

The use of interventional ultrasound in early pregnancy complications

Abstract

Background: The use of ultrasound to establish pregnancy location, viability and gestational age in the first trimester is well established. In addition to the conventional uses of ultrasound in early pregnancy, interventional ultrasound may also be used to guide clinicians during surgical procedures for the management of early pregnancy complications (i.e. treatment of ectopic pregnancy, caesarean section scar pregnancy, molar pregnancy, retained products of conception, and removal of intra-uterine devices in early pregnancy).

Aims: This review discusses the role of interventional ultrasound as it pertains to the management of first trimester complications, particularly with regard to the use of ultrasound in conjunction with surgical modalities.

Materials and Methods: This review was based on recently published research, as cited in the PubMed database, regarding the use of either transvaginal or transabdominal ultrasound to assist with the management of early pregnancy complications.

Conclusions: In addition to the diagnostic capabilities of ultrasound in early pregnancy, interventional ultrasound plays an important role in the management of various first trimester pregnancy complications. With the advent of more conservative approaches to early pregnancy complications, interventional ultrasound is a viable option which is not only safe in experienced hands but also enables fertility preservation.

Keywords: ectopic pregnancy, first trimester pregnancy, interventional ultrasound.

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Introduction

Ultrasound plays an essential role in the assessment of early pregnancy, in terms of determining pregnancy location, gestational age, viability, as well as for the diagnosis of early pregnancy complications. Interventional ultrasound techniques have been used successfully to manage various types of abnormal early pregnancies. Studies have reported the use of ultrasound guidance for the treatment of ectopic pregnancy (EP), both tubal and non-tubal (interstitial, cervical, intra-abdominal), as well as caesarean section scar pregnancy and molar pregnancy. Sonographic guidance may also be used in combination with laparoscopy, when indicated, for the management of EP and for complications following dilatation and curettage (D&C), such as uterine perforation. When a D&C is performed in the presence of uterine anomalies or uterine adhesions, sonography may guide the clinician in the removal of products of conception. Ultrasound guidance may also aid in the removal of an intrauterine device (IUD) during early pregnancy, and allow for pregnancy progression. This review will focus on the role of interventional ultrasound to guide surgical procedures, as it relates to the management of early pregnancy complications in the first trimester.

Ectopic pregnancy

The role of ultrasound for the diagnosis of potentially serious pregnancy complications such as EP is well established.^{1,2} A leading cause of maternal mortality in the first trimester, EP accounts for up to 4% of maternal deaths.^{3,4} Although a proportion of EPs will resolve spontaneously, many women will require either surgical or medical treatment for EP. Multiple reports have demonstrated the successful management of EPs with the use of ultrasound-guided injection of fetotoxic substances into the intra-amniotic and/or intrachorionic sac, with the use of methotrexate (MTX), etoposide, potassium chloride (KCl), and/or hyperosmolar glucose.⁵⁻⁷ This ultrasound guided method has been used to successfully treat EP located in the fallopian tubes, interstitium, cervix, and abdomen, as well as for caesarean section scar pregnancies. Ultrasound may also be used to guide the laparoscopic treatment of EP.^{6,8,9}

In a prospective non-randomised study of 120 women with unruptured tubal EP, the efficacy of transvaginal injection of MTX under sonographic guidance was found to be superior to intramuscular (IM) injection of MTX.¹⁰ Live tubal EP may also be treated successfully with the injection of KCl or MTX under transvaginal ultrasound

guidance.^{11,12} Hajenius, *et al.* reviewed 35 studies which used surgical, medical and expectant management of tubal EP.¹³ There were two randomised controlled trials included in this review that found transvaginal ultrasound guided injection of either MTX or hyperosmolar glucose was significantly better at treating tubal EP than with local tubal injection under laparoscopic guidance.^{14,15} Linear laparoscopic salpingostomy has been reported to be more successful in the treatment tubal EP than ultrasound guided local injection of MTX, however, the local injection of MTX resulted in improved long term outcomes such as a significantly higher intrauterine pregnancy rate and a reduction in recurrence of ectopic pregnancy.¹⁶

Ultrasound guidance may also be used for the local injection of fetotoxic substances for EP in more uncommon locations. In a study by Andres, *et al.*, ultrasound guidance was used to inject a single dose of MTX into the gestational sac for the management of 14 EPs, located in the fallopian tubes, cervix, interstitium, and abdomen. The average gestational age was seven weeks and three days, and the success rate for this technique was 92.96%.⁵ In another study by Doubilet, *et al.*, 25 out of 27 women with EP located at the cervix, interstitium, caesarean section scar and fallopian tube (heterotopic pregnancy) were treated successfully with KCl injection of the gestational sac under either transvaginal or transabdominal ultrasound guidance.¹⁷ With regard to cervical EP, one study showed the successful management of all 38 cases of cervical EP with ultrasound guided transvaginal injection of MTX ± KCl (in the presence of cardiac activity) into the gestational sac.¹⁸ In a case study of a seven week heterotopic cervical pregnancy with a heartbeat, KCl was injected under transvaginal ultrasound guidance to successfully treat the EP and allow for continuation of the intrauterine pregnancy.¹⁹

