

# Ectopic pregnancy: pictorial essay focusing on computed tomography and magnetic resonance imaging findings\*

*Gravidez ectópica: ensaio iconográfico com enfoque em achados de tomografia computadorizada e ressonância magnética*

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**Abstract** The objective of the present study is to describe key computed tomography and magnetic resonance imaging findings in patients with acute abdominal pain caused by ectopic pregnancy. For this purpose, two radiologists consensually selected and analyzed computed tomography and magnetic resonance imaging studies performed in female patients with acute abdominal pain caused by proven ectopic pregnancy in the period between January 2010 and December 2011. The imaging diagnosis of ectopic pregnancy is usually obtained by ultrasonography, however, with the increasing use of computed tomography and magnetic resonance imaging in the assessment of patients with acute abdomen of gynecological origin it is necessary that the radiologist becomes familiar with the main findings observed at these diagnostic methods.

**Keywords:** Acute abdomen; Ectopic pregnancy; Computed tomography; Magnetic resonance imaging.

**Resumo** O objetivo deste trabalho é descrever os principais achados de tomografia computadorizada e ressonância magnética em pacientes com dor abdominal aguda causada por gravidez ectópica. Para isso, dois radiologistas em consenso selecionaram e analisaram exames de tomografia computadorizada e ressonância magnética realizados entre janeiro de 2010 e dezembro de 2011 de pacientes com dor abdominal aguda comprovadamente decorrente de um quadro de gravidez ectópica. O diagnóstico por imagem de gravidez ectópica é usualmente obtido por ultrassonografia, no entanto, o uso crescente da tomografia computadorizada e ressonância magnética na avaliação do paciente com abdome agudo de origem ginecológica tem requerido que o radiologista se familiarize com os principais aspectos observados nestes métodos diagnósticos.

**Unitermos:** Abdome agudo; Gravidez ectópica; Tomografia computadorizada; Ressonância magnética.

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## INTRODUCTION

Ectopic pregnancy is one of the most common first trimester complications and

one of the most frequent causes of presentation of patients with acute abdominal pain to emergency departments, with an increase in incidence from 0.37% in 1948 to 2% of pregnancies in 1992<sup>(1)</sup>, and with a considerable mortality rate currently estimated to be between 9% and 20%<sup>(2)</sup>.

Such a remarkable increase in prevalence over the last two decades may result from different factors such as utilization of ultrasonography (US) apparatuses with higher sensitivity and more advanced technological resources, increased incidence of endometriosis among the general population, or disseminated utilization of laparoscopy<sup>(2)</sup>.

As a parallel to the increase in incidence of such condition, morbidity and mortality rates have decreased, probably as a result of more swift and timely diagnoses allowed by technological developments in imaging

diagnosis methods<sup>(3)</sup> whose utilization became indispensable for characterizing this entity.

In 95% of cases, the fertilized egg implantation occurs within the uterine tubes; and in the other 5% of cases, in the ovaries, cervical canal, prior Caesarean section scar or peritoneal cavity<sup>(3)</sup>.

There are several risk factors implied in the ectopic pregnancy etiopathogenesis which are summarized as follows<sup>(3)</sup>:

- prior ectopic pregnancy;
- previous history of pelvic inflammatory disease;
- previous history of gynecologic surgery;
- infertility;
- use of intrauterine devices;
- previous history of placenta previa;
- personal smoking history;
- recent use of *in vitro* fertilization;
- congenital uterine anomalies;

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- endometriosis;
- exposure to diethylstilbestrol.

### CLINICAL AND LABORATORY FINDINGS

The most frequent clinical presentation includes mild lower abdominal pain, irregular vaginal bleeding and duration of amenorrhea ranging between five and nine weeks<sup>(3)</sup>.

The main laboratory marker of this condition is serum  $\beta$ -hCG, whose levels increase by at least twice within a 48-hour period in patients with topic pregnancy up to 9-11 weeks. From the 12th gestational week,  $\beta$ -hCG levels stabilize, tending to remain on a plateau, persisting up to about the 20th week, and thereafter start decreasing progressively<sup>(3)</sup>.

