

## Original Article

# Ultrasound vs. histologic findings in 40 patients with special types of ectopic pregnancy

Haifeng Feng<sup>1</sup>, Yi Zheng<sup>2</sup>, Yan Ke<sup>2</sup>

Departments of <sup>1</sup>Ultrasound, <sup>2</sup>Radiology, Xianning Central Hospital, The First Affiliated Hospital of Hubei University of Science and Technology, Xianning 437100, Hubei Province, China

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**Abstract:** Purpose: The purpose of the study was to analyze the ultrasound findings and imaging features of patients with special types of ectopic pregnancy. Methods: The ultrasound findings of 40 patients with special types of ectopic pregnancy in our hospital were retrospectively analyzed. Results: Among 40 patients, there were 17 cases of cornual pregnancy, 12 cases of cervical pregnancy, 8 cases of uterine scar pregnancy, and 3 cases of incomplete abortion confirmed by operation and pathology. The accuracy rate of ultrasound findings in the diagnosis of 40 special types of ectopic pregnancy was 77.50%, with a consistency rate of 70.59% for cornual pregnancy, 83.33% for cervical pregnancy, 100.00% for cesarean scar pregnancy and 33.33% for incomplete abortion. There were 9 misdiagnoses in ultrasound diagnosis, including 5 misdiagnoses of angular pregnancy (misdiagnosed as 4 cases of tubal interstitial pregnancy and 1 case of trophoblastic tumor), 2 misdiagnoses of cervical pregnancy (misdiagnosed as incomplete abortion), and 2 misdiagnoses of incomplete abortion (misdiagnosed as isthmus pregnancy). There was no misdiagnosed case of cesarean scar pregnancy. Conclusion: Ultrasound findings have some value in the diagnosis of specific types of ectopic pregnancy and can help identify different types of ectopic pregnancy. Transabdominal ultrasound and transvaginal ultrasound should be clinically combined to obtain more information for diagnosis.

**Keywords:** Surgical pathology, specific types, uterus, ectopic pregnancy, ultrasound, diagnosis

## Introduction

Ectopic pregnancy refers to implantation in a place other than the normal location in the lining of the upper uterine cavity. Special types of ectopic pregnancy have low incidence, such as cornual pregnancy, isthmus pregnancy, and cervical pregnancy [1]. The incidence of cervical pregnancy remains low, accounting for 1%-2% of ectopic pregnancies occurring in the same period and seriously threatens the life of pregnant women [2]. Isthmus pregnancy is difficult to manage clinically; the incidence of scar pregnancy is less than 1% of ectopic pregnancies in the same period, and the incidence of cornual pregnancy ranged 1%-7% [3, 4].

The incidence of ectopic pregnancy has gradually increased due to the increase in uterine operations, the prevalence of in vitro fertilization and embryo transfer techniques as well as cesarean delivery. Ectopic pregnancy may be associated with the following factors. First,

some patients place IUD for contraception, affecting the normal implantation of fertilized egg. Second, some patients have dysplasia of the uterus, endocrine disorders, uterine malformations, etc., which will lead to changes in the shape of the uterine cavity, and such patients are prone to ectopic pregnancy after conception. Third, assisted reproductive technology will affect the uterine cavity in cervical canal. Fourth, the endometrium of the uterine cavity has been damaged in the past, and scars or adhesions occur, preventing the implantation of the fertilized egg in the uterus. Previous damage to the endometrial surface of the uterine cavity, followed by scarring or adhesions, obstructs fertilization of the egg. It was found that patients with multiple abortions, cesarean delivery, indwelling intrauterine devices, and postpartum curettage for placental residue were more likely to develop endometrial adhesions [5]. Curettage is an independent influencing factor [6] for the occurrence of ectopic pregnancy in the lower uterine segment. Fifth, the

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fertilized egg moves quickly and does not have the ability to plant when passing through the uterine cavity. Due to the delay of the maturation of the endometrium and abnormal contraction of the smooth muscle, the fertilized egg enters the cervical canal, followed by cell division and implantations in the cervical canal, causing an ectopic pregnancy [7, 8].

The low incidence of specific types of ectopic pregnancy leads to a high rate of clinical misdiagnosis, and some patients experience uncontrollable vaginal hemorrhage and undergo hysterectomy to ensure life safety. Patients may lose fertility, and in a few cases, even experience hemorrhagic shock or death from excessive blood loss [9]. This highlights the importance of early diagnosis of ectopic pregnancy. Ultrasound is a common method for the diagnosis of ectopic pregnancy, but few studies have centered on special types of ectopic pregnancies, and the value of ultrasound in these patients has not been clearly described. In this study, 40 patients with special types of ectopic pregnancy in our hospital were retrospectively analyzed to investigate the diagnostic value of ultrasonography.

