. In obese patient or patient with a retroflexed uterus, the use of transvaginal probe with doppler ultrasound or M-mode tracings may be helpful in detection of fetal heart activity.

Molar pregnancy

A molar pregnancy should be considered in the patient presenting with exaggerated symptoms of pregnancy, for example hyperemesis or a uterus that is large for dates. This entity can usually be diagnosed by transabdominal ultrasound. The transvaginal approach should be used in obese patients or those with an inconclusive image on transabdominal sonography. The sonographic picture obtained by transvaginal sonography shows a multitude of different sized sonolucent structures with great clarity, thus, a reliable diagnosis of hydatidiform mole or molar degeneration can be

made.

Ectopic pregnancy

The diagnosis of extrauterine or ectopic pregnancy has been largely based on history, clinical examination and biochemical tests before the advent of ultrasound techniques. The combined use of transabdominal sonography and serum hCG determinations has resulted in a relatively high accurate in predicting ectopic pregnancy. Suspicion for the diagnosis of ectopic pregnancy is raised in the presence of a positive pregnancy test and clinical signs or symptoms, an abnormally rising titer of hCG, or the absence of an identifiable intrauterine gestational sac on abdominal ultrasound examination when the hCG titer has reached 6500 mIU/ml utilizing The First International Reference Preparation[26,27]. However, with multiple follicular development and embryo replacement the incidence of heterotopic pregnancy (intrauterine and extrauterine pregnancy) has risen sharply. Thus, a presumptive diagnosis that ectopic pregnancy can be excluded when an intrauterine gestation sac seen is not always applicable. Even though low hCG levels have been shown to be associated with ectopic pregnancy, these can also occur with intrauterine pregnancies that are nonviable or in those with retroimplantation bleeds. The ability to detect an ectopic pregnancy would, therefore, be enhanced if the adnexal mass itself could be identified. In most reports the specificity and the sensitivity for making the correct diagnosis of ectopic pregnancy by transabdominal sonography were 97% and 77 to 88% respectively[28-30]. As previously described, transvaginal sonography can be used to detect early gestation and focus on the fallopian tube. Attention has been directed to the early and reliable imaging of tubal gestations (Figure 19). In a recent report of 145 patients who were referred for ultrasonographic work-up because of a suspected ectopic gestation, the sensitivity of diagnosing ectopic pregnancy by high-frequency transvaginal sonography was 100%, the specificity was 98.2%[31]. The positive predictive value of this method was 98%, and the negative predictive value was 100%. The rate of the beating fetal heart seen and unruptured

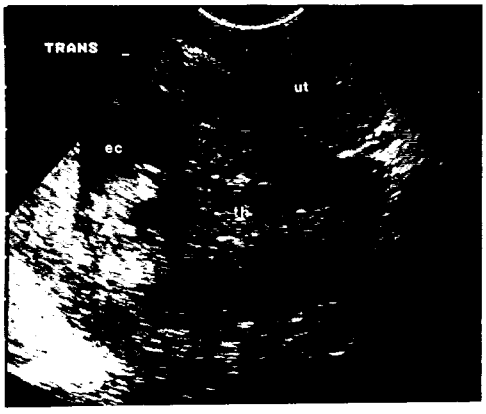

Fig.19 Transverse transvaginal sonography confirms an empty uterus (ut), right extrauterine gestational sac with viable fetus (ec) and thrombus in the region of the cul-de-sac (th) in a ruptured right tubal pregnancy.

tubal pregnancies were 23% and 66% respectively. A prospective study has been conducted to compare the accuracy of transvaginal sonography in 100 women suspected of having an ectopic pregnancy with transabdomonal sonograbhy[32]. It was found that the vaginal scanning was more accurate than the abdominal scanning in detecting the ectopic pregnancy (90 versus 80%) and cul-de-sac fluid (77 versus 46%), in identifying an ectopic gestational sac (69 versus 44%), and in diagnosing a tubal pregnancy as unruptured (76 versus 50%).

In addition to the usefulness of transvaginal sonography in diagnosing early ectopic pregnancies, conservative treatment of ectopic pregnancies by transvaginal aspiration and methotrexate injection has been reported[33]. Thus, transvaginal sonography affords investigation of new types of treatment for ectopic pregnancies in selected patients in the future.

Doppler ultrasound

Doppler ultrasound has been widely used in the second and third trimesters to study flow velocity waveforms from the arcuate artery, uterine artery, fetal umbilical artery, descending aorta and cerebral artery. Many statistical correlations have been reported between perinatal complications and quantitative alterations, often minor, in indices of flow resistance. Doppler ultrasound can now be performed in the first trimester with the use of pulsed wave doppler instrument with transvaginal sector probe. However, the interpretation of the Doppler waveforms in the first trimester may be entirely different from the second or third trimesters. Absence of end-diastolic frequencies in the umbilical arteries, which is strongly associated with adverse perinatal outcome[34-36], appears to be physiological in the first trimester (Figure 20)[37]. Recently, in a series of 8 patients, it has been found that pulsed Doppler ultrasound does not offer the clinician additional information in the diagnosis of early pregnancy failure[38]. The applications of transvaginal Doppler ultrasound in the prediction of pregnancy outcomes requires further evaluation in the large longitudinal studies.

