

SIG Newsletter

June 2024

SIG- Early Pregnancy



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From Pyramid to Inverted Pyramid: Revolutionising Antenatal Care

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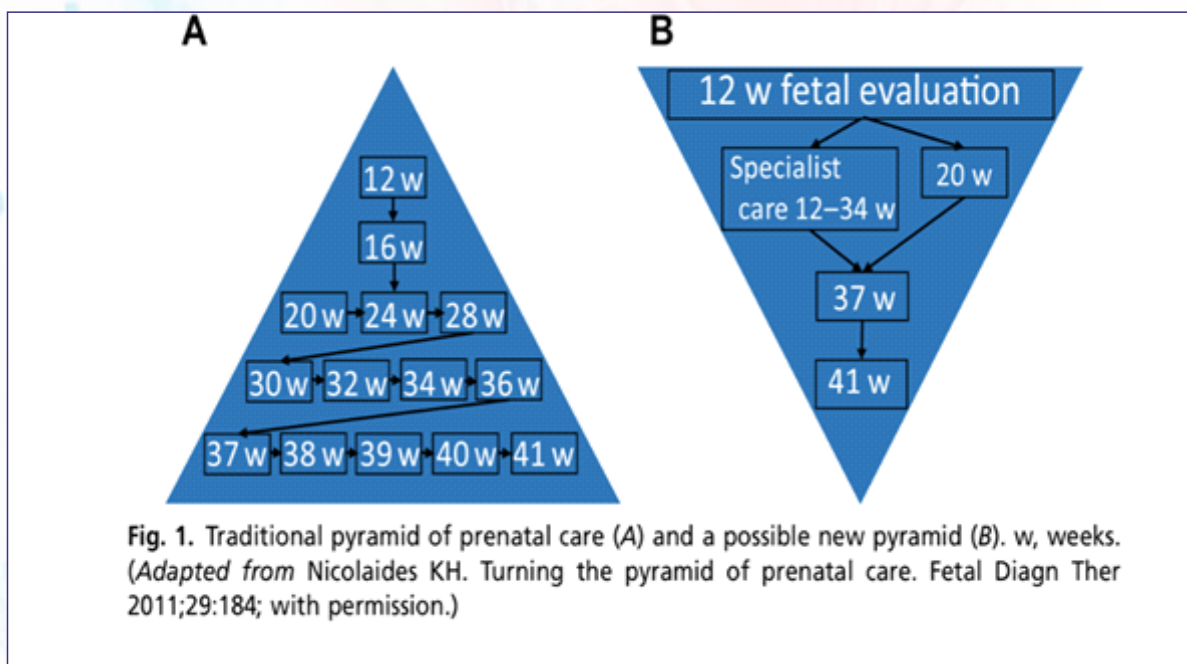
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Introduction

Antenatal care is a cornerstone of maternal healthcare, aimed at ensuring the well-being of both mother and baby during pregnancy. Traditionally, antenatal care followed a pyramid model, with a hierarchical approach to information dissemination and antenatal visits. However, in recent years, there has been a paradigm shift towards an inverted pyramid model, which prioritises patient centered care and empowerment. Recently the “tube” of pregnancy care has been emerging concept.

Historically, antenatal care has been structured around a pyramid model, characterized by a top-down approach where healthcare providers hold most of the knowledge. Visits typically begin in the 16th week of the second trimester and continue through weeks 24, 28, fortnightly, and weekly beyond 37 weeks [1].

In order to detect foetal aneuploidies, foetal malformations, early screening for foetal growth limitations, preeclampsia, risk of miscarriage and stillbirth, and premature labour, the straight pyramid of antenatal care of antenatal care was inverted, with more focus on first trimester [2].



First trimester screening for fetal aneuploidy

Fetal aneuploidy combined screening test can be offered to the pregnant woman at 11 to 13+6 weeks which includes nuchal translucency PAPP-A and free beta hCG estimation. This combined has an over 90% detection rate for trisomy 21 and for trisomy 13 and 18 approximately 95%.

Cell free DNA (cfDNA) tests have a higher detection rate (>99%) for trisomy 21 for a much lower false-positive rate (about 0.1%) than the first trimester combined test. The performance of cfDNA in screening for trisomy 18 (detection: 96.4%–99.9%), trisomy 13 (detection: 91.7%–99.0%), and monosomy X (detection: 92.9%–96.6%) is very good [3]. However, each positive test needs to be confirmed by a diagnostic testing.

The effectiveness of the first-trimester combined screen can be further augmented by the additional nasal bone evaluation and Doppler evaluation of the ductus venosus and blood flow across the tricuspid valve.

Accuracy of first-trimester screening could also be further enhanced by including additional maternal serum markers, such as placental growth factor (PIGF) and maternal serum alpha-fetoprotein (AFP) [4]. It has been recognized that a thickened NT increases the risk of congenital fetal defects even in the absence of aneuploidy. This risk increases significantly for an NT greater than 3.5 mm. In fetuses with a NT of 6.5 mm or greater, this risk is almost 50%. There is higher detection rate of cardiac complications when NT is combined with tricuspid regurgitation and ductus venous assessment.

A prospective analysis of 3094 fetuses confirmed that major fetal abnormalities can be diagnosed with a great reliability in the late first trimester even in a low-risk population (prevalence of major fetal anomalies was 2.8%). The overall detection rate of major anomalies, including congenital heart defects (CHDs), was 84%. In those cases where the NT measurement was 2.5 mm or greater, the detection rate was 98%[7].