### Materials and methods

#### *Clinical data*

A total of 40 patients with specific type of ectopic pregnancy, aged 21-43 years, with 5-15 weeks of amenorrhea, were enrolled, with  $\beta$ -human chorionic gonadotropin ( $\beta$ -hCG) levels ranging 24.01-4595 IU/L. Among all patients, 31 cases were postpartum women, 34 cases had received at least one artificial abortion, 13 cases had a history of abdominal pain, 37 cases had a history of vaginal bleeding, and 4 cases had a history of syncope. All patients had clear pathologic results. Among them, cervical pregnancy and cesarean scar pregnancy were first treated with uterine artery embolization followed by curettage. For cornual pregnancy, ultrasound-guided curettage, total hysterectomy, and cornual wedge resection were performed. This study was approved by the Medical Ethics Committee. All patients signed the written informed consent before participating in the study.

#### *Methods*

Diagnostic instruments included Siemens real-time ultrasonic diagnostic equipment, Parkson

color Doppler ultrasonic diagnostic equipment. The frequency of transabdominal ultrasound probe was set to 3.75 MHz, and the frequency of transvaginal ultrasound probe was set to 7.5 MHz. Prior to the transabdominal ultrasound examination, the patient drank plenty of water to fill the bladder. After applying the coupling agent to the abdomen probe, the cross-section, longitudinal section, and oblique section were examined to determine the position of the gestational sac in the uterus. After transabdominal ultrasound examination, the patient was ordered to empty the bladder, and the vaginal probe was inserted into the vagina after putting on a sterile condom to examine the location of the gestational sac and the relationship between the gestational sac and the endometrium. After completion of the above real time ultrasound diagnosis, color Doppler ultrasound was continued, and the transabdominal and transvaginal examinations were performed to evaluate the blood flow around the gestational sac and the condition of the lesion.

#### *Observation indicators*

The specific types of ectopic pregnancies were determined by pathologic findings, including cornual pregnancy, cervical pregnancy, uterine scar pregnancy, and incomplete abortion. The number of ectopic pregnancies of cornual pregnancy, cervical pregnancy, uterine scar pregnancy, and incomplete abortion correctly diagnosed by ultrasound and the number of misdiagnoses were determined based on pathologic findings. The specific types of ultrasound misdiagnosis were analyzed.

The sonographic presentations of the uterus, including those of the ruptured and unruptured types, were analyzed, respectively. Specifically, the uterine morphology, location of fertilized egg, mass, echo, liquid dark area and blood flow signals were observed.

The characteristics of sonographic presentation of different types of ectopic pregnancies were analyzed. Specifically, size, endometrial echo, mass, boundary, and blood flow condition were observed.

#### *Statistical methods*

Statistical analysis was performed with SPSS 23.0, and count data were expressed as [n (%)] and examined by  $\chi^2$  test.  $P < 0.05$  indicated a significant difference.

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**Table 1.** Analysis of 40 ectopic pregnancies diagnosed by ultrasound (cases, %)

Types confirmed by pathologic data	Number of cases confirmed by surgical pathology	Number of cases confirmed by ultrasound diagnosis	Accuracy rate by ultrasound diagnosis
Cornual pregnancy	17	12	70.59
Cervical pregnancy	12	10	83.33
Scar pregnancy	8	8	100.00
Incomplete abortion	3	1	33.33
Total	40	31	77.50

**Table 2.** 9 cases of ectopic pregnancy misdiagnosed by ultrasound (cases, %)

Type of misdiagnosis	Number of misdiagnosed cases	Proportion of misdiagnosis	Correct type
Interstitial tubal pregnancy	4	44.44	Cornual pregnancy
Incomplete abortion	2	22.22	Cervical pregnancy
Trophoblastic tumors	1	11.11	Cornual pregnancy
Isthmus pregnancy	2	22.22	Incomplete abortion
Total	9	100.00	-

### Results

#### *Pathologic findings*

Among the 40 patients included in the study, there were 17 cases of cornual pregnancy, 12 cases of cervical pregnancy, 8 cases of uterine scar pregnancy, and 3 cases of incomplete abortion confirmed by operation and pathology.