On the contrary, in cases of ectopic embryo implantation, the increase in serum levels is slower. In cases where the increase is < 50% of the previous values, there is a high likelihood of gestation abnormality, either intrauterine (ongoing miscarriage) or extrauterine<sup>(4)</sup>.

It is important to observe that 85% of ongoing ectopic pregnancies may present an increase of more than 60% in  $\beta$ -hCG levels<sup>(4)</sup>. Equally, a plateau occurring before the 9<sup>th</sup> gestational week, with values below the expected value for the period, also suggests the possibility of ectopic pregnancy<sup>(4)</sup>.

It is important to note that  $\beta$ -hCG levels should be > 2.000 mUI/ml to allow

transvaginal US to demonstrate the presence of an intrauterine gestational sac<sup>(5)</sup>. In cases where such evaluation is performed by transabdominal US,  $\beta$ -hCG levels should be around 6.500 mUI/ml<sup>(4)</sup>.

### IMAGING FINDINGS

The utilization of US in the routine prenatal follow-up has allowed pregnancy monitoring at the first gestational trimester<sup>(6)</sup>, and this method has been the main imaging tool both in the normal prenatal follow-up and diagnosis of first-trimester abnormalities, with diagnostic criteria well established in the literature for the main abnormalities in this period<sup>(7)</sup>, besides being the method of choice as the first approach for pregnant patients in emergency departments<sup>(2)</sup>. The sonographic aspect of ectopic pregnancy varies according to the gestational age and location<sup>(7)</sup>.

Despite the unquestionable utility of US in patients who arrive at emergency departments with acute abdominal pain, computed tomography (CT) and magnetic resonance imaging (MRI) have progressively been utilized as a first diagnostic method<sup>(8)</sup>. Thus, patients who eventually present unsuspected signs of ectopic pregnancy may be primarily submitted to CT and MRI.

At CT, the main finding corresponds to a heterogeneous, predominantly cystic, adnexal mass with clear cleavage planes with ovaries and uterus, either in association or not with peripheral contrast enhancement. Common associated findings

include presence of free fluid in the peritoneal cavity, many times with presence of intermingled hyperdense foci compatible with hematic content<sup>(9)</sup> (Figure 1).

However, the presence of hemoperitoneum is not necessarily indicative of uterine tube rupture, but, the greater the amount of fluid, the higher is the probability of such complication<sup>(10)</sup>.

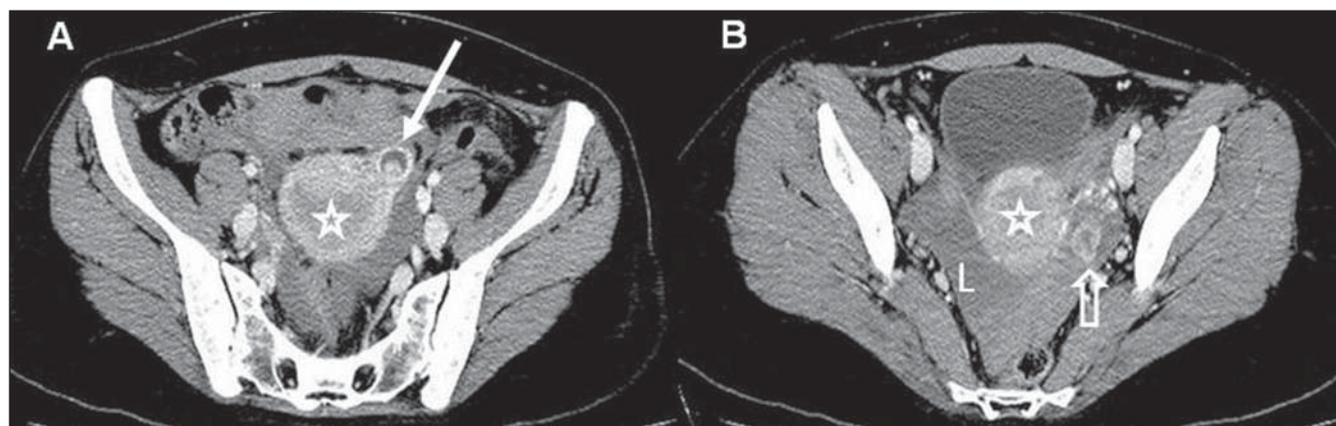
Because of the higher spatial and contrast resolution of pelvic structures, MRI can detect ectopic pregnancy more accurately than CT, with 95% sensitivity and 100% specificity for T2-weighted images<sup>(11)</sup>. Findings include hematosalpinx, ascites with hematic content, and presence of adnexal mass/hematoma, as well as identification of a gestational sac in the adnexal region, with clear cleavage planes with uterus and ipsilateral ovary<sup>(8)</sup> (Figures 2 and 3).