With the guidance of ultrasound, laparoscopic procedures such as the the local injection of fetotoxic substances for the management of EP may be performed. Chen, *et al.* published a case study where transvaginal ultrasound was used to successfully guide the laparoscopic assisted local injection of etoposide into a caesarean section scar pregnancy.⁶ In another case study by Poujade, *et al.*, transabdominal ultrasound was used to guide the evacuation of an intrauterine pregnancy in the presence of a cornual heterotopic pregnancy. Using ultrasound guidance, the clinicians were able to avoid uterine perforation during the D&C and subsequently perform MTX injection into the cornual sac via laparoscopy.⁹ The patient had an uneventful recovery, with a continued fall in weekly hCG and complete resolution of the cornual gestational sac after two months. In another study by Thakur, *et al.*, cornual EP was managed successfully with laparoscopic and ultrasound-guided transcervical evacuation.⁸

In addition to the injection of fetotoxic substances under sonographic guidance, ultrasound may also be used to guide the clinician during the aspiration of an EP. The use of transvaginal ultrasound guided aspiration and instillation of hyperosmolar glucose into the gestational sac of heterotopic pregnancies has been described in the literature. This technique may allow for preservation of the fallopian tubes and continuation of the intrauterine pregnancy.^{20,21} In a case series of 13 women with live tubal EP, aspiration of the embryo followed by injection of MTX into the gestational sac was used to successfully treat 12/13 cases (92%).²² Transvaginal ultrasound has also been used to

guide the aspiration of heterotopic interstitial pregnancies in the absence of injecting a fetocide drug, although three of the five patients aborted the intrauterine pregnancy following embryo reduction in this study.²³

Ultrasound guidance may also be used to guide the surgical management of EP, particularly with regard to cervical and caesarean section scar EP. Bianchi, *et al.* placed prophylactic sutures at the cervicovaginal branches of the uterine artery and then used transabdominal ultrasound guidance during D&C for the treatment of a cervical ectopic pregnancy.²⁴ Kim, *et al.* used ultrasound to guide the successful hysteroscopic resection of 10 cervical pregnancies.²⁵ There has also been a case report of a heterotopic twin pregnancy at nine weeks gestation, one intrauterine pregnancy and one cervical ectopic pregnancy, where the cervical EP was successfully treated with curettage under sonographic guidance. The pregnancy resulted in a live newborn at 39 1/2 weeks.²⁶ Bignardi and Condous used transrectal ultrasound to guide the surgical uterine evacuation for five out of seven caesarean section scar pregnancies. The remaining two caesarean section scar pregnancies were treated with systemic MTX, one of which failed and was subsequently treated with transrectal guided curettage.²⁷ In another study, 39 women with a caesarean section scar pregnancy were treated with hysteroscopic removal of the pregnancy tissue under ultrasound guidance, with only two women requiring further surgery after the procedure.²⁸

The ability to successfully manage EP of various locations with aspiration and/or local injection under ultrasound guidance may reduce the need for definitive surgical intervention, and therefore allow for the preservation of uterine/fallopian tube integrity and future fertility. In addition, ultrasound guidance may also aid in the success of endoscopic and suction procedures, especially with regard to caesarean section scar pregnancy and cornual pregnancy. In the case of heterotopic pregnancies, the evidence seems to suggest that ultrasound assisted procedures for the treatment of EP may be associated with favourable outcomes for the co-existing intrauterine pregnancy.

Molar pregnancy

In general, ultrasound guidance is not required for the surgical evacuation of a molar pregnancy. When considering persistent gestational trophoblastic disease, chemotherapy is usually successful. However, there has been a case report in which treatment with systemic MTX and repeat D&C did not successfully resolve a persistent molar pregnancy with myometrial invasion. The authors reported the use of transvaginal ultrasound guidance to locate and directly inject the persistent molar pregnancy with MTX, allowing for resolution of the molar pregnancy.²⁹ In another case study, a molar pregnancy was located within a caesarean section scar post-termination, and successfully treated with suction curettage under sonographic guidance.³⁰ Although most cases of molar pregnancy may be managed without the use of ultrasound guidance, this modality may offer additional benefit in the case of persistent gestational trophoblastic disease, particularly when myometrial invasion is present.