#### *Accuracy rate of diagnostic results by ultrasound*

According to the pathologic results, the ultrasonic diagnosis of 40 cases of special types of ectopic pregnancy was correct in 31 cases and 9 cases were misdiagnosed. The accuracy rate was 77.50%, with consistency rate of 70.59% for cornual pregnancy, 83.33% for cervical pregnancy, 100.00% for cesarean scar pregnancy and 33.33% for incomplete abortion (**Table 1**).

#### *Ultrasound misdiagnosis*

Compared with surgical pathology, 9 cases were misdiagnosed, including 5 cases of cornual pregnancy, 2 cases of cervical pregnancy, and 2 cases of incomplete abortion. Specifically, 5 cases of cornual pregnancy were misdiagnosed as 4 cases of tubal interstitial pregnancy and 1 case of trophoblastic tumor, 2 cases of cervical pregnancy were misdiagnosed as incomplete abortion, and 2 cases of incom-

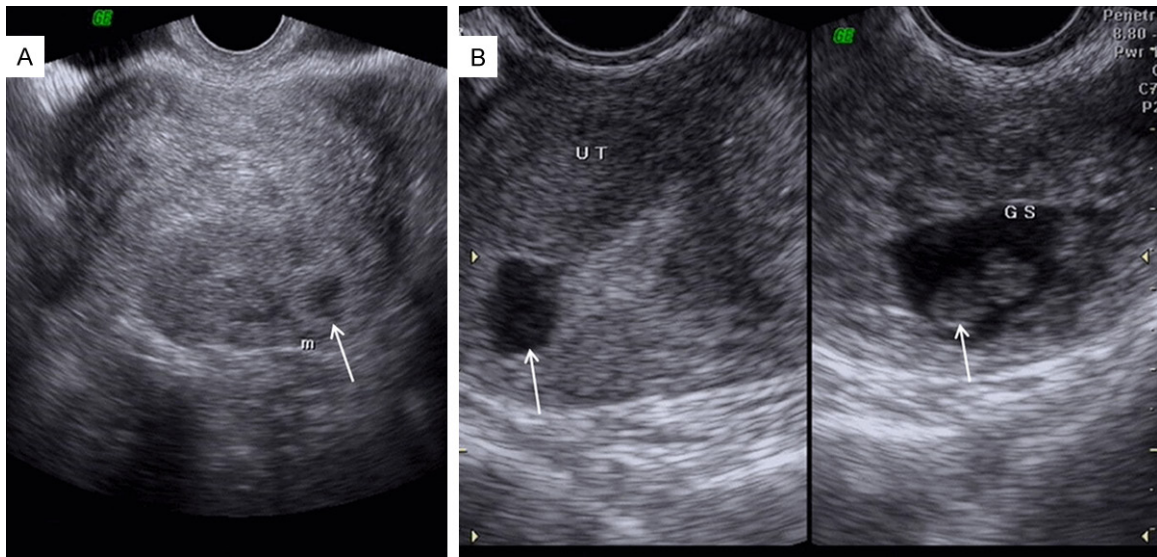
plete abortion were misdiagnosed as isthmic pregnancy (**Table 2**).

#### *Sonographic presentation of the uterus*

The uterine morphology varies depending on gestational sac implantation site, the timing of implantation, and the shape of the uterus. The ultrasound sonogram of the uterus can be divided into ruptured type and unruptured type. Of the 40 patients, there were 10 cases of ruptured type, including abnormal uterine anatomy and abnormal location of fertilized egg, e.g. protruding mass with heterogeneous echogenicity was observed in the uterine horns and isthmus, encircled with liquid dark area. Color Doppler ultrasonography, on the other hand, showed abundant blood flow signals in the mass.

There were 30 cases of unruptured type. Differential analysis was conducted according to whether the uterine morphology had changed. Among them, 12 cases of uterine morphology were changed to varying degrees. The uterus enlarged into a flask-shaped body or was fusiform in shape, or showed local protrusion. Masses were found locally in the uterus, and they had irregular shapes. There was heterogeneous echogenicity and liquid dark areas in the masses. Color Doppler ultrasonography revealed a very abundant blood flow signal in the vicinity of the masses. In the other 18 cases, there was no significant change in the morphology of the uterus, and a gestational

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**Figure 1.** Sonogram of cornual pregnancy. Ultrasonography showed an echogenic protrusion in the left uterine horn (A) and a gestational sac echo in the right uterine horn (B).

sac was observed at the abnormal implantation site of the uterine ovum, which closely attached to the myometrium. Color Doppler ultrasonography revealed rich blood flow signals in myometrium that was adjacent to, and in contact with, the fetal sac.