The hematic content is represented by foci of high signal intensity on T1-weighted images with fat saturation, while T1- and T2-weighted images with fat saturation demonstrate contents with mixed signal intensity<sup>(8)</sup> (Figure 3).

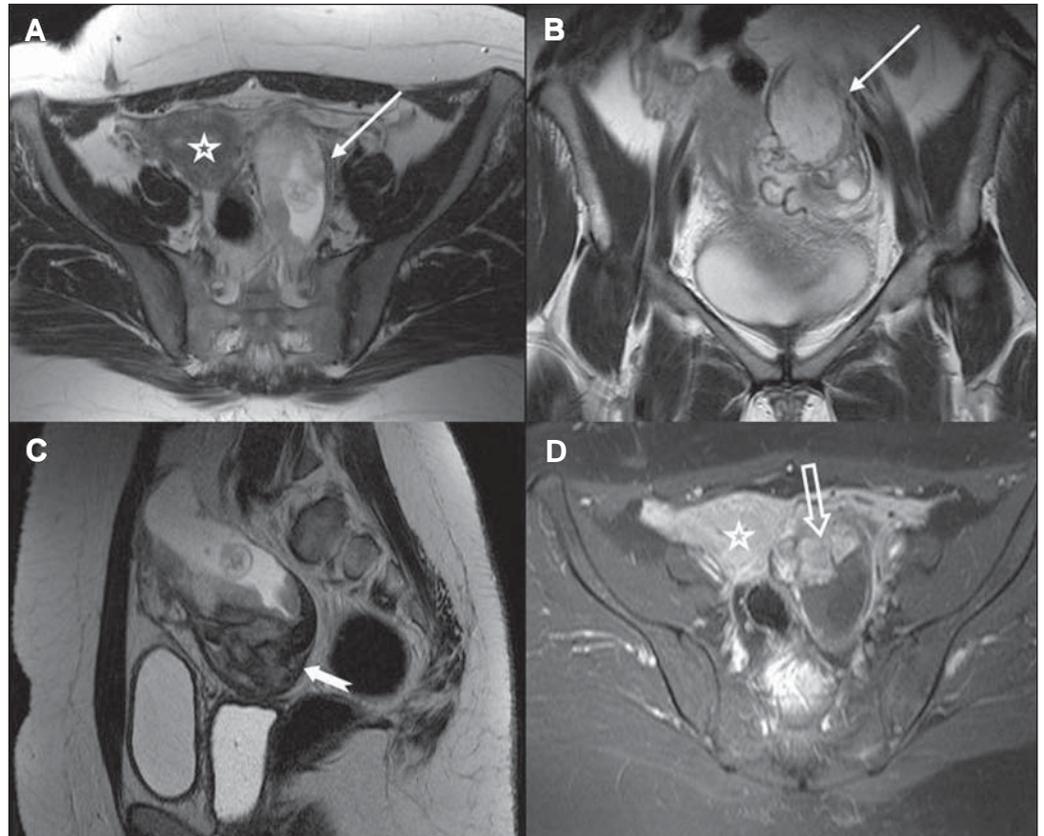
The fertilized egg implantation may occur in less common sites such as the cornual region. The corresponding findings may be seen on Figure 4.

### CONCLUSION