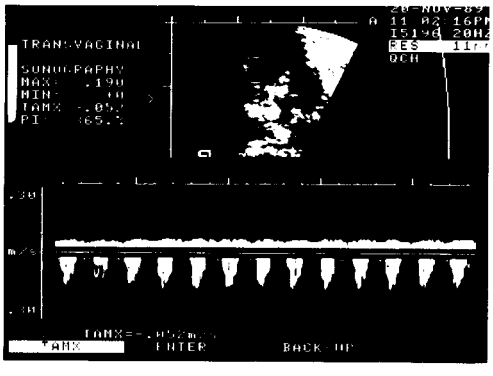

Fig. 20 Doppler umbilical artery velocity waveforms at 9 weeks gestation demonstrate physiologic absent end-diastolic frequencies (lower channel).

Transvaginal sonography in later pregnancy

The potential clinical applications of transvaginal sonography in later pregnancy are shown in Table 4.

Table 4 Transvaginal sonography in later pregnancy

Complimentary role to abdominal ultrasound
- Visualisation of fetal anatomy in the presenting part
- Localisation of placenta previa
A role in cervical assessment
- Cervical incompetence
- Preterm labour
- Pre-induction of labour

Later gestational development

In spite of the fact that the use of transvaginal sonography in fetal scanning is probably limited by gestational age, fetal size and presentation, one should remember that any fetal organs in close proximity to the cervix may be examined at any given time throughout the pregnancy. Therefore, transvaginal ultrasound should be considered when fetal anomalies are suspected in the presenting part or detailed views of the presenting part are required.

Placenta previa

Transabdominal sonography remains the first step in the work-up of antepartum hemorrhage. However, if that scan is unsatisfactory or equivocal, as in obesity, a low-lying posterior placenta or an acoustic shadow being cast by the fetal head, then transvaginal sonography should be considered (Figure 21). There is some controversy in this recommendation since vaginal manipulation is

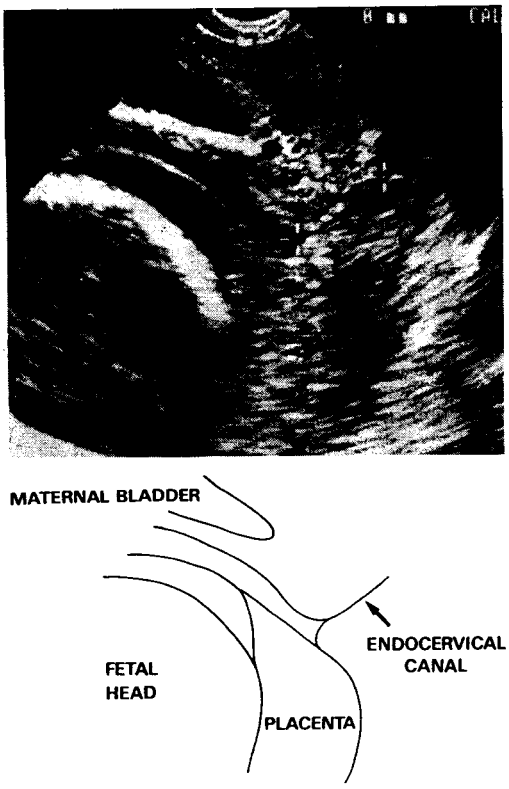

Fig. 21 Transvaginal sonography demonstrating posterior placenta previa.

usually contraindicated in patients with suspected placenta previa. However, the probe need not be inserted more than 3 cm, if this is done properly by careful insertion of the probe and constant monitoring of the image as the probe is advanced there should be no

contact with the cervix or lower uterine segment, so further bleeding should not be provoked if placenta previa is present. Preliminary studies suggest that not only is the procedure safe but also that it is better at diagnosing and excluding placenta pre via[39,40]. In a recent series of 63 patients suspected of placenta previa, transvaginal sonographic localization of the placenta was performed. A predictive value of a positive test was 100% and a negative test 98%. Sensitivity and specificity of the technique were 92% and 100%, respectively[41].

Cervical assessment

Transvaginal sonography may have a role in cervical evaluation. The closed, uneffaced cervix with a clear internal and external os can be seen early, in the first and early second trimesters of pregnancy. Therfore, transvaginal sonography may have the potential in identifying patients at risk for an incompetent cervix or preterm labour. In addition, it may be used to evaluate the favourability of cervix (i.e. cervical length, width, dilatation, application and position, and lower uterine segment thickness), as Bishop scores, before induction of labour. However, these cervical assessment by transvaginal sonography need randomized clinical trial before it is used in routine practice.

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