### *Ultrasonographic manifestations of cornual pregnancy*

Ultrasonography showed that the uterus was enlarged asymmetrically, without pregnancy-related signs in the uterine cavity, and the endometrial echo was thickened. A cyst may be found on one uterine horn, and some cyst-like masses appeared on the upper side of the uterine horn, and connected with the endometrial line, and the boundary between the cyst and the uterine horn was not clear. The cyst wall was thicker, and the echo was enhanced. Echoes around intact myometrium were observed. The echogenicity of embryos was detected in some patients with late rupture and embryonic heart pulsation could also be observed. There was abundant blood flow, *i.e.* trophoblastic blood flow, in the proximity of the gestational sac and mass, with a RI ranging between 0.40 and 0.50 (**Figure 1**).

### *Sonographic presentation of uterine isthmus pregnancy*

An isthmus pregnancy occurs when the fertilized egg is implanted above the histologic internal os but is anatomically located in the isth-

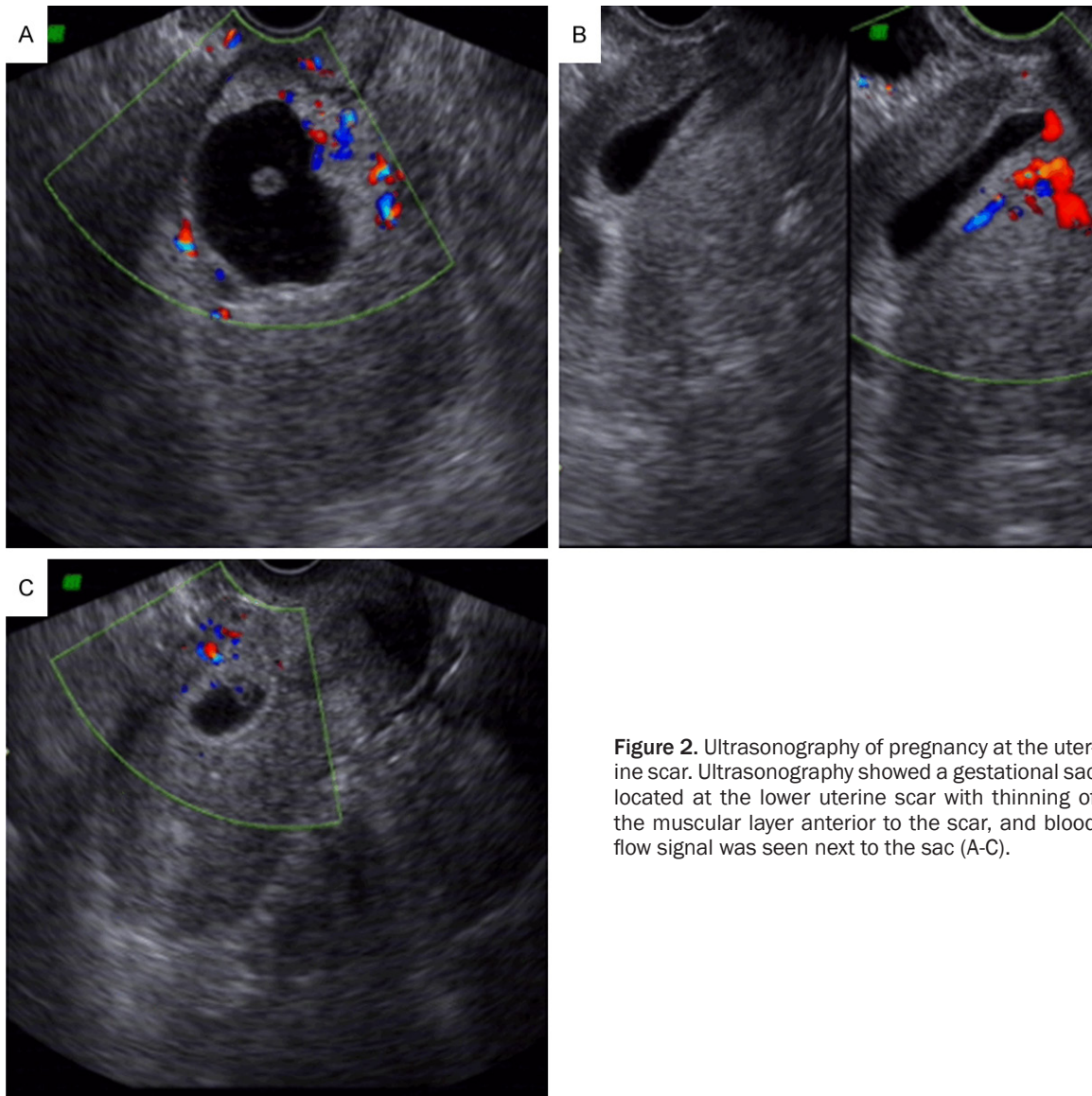
mus below the internal os. The sonographic manifestations of this type of ectopic pregnancy are characterized by the presence of abundant blood flow, *i.e.*, trophoblastic blood flow, with a RI of no more than 0.4. The second is that the change in the shape of isthmus cannot be judged. The third is a change in the morphology of the uterus, which was pyknotic in shape. The above is the body of the uterus and the internal sound waves are still detectable, and the middle is a small bulge with a complex echogenicity. Below is one portion of the cervix. In the present study, two incomplete abortions were misdiagnosed as isthmus pregnancies, and a hypoechoic mass could be observed near the endocervix on ultrasonography, which did not reveal the presence of a fetal sac and lacked abundant blood flow signals. The misdiagnosis was due to the presence of prolonged vaginal bleeding, the fetal tissues were basically in the endocervical region and the uterine isthmus had a more prominent presence, resulting in the misdiagnosis. Uterine artery embolization and curettage were performed to remove a large amount of old clot and necrotic tissue. Ultrasonography revealed that the hypoechoic mass was no longer observed in the endocervical area.