Intrauterine pregnancy complications

Transabdominal ultrasound guidance may be used to ensure the uterus is completely evacuated of all contents during D&C

for early failed or terminated pregnancies. This is especially true for women who have retained products of conception after the initial D&C has been performed. Ultrasound guidance may also be useful during D&C when there is difficulty with dilatation of the cervix (i.e. cervical stenosis), as transabdominal sonography can aid in determining the cervical orientation and to guide the instrument along the cervical canal.³¹

The use of ultrasound for the diagnosis of retained products of conception has been well studied.³²⁻³⁶ In a study by Wolman, *et al.*, sonographic guidance with saline infusion sonohysterography was performed to successfully evacuate the uterus of retained products of conception.³⁷ Ultrasound guidance may also be used to assist in the removal of retained products of conception in women with uterine anomalies or adhesions. In a study by Pennes, *et al.*, real-time ultrasound guidance was used to successfully evacuate retained products of conception following four failed therapeutic abortions in women with unsuspected uterine anomalies.³⁸ Although rare, intrauterine adhesions may also be associated with complications during first trimester surgical abortion. In a case study by Luk, *et al.*, a multiparous woman with a six-week intrauterine pregnancy underwent three unsuccessful D&Cs, followed by failed treatment with MTX. The pregnancy was finally removed from behind the intrauterine adhesions using ultrasound guided hysteroscopy with suction curettage.³⁹

Another uncommon complication of early pregnancy that may be managed with the aid of ultrasound guidance is the co-existence of an intrauterine device (IUD). In a retrospective study of nine women with early intrauterine pregnancies (six–thirteen weeks gestation) and a concurrent IUD, sonographic guidance was used to successfully remove the IUD in eight of the nine cases. The IUDs were located and removed, by passing forceps through the cervix and grasping the IUD, under transabdominal ultrasound guidance. Removal of one of the IUDs failed, as the IUD was situated between the fundus and gestational sac. Seven out of the eight pregnancies which had IUD removal progressed to delivery of a live baby.⁴⁰ In another study of 16 women with early pregnancy and the presence of an IUD, the IUD was successfully removed in all 16 women under ultrasound guidance, with one pregnancy resulting in fetal loss. In this study the IUDs which were located behind the gestational sac were also removed successfully.⁴¹ Schiesser, *et al.* reviewed 82 women with IUDs present in early pregnancy and successfully removed the IUD under ultrasound guidance in 81/82 women. Seventy five out of the 81 (93%) women underwent ultrasound guided IUD removal in the first trimester, and the total miscarriage rate was 22.1%. The rate of live births was 77%, providing further support for the use ultrasound guided removal of IUDs to allow for pregnancy continuation.⁴²

Pregnancy following endometrial ablation is associated with increased risks for the pregnancy, as well as an increased risk for failure and complications during D&C. In a case study of a 29-year-old woman who became pregnant after endometrial ablation, ultrasound guidance was used to guide the local injection of MTX into the gestational sac to successfully resolve the unplanned pregnancy.⁴³

Sonography has also been used to guide gestational sac aspiration in early failed pregnancy. In a prospective historical cohort study of 60 women with failed early pregnancy following

in vitro fertilisation or intrauterine insemination, the researchers compared gestational sac aspiration under ultrasound guidance with conservative management to determine whether gestational sac aspiration was an effective alternative to D&C.⁴⁴ Gestational sac aspiration was performed under transvaginal ultrasound guidance, and was found to be successful in the management of early pregnancy failure for 19/20 women in this group. In addition, this ultrasound guided technique allowed for the evaluation of the aspirated tissue for chromosome analysis. The researchers concluded that gestational sac aspiration under sonographic guidance is a safe and effective technique for the management of early pregnancy failure, allowing for the collection of adequate tissue sample and avoiding the more invasive surgical procedure of D&C.

Conclusions

In addition to the diagnostic capabilities of ultrasound in early pregnancy, interventional ultrasound plays an important role in the management of first trimester pregnancy complications. Transvaginal ultrasound allows for the visualisation of EP localisation (tubal versus non-tubal) and subsequent surgical and/or medical treatment of EP. Sonography may be used to guide laparoscopic procedures to safely treat EP, especially with regard to cornual EP and caesarean section scar pregnancies. For cases of early pregnancy in the presence of an IUD, ultrasound can be used to successfully guide the removal of the IUD and allow for pregnancy progression. Ultrasound guidance may also be useful in the removal of retained products of conception during D&C. With the advent of more conservative approaches to early pregnancy complications, interventional ultrasound is a viable option which is not only safe in experienced hands but also enables fertility preservation.

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