First trimester screening for structural anomaly

First trimester screening is not limited to detection of raised nuchal thickness. Transabdominal and transvaginal 2D and 3D USG have helped to assess the prevalence and detection rate of major anomalies by applying first trimester anomaly scan and fetal echocardiography. A significant number of fetal anomalies occur even with normal NT and more than half of them could be detected in first trimester. Therefore, even when fetuses have normal NT, mother's should be offered first trimester structural anomaly scan and fetal echocardiography. Anomalies which can be picked up before 12 weeks include the following:

- Acrania, anencephaly, encephalocele, ectopia cordis (100% detectable)
- Spina bifida, hydrocephalous, holoprosencephaly
- Cystic hygroma,
- Hypoplastic left heart syndrome, atrioventricular septal defect
- Limb reduction defects
- Megacystis
- Skeletal dysplasia

It is important to detect fetal malformation before 12 weeks as first trimester detection leads to relatively easy termination of pregnancy and reduces mental, physical, and psychological trauma for the mother. However, a normal scan in the first trimester should be followed by 2nd trimester anomaly scan as some of the fetal organs develop later and may be missed in the 12 wks scan.

First trimester prediction of maternal fetal complications

Most of the placental formation and circulation is well established by 13-14 weeks. Assessment of placental circulation in the first trimester might assist to uncover placental abnormalities. In order to reduce complications associated to placental malfunction, it also encourages the implementation of early treatment for pregnant women. Preeclampsia and foetal growth restriction are the two main complications that can be predicted in the first trimester itself and help reduce fetal and maternal morbidity.

Measuring the pulsatility index (PI) in the uterine arteries along with maternal blood pressure measurement in the late first trimester are predictors of preeclampsia in first trimester. Third is evaluation of certain placental product levels in maternal serum, such as PAPP-A and PlGF. Historical factors, maternal blood pressure measurement, and uterine artery PI increases detection rate to 90%. The addition of PAPP-A and PlGF levels increases the detection rates to 96%. As a result of these studies, it is now recommended that prophylactic low-dose aspirin treatment should be initiated before 12 weeks' gestation in women who are found to be at an increased risk of PE (Pre Eclampsia) based on a combination of factors, such as body mass index, parity, and personal as well as family history [5].

Applications of first trimester screening tools

Screening for SGA (Small for Gestational Age) can also be initiated in the first trimester. The risk is increased with an increase in the uterine PI and maternal mean arterial pressure. Decreased maternal serum PAPP-A, free beta-hCG, PlGF, placental protein 13 (PP13), and A disintegrin and metalloproteinase 12 (ADAM12) also increase the risk of SGA [6].

For a false positive rate of 10%, the combination of these markers along with maternal characteristics could identify approximately 75% of SGA fetuses delivering before 37 weeks' gestation and 45% that deliver at term.

The assessment of multifetal gestation is by chorionicity that is best assessed in first trimester between 11-13 weeks. This allows adequate counselling about risk of pregnancy and further management. In multiple pregnancy fetal reduction can be best accomplished in first trimester

USG in the first trimester is also able to confirm the location of pregnancy and visualise ectopic pregnancy in the tube, previous scar, cervix, ovarian, broad ligament or any other site. The precise size, location and correlation with beta HCG can guide the option for conservative, medical management with intralesional or systemic administration of drugs or surgical management. USG monitoring also aids during follow up of these women medical or conservative approach..

Women with recurrent pregnancy loss with obstetric APLA syndrome need close monitoring through transvaginal scan so that low dose heparin and aspirin can be added before 12 weeks' gestation. USG is done for follow up to review fetal growth. Women with APLA syndrome with previous history of thrombosis need to be initiated on aspirin and heparin/enoxaparin before conception which should be continued throughout pregnancy in therapeutic doses.

The fact that risk of spontaneous preterm delivery is associated with cervical shortening is well established in the second trimester, and the same seems to hold in the first trimester. Transvaginal cervical length assessment helps selecting high-risk group that may benefit from close follow-up and possible treatment by use of progestogens or cervical encirclage.

First-trimester screening for gestational diabetes mellitus (GDM) is possible using maternal serum biochemistries. Adiponectin and sex hormone-binding globulin are reduced and visfatin is increased in association with increased risk for GDM.

Combination of maternal characteristics and biochemical markers can identify about 75% of pregnancies that will develop GDM for a 20% false-positive rate [8].

First trimester screening markers such as increased NT measurements, increased levels of maternal serum free beta-hCG and PAPP-A, and a decreased level of adiponectin help in detecting large for gestational age fetus [9].

Nicolades et al followed an inverted pyramid with visits at 12 weeks, 20-23 weeks and then at 39 weeks [1]. The inverted pyramid identifying high risk women with early implementation of appropriate intervention in these women will avoid unnecessary antenatal investigations and visits during latter half of pregnancy.

While the pyramid model served as a framework for antenatal care for many years, it had its limitations. The inverted pyramid is being replaced by tube of pregnancy care for better antenatal care and management.

Benefits of the Inverted Pyramid Model

The shift towards the inverted pyramid model in antenatal care offers numerous benefits for both expectant mothers and healthcare providers.

Moreover, the personalized approach of the inverted pyramid acknowledges the unique needs of each woman, ultimately contributing to better maternal and fetal health.

Conclusion

The transition from the pyramid to inverted pyramid model represents a significant evolution in antenatal care, placing greater emphasis on antenatal care. By prioritising the needs and preferences of expectant mothers, the inverted pyramid model enhances the quality of care and the overall pregnancy experience. As healthcare systems continue to embrace this innovative approach, the journey towards safer tube of pregnancy care.

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