### *Sonographic presentation of pregnancy at the incisional scar*

Scar pregnancy at the lower uterine segment mainly refers to the implantation of the fertil-



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**Figure 2.** Ultrasonography of pregnancy at the uterine scar. Ultrasonography showed a gestational sac located at the lower uterine scar with thinning of the muscular layer anterior to the scar, and blood flow signal was seen next to the sac (A-C).

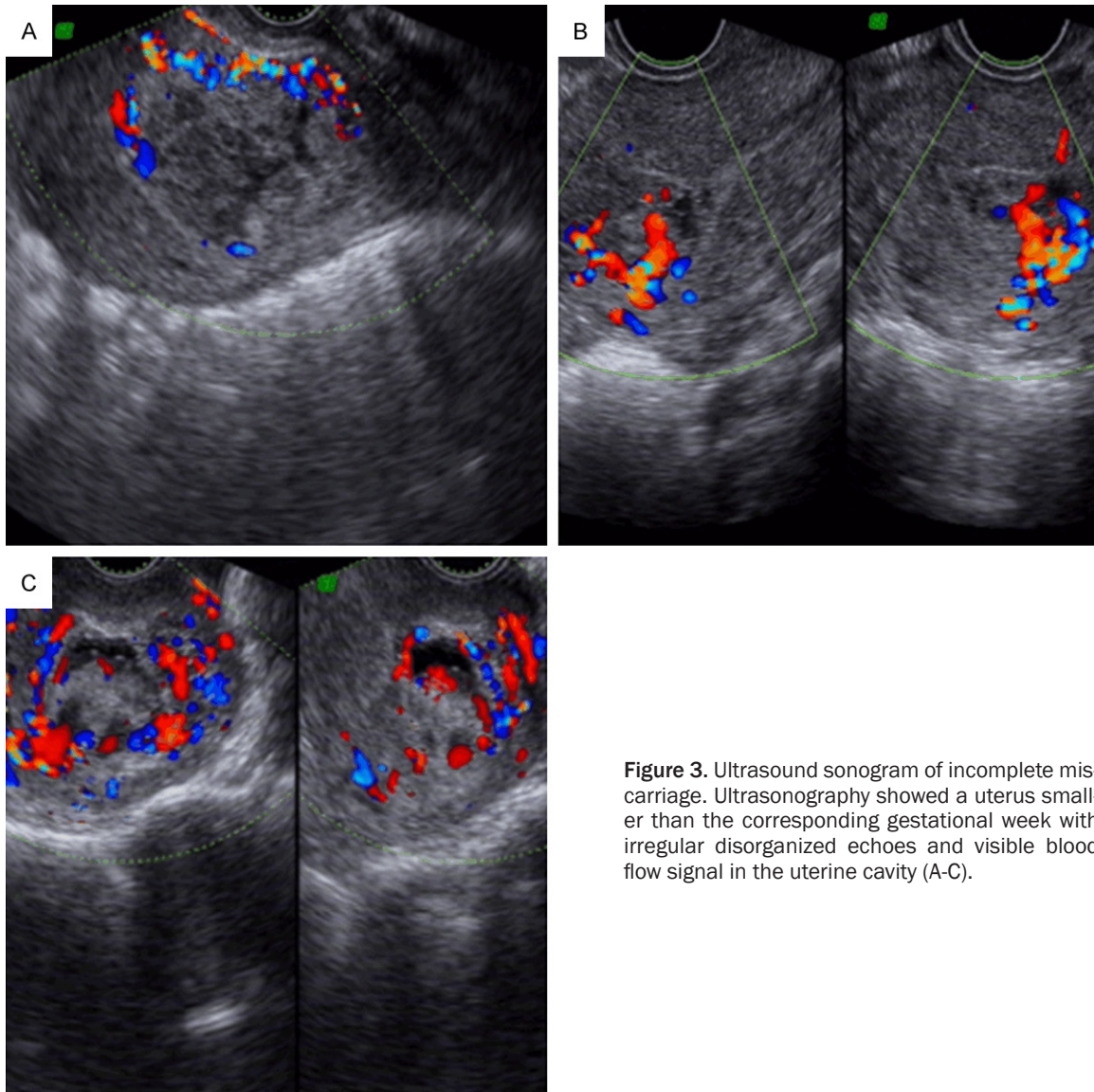
ized egg in the scarred area of the lower uterine segment, resulting in a more fragile and breakable scar due to the invasion of the villi tissue and blood vessels into the scar where the gap exists. Ultrasonography reveals three typical manifestations, i.e. the presence of abundant blood flow signals as well as trophoblastic blood flow. The second is a closed internal os. The third is a slightly enlarged uterus with a fertilized egg that has settled in the lower uterine scar and the echogenic signals of villi tissue can be observed. In this study, cesarean scar pregnancy was diagnosed by ultrasonography in all patients with a history of cesarean delivery, and a heterogeneous mass could be found in the incision site within which a rich blood flow signal, uterine waves, and closed internal os

