1. INTRODUCTION

The aim of maternal care is the protection of fetus and mother. Globally, around 80% of all maternal deaths are the direct result of complications arising during pregnancy, delivery, or the puerperium. In developed countries, the maternal mortality ratio averages around 27 maternal deaths per 100,000 live births. In developing countries the ratio is nearly 20 times higher, at 480 per 100,000, and may be as high as 1,000 per 100,000 in some regions [73].

Major causes for maternal and fetal morbidity and mortality are pregnancy complications like pre-eclampsia, placental insufficiency and bleeding because of abruptio of the normal-positioned placenta. The single most common cause - accounting for a quarter of all maternal deaths is severe bleeding. In the United States it accounted for 30.2% in 1979-1986 and 28.7% in 1987-1990 [6,7] of maternal deaths.

Death rate associated with the atypical systemic form of pre-eclampsia, the HELLP syndrome, has been high, reaching 3-3.5% maternal mortality and 22.6-24.2% perinatal mortality [2,37,55].

Patients who later develop pre-eclampsia are characterised by changes that may be detected in the very early phase of pregnancy and even in non pregnant women. Haemostatic abnormalities are found in 40% of women with a history of pre-eclampsia. This is four times higher than in a normal population, suggesting a haemostatic component of severe pre-eclampsia [71]. A low urinary excretion of calcium in the first half of gestation is also a risk factor for pre-eclampsia [68]. Those patients developing pre-eclampsia are characterised by a high cardiac output volume, which is present as early as the first and second trimester and can persist postpartum [25].

There is evidence that pre-eclampsia and fetal growth restriction are due to abnormal development during early stages of pregnancy. The beginning of fetal life is

associated with remarkable haemodynamic changes in the placental circulation. During the first three months of gestation, the young embryo is separated from the maternal circulation by the trophoblastic shell. The tips of the spiral arteries are obstructed by intravascular trophoblastic plugs, and the intervillous space is bathed by a clear fluid, possibly made of filtered plasma and uterine gland secretions. The spiral arteries widen progressively, and around 12 weeks gestation the trophoblastic plugs are eventually loosened and dislocated, allowing free blood circulation in the intervillous space [35].

Normal fetal growth and development is dependent on normal development and function of the placenta. During the first half of gestation, trophoblastic cells invade the decidual and sub-placental vessels resulting in an opening of the arteries into sac-like lagoons without contractile capacity [14].

Pre-eclampsia and fetal growth restriction are said to be associated with impaired utero-placental perfusion, which is thought to be due to failure of trophoblastic invasion of the spiral arteries in early pregnancy [12,48,59]. Recent observations would seem to indicate that an excessive maternal intravascular inflammatory response to pregnancy might be the underlying problem of pre-eclampsia [62].

The natural history of pre-eclampsia without adequate prenatal care, results in substantial maternal morbidity and mortality associated with prematurity, fetal growth restriction and demise. Ideally, identification of patients at risk for pre-eclampsia and effective treatment would permit the safe completion of pregnancy for the mother and her infant. Pre-eclampsia remains a major cause of maternal and perinatal morbidity and mortality. The natural progression of the established disease is unpredictable. A predictive test for this condition in early pregnancy would allow the possibility of timely antenatal surveillance and the consequent initiation of appropriate preventive measures, thus avoiding or reducing serious consequences.

Since the introduction of Doppler sonography of uterine arteries (DSUA) by Campbell [15], it is well known that abnormal Doppler waveforms of the uterine arteries correlate with pregnancy problems like poor fetal growth, fetal hypoxia and proteinuric hypertension.

The lack of trophoblastic invasion of the decidual and myometrial segment of the spiral arterial vasculature, resulting in an increased flow resistance in the uterine arteries [51,58], has provided the possibility of using Doppler velocity waveform analysis in the second trimester as a screening test for pre-eclampsia [66]. Furthermore, these abnormal morphological changes have been shown to precede the clinical manifestation of the disease.

Meanwhile, the value of Doppler sonography in surveillance of manifest problems, like intrauterine growth restriction and pre-eclampsia, seems to be clear. Several studies show the value of Doppler assessment of the uterine arteries in the surveillance of high-risk pregnancies [3,75]. Also, Doppler sonography of the umbilical artery, may reduce perinatal mortality [3]. In high-risk pregnancies managed with Doppler, there is a significant decrease of 50 percent in perinatal mortality and in stillbirths of anatomically normal fetuses [28].

For more than a decade the use of DSUA as a screening method in normal pregnancies (“low-risk pregnancies” or “medium-risk pregnancies” [17,56]) to identify women who later develop complications like pregnancy induced hypertension, intrauterine growth retardation and fetal asphyxia [16] has been indicated. Meanwhile, it can be shown that some cases of antepartum haemorrhage, intrauterine death and preterm delivery may be predicted [31,45,67]. Several studies have tried to establish routine DSUA as a screening test [45,47] with positive [8,9,16,31,66] or negative [18,22,30,37,49,53,56,57,65] results. Thus, the value of DSUA as a screening procedure in low risk pregnancies is not yet established [26,60]. Although the test is cheap, non-invasive and easy to carry out [66], DSUA is not yet part of routine maternity care [64].

Some of the major reasons for ongoing discussion are, unclear definitions concerning the optimal time for screening, the definition of abnormal waveform, the definition of outcome variables and the value of therapeutic interventions.

The aim of the following retrospective study was: To evaluate different known definitions of (i) pathological waveform and (ii) to find out the definition of pathological waveform that preserves a high sensitivity of some of the major pregnancy complications with an acceptable specificity for screening of a low-risk population.