

Early confirmation of intrauterine pregnancy- is color doppler useful?

Abstract

The research question: Is color Doppler useful in the early confirmation of intrauterine pregnancy?

Study Design: Review of the literature was undertaken in 1998, when this idea was conceived, on development of early pregnancy, diagnosis of early pregnancy and use of color Doppler in early pregnancy.

Findings: Intrauterine pregnancy is usually diagnosed by a positive pregnancy test and demonstration of a gestational sac in the uterus. The earliest an intrauterine gestational sac can be seen by a transvaginal scan is 4-5 weeks' gestation (2-3 weeks embryo). Sometimes, early pregnancy problems create confusions because of uncertainty about the site of the pregnancy, leading to further investigations and interventions. These often increase patient's anxiety and the cost. With the advent of expectant and medical treatment of ectopic pregnancy, an early confirmation of the site of pregnancy has become more relevant. Color Doppler has been used to investigate uteroplacental circulation in early pregnancy and early pregnancy problems. It might be worthwhile to investigate the potential of color Doppler to locate very early changes that are associated with intrauterine pregnancies. If it were successful, it may be very useful in managing early pregnancy problems.

Implications: Further research in to the area would be useful to find out whether color Doppler could confirm the diagnosis of intrauterine pregnancy earlier than conventional ultrasound scan. If it does that would be a useful tool in the management of early pregnancy problems. N.B. The hypothesis was originally conceived and the article was written by the author in 1998 and has been included here as it was written in 1998.

Keywords: early pregnancy diagnosis, color doppler

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Introduction

Intrauterine pregnancy is usually diagnosed by a positive pregnancy test and demonstration of a gestational sac in the uterus. Though serum beta-hCG is detectable from 23rd day of gestation (9 days after ovulation) it merely suggests the presence of a pregnancy. An ultrasound scan is required to confirm the site of the pregnancy. The earliest an intrauterine gestational sac can be seen by a transvaginal scan is 4-5 weeks' gestation (2-3 weeks embryo).

Sometimes, early pregnancy problems create confusions because of uncertainty about the site of the pregnancy, leading to further investigations and interventions. These often increase patient's anxiety and the cost. With the advent of expectant and medical treatment of ectopic pregnancy, an early confirmation of the site of pregnancy has become more relevant. Color Doppler has been used to investigate uteroplacental circulation in early pregnancy and early pregnancy problems. It might be worthwhile to investigate the potential of color Doppler to locate the presence of the trophoblastic lacunae which forms as early as 23rd day of gestation (9 days embryo). If it were successful, it may be very useful in managing early pregnancy problems.

Methods and materials

Review of the literature was undertaken in 1998, when this idea was conceived, on development of early pregnancy, diagnosis of early pregnancy and use of color Doppler in early pregnancy.

Result

Diagnosis of pregnancy is usually done by a positive urinary

pregnancy test after a missed period. The earliest a pregnancy can be diagnosed by serum beta-hCG is 9 days after ovulation (23rd day of gestation).¹ But it cannot confirm an intrauterine pregnancy or its viability, which requires an ultrasound examination.

The role of ultrasound

A transvaginal scan (more sensitive than a transabdominal scan) can detect an intrauterine gestational sac at 4-5 weeks, an embryo at 5 weeks and fetal heart beat at 5 - 6 weeks of gestation at the earliest.^{2,3} A gestational sac can be seen when the serum beta-hCG is between 500-1500mIU/ml.² Absence of an intrauterine gestational sac with such levels of serum beta-hCG implies an ectopic pregnancy or a recent complete miscarriage. An empty uterus with a positive urinary pregnancy test may also be due to a very early pregnancy and needs a repeat ultrasound scan.⁴ In cases of ectopic pregnancy, a pseudo sac (due to decidual reaction in the endometrium) may give a false impression of an intrauterine pregnancy.²⁻⁴

The role of serum beta-hCG

In suspected cases of ectopic pregnancy the levels of serum beta-hCG are checked with an interval of 48 hours to determine the doubling time. In ongoing intrauterine pregnancy the serum beta-hCG doubles in less than 48 hours, while in ectopic pregnancy it takes more than 48 hours. But 15% of normal pregnancies may have an abnormal hCG rise and in case of miscarriage of an intrauterine pregnancy the serum beta-hCG levels may be inconclusive. Serum progesterone measurement is also not useful to distinguish between intrauterine and ectopic pregnancies.⁵

Why early confirmation is important

With the advent of expectant and medical treatment, and conservative laparoscopic management of ectopic pregnancy, an early diagnosis has become more important. Confirmation of an intrauterine pregnancy at an early stage would avoid many confusions, unnecessary investigations and interventions in early pregnancy problems. This would reduce patient anxiety associated with uncertainty about the diagnosis, investigations and interventions. It would also save resources and the cost in the long run.

The trophoblastic lacunae – the earliest vascular change

During early embryological development trophoblastic lacunae develop from the spiral arteries on day 9 (23rd day of gestation) as vacuoles open within the syncytio trophoblasts.⁶ The uteroplacental circulation is established by 21st day (5 weeks gestation) and the heart begins to beat on 22nd day (5 weeks and 1 day gestation).⁷

Hypothesis: Detection of the trophoblastic lacunae by color Doppler

In the macaque the process of placentation closely resembles that in the human. In them color Doppler imaging and color Doppler energy clearly visualized the uteroplacental vasculature, and flow within the intervillous space was noted from day 20 of gestation.⁸ Color Doppler capacities further enhance the diagnostic sensitivity of transvaginal ultrasound for the early recognition of abnormal and normal intrauterine pregnancy, and small extra uterine pregnancies.^{9,10} With color Doppler, it may be worthwhile to check for the presence of the trophoblastic lacunae in the uterus as early as 9th day embryo (23rd day of gestation) when the serum beta-hCG becomes detectable. This with a detectable serum beta-hCG level would suggest the presence of an intrauterine pregnancy.

Testing the hypothesis

Color Doppler has been used to investigate establishment of uteroplacental circulation in early pregnancy⁸⁻¹⁰ and for the early recognition of normal and abnormal intrauterine pregnancy and ectopic pregnancy. A characteristic flow velocity waveform has been observed at the point of discharge of the spiral arteries into the intervillous space.⁸ The spiral arteries could be followed up to the endometrial surface by color Doppler to detect any lacunae of blood at the end of the artery (trophoblastic lacunae). This could be tested in in-vitro fertilization cases where the exact date of embryo transfer is known.

Conclusion

The earliest the site of a pregnancy can be confirmed by the modalities available in clinical practice is 4-5 weeks. Considering the wide variability in actual efficiency in practice, the diagnosis is often delayed causing a lot of concern for the women and the gynecologists involved in her management. It also increases the cost of treatment through prolonged hospital stay, repeated hospital attendances and

investigations, and sometimes unnecessary interventions. Color Doppler has been used to investigate early pregnancy problems with promising results. If its efficacy to detect the trophoblastic lacunae in extremely early embryo (after 9 days) could be established, it would have a substantial impact on the management of early pregnancy problems. It would also give an insight in to the development of very early uteroplacental circulation.

Author's role

Sudipta Paul is the sole Author who contributed to the study including participation in study design, execution, analysis, manuscript drafting and critical discussion.

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Conflicts of interest

The authors declare there is no conflict of interests.

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