could be found. The uterus was fusiform, which was easy to be diagnosed as isthmic pregnancy. This ultrasound examination showed no abnormal echogenicity of the cervical structures, a centered cervical canal, and a closed internal os (**Figure 2**), leading to 100% accuracy.

### *Sonographic presentation of cervical pregnancy*

Cervical pregnancy refers to the implantation of the fertilized egg in the cervical canal with villi invading into the endometrium with no bleeding or painful manifestations in the early stages and heavy bleeding in third trimester. Ultrasound examination shows two main types

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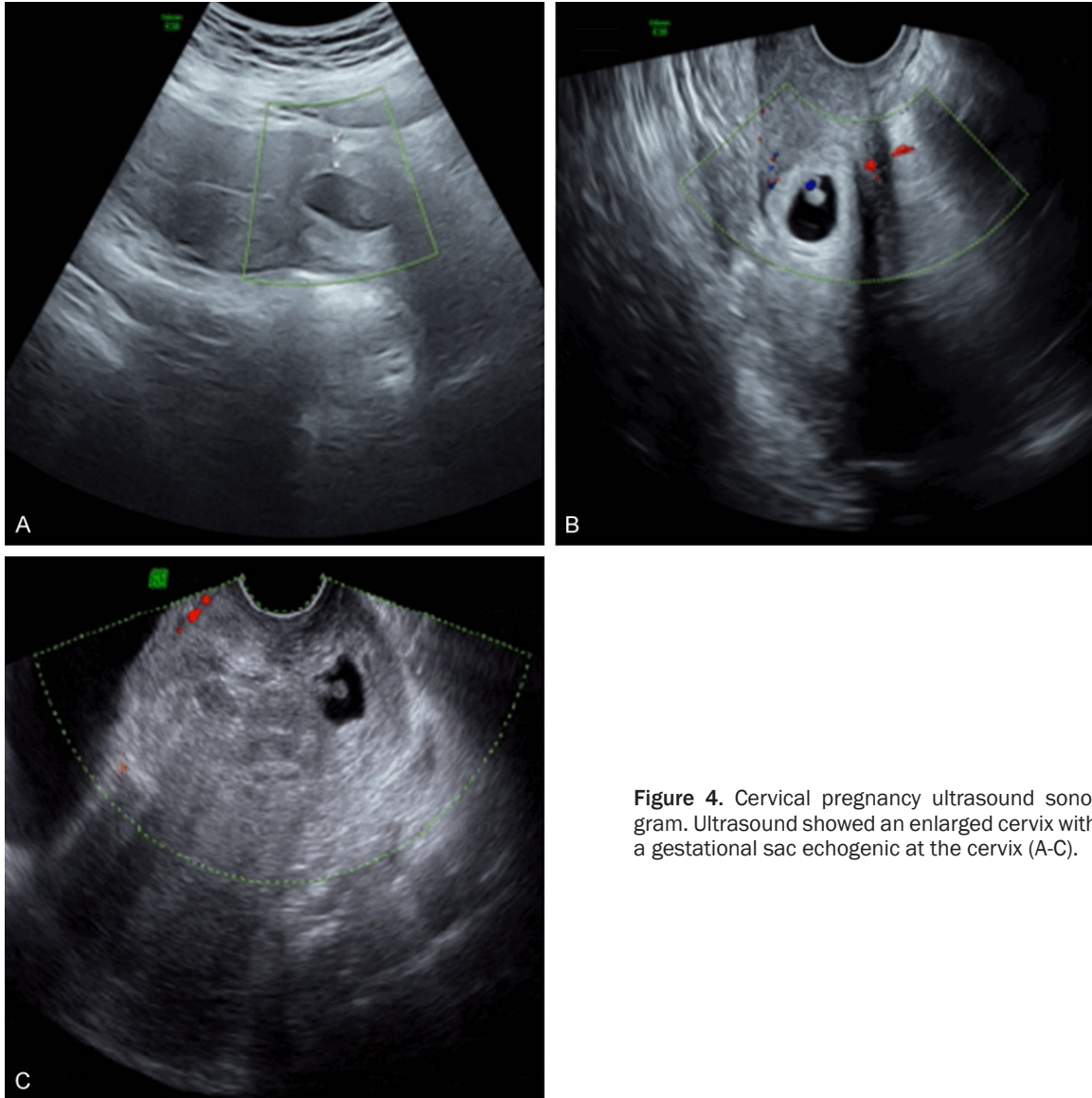


**Figure 3.** Ultrasound sonogram of incomplete miscarriage. Ultrasonography showed a uterus smaller than the corresponding gestational week with irregular disorganized echoes and visible blood flow signal in the uterine cavity (A-C).

of manifestations. The first is the closure of internal os and the slightly loose external os with abundant blood flow (trophoblastic flow,  $RI \leq 0.4$ ). The second is a full uterus in the early stage, and in some patients, a fetal sac can be observed in the cervical canal, or a fetal heart-beat or fetal bud can be observed. As the embryo grew, the uterus became flask-shaped, with a uterine body in normal size on the top, within which the uterine waves could be observed, and below was an enlarged cervix. The contents were disorganized with no homogeneous echogenicity and intact fetal sacs were present in few patients. In this study, 2 cases of cervical pregnancy were misdiagnosed as incomplete miscarriages. For incom-

plete miscarriages, the uterus was less than that at the time of menopause or largely compatible in size, the cervical opening was dilated, and embryonic tissue or a gestational sac detached from the cervical opening could be observed. Color Doppler ultrasonography showed no trophoblastic blood flow signal near the cervical gestational sac, and the gestational sac was shrunken and jagged, with low tension. The intracervical echo and intrauterine echo were continuous (**Figure 3**). In contrast, the gestational sac in cervical pregnancy was oval or round, and there was no continuity with the uterine cavity echogenicity and abundant trophoblastic blood flow could also be observed (**Figure 4**).

## Ultrasound findings vs. histologic findings



**Figure 4.** Cervical pregnancy ultrasound sonogram. Ultrasound showed an enlarged cervix with a gestational sac echogenic at the cervix (A-C).

### Discussion

Due to the high incidence of pelvic inflammatory disease, the incidence of abortion and caesarean section is gradually increasing, leading to an increase in ectopic pregnancy cases. Some special types of ectopic pregnancy with low incidence are sometimes misdiagnosed as early pregnancy in clinical practice, and direct abortion may lead to hemorrhage and uterine rupture, threatening the life of patients. Therefore, it is necessary to make early diagnosis to guide the clinical management.

Cornual pregnancy is a special type of ectopic pregnancy, which is difficult to distinguish from

interstitial pregnancy [10] when the gestational sac ruptures and the local structure is disordered. The present study also showed that cornual pregnancy was misdiagnosed as interstitial pregnancy. Ultrasonography of interstitial pregnancy shows protrusion of the horn of the uterus, with the gestational sac deviating laterally and very close to the parametrium. The embryo sac is surrounded by the muscle layer, but the outer superior muscle layers lack integrity or disappears completely. The isthmus and endometrial line are not connected, that is, the structure of the gestational sac is displayed after the uterine echogenicity disappears. The distance between the two is approximately 1 cm, which is the interstitial line sign [11, 12].



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Ultrasonography of cornual pregnancy shows a gestational sac structure that appears immediately as the uterine echogenicity is about to disappear, with a gestational sac attached to the uterine cavity and a gestational sac proximally encircled by the intact muscle layer [13]. To achieve an accurate diagnosis, abdominal ultrasound and vaginal ultrasound should be combined to provide a comprehensive view of the whole uterus, the relationship between the uterus and the gestational sac, to determine whether the gestational sac is normally contained within the uterus and whether there is any encapsulated muscle tissue adjacent to the gestational sac [14]. The diagnosis of isthmus pregnancy could be confirmed by excluding cervical pregnancy and incomplete abortion. In isthmus pregnancy, the gestational sac is located in the area of the internal os, with a pyknotic shape and limited dilatation, the internal os of the uterus is mostly widened, and only part of the cervical structures can be observed on ultrasonography [15]. Cervical pregnancy is generally not abnormal in size of the uterus, with internal os closed, the cervix enlarged, and the uterine body in an hourglass shape; and trophoblast blood flow signals can be observed near the gestational sac [16]. In an incomplete abortion, the size of the uterus is slightly smaller than the number of menopausal weeks, the cervix is dilated, and the gestational sac or embryo tissue that falls off the cervix can be observed [17]. Color Doppler ultrasound examination showed no trophoblast blood flow signals near the gestational sac, and the gestational sac was shrunken and jagged, with low tension, and the intracervical echo and intrauterine echo were continuous [18]. The main point of ultrasound diagnosis of isthmus pregnancy is to confirm that the gestational sac is close to the trophoblast blood flow, and the isthmus has continuous muscular layer with enlarged internal os. The uterine body above the gestational sac is enlarged or basically normal, the isthmus is enlarged, and the uterus is in fusiform shape. The gestational sac is in the isthmus of the uterus [19].

After cesarean section, cesarean scar pregnancy is actually a type of isthmic pregnancy [20], and all scar pregnancies in this group were diagnosed and confirmed by ultrasonography without misdiagnosis. In this study, we proposed that for patients with a history of cesar-

ean delivery, when the examination reveals a poorly defined relationship between the implantation site of the gestational sac and the incision location, vaginal ultrasound should be implemented to observe the morphology of the lower end of the gestational sac, the relationship between the gestational sac and the incision, the thickness of the muscular layer at the scar site, and the blood flow of the gestational sac, so as to predict the possibility of adhesions between the gestational sac and the muscular layer of the incision, providing more useful information for diagnosis and preventing misdiagnoses leading to serious complications and threatening the life of the patient [21]. Cervical pregnancy should be distinguished from cesarean scar pregnancy, isthmus pregnancy, and intracervical abortion [22]. In the case of scar pregnancy in the lower uterine segment, the sac is above the internal os and the cervical structure is well-defined [23]. In isthmus pregnancies, the gestational sac is in the area of internal os and shows a restricted enlargement, which is pyknotic in shape, and the endocervix is mostly open. The complete cervical structure cannot be observed on ultrasonography [24]. Ultrasonography of intracervical abortion may reveal an enlarged uterine body with marked cervical dilatation, a full uterus resembling a gourd with an open internal os. The cervical canal is filled with fetal tissue [25]. Therefore, in the differential diagnosis of these types of ectopic pregnancies, it is important to determine whether the internal os is open and whether a normal cervical structure can be observed on the ultrasound image.

In conclusion, ultrasound exhibited some value in the diagnosis of specific types of ectopic pregnancy and can help identify different types of ectopic pregnancy. In order to improve diagnostic accuracy, the diagnostician needs to know the key points of diagnosis and features of different ectopic pregnancies. In the application of ultrasound diagnosis, transabdominal ultrasound should be combined with transvaginal ultrasound, and the sonograms of both should be analyzed to obtain rich information for diagnosis. However, as this was a retrospective study, only 40 patients were analyzed, and the types of ectopic pregnancies analyzed were few, there are limitations to the findings, which should be improved in future studies.



### Disclosure of conflict of interest

None.

**Address correspondence to:** Yan Ke, Department of Radiology, Xianning Central Hospital, The First Affiliated Hospital of Hubei University of Science and Technology, No. 228 Jingui Road, Xian'an District, Xianning 437100, Hubei Province, China. Tel: +86-13797220662; E-mail: keyanrad@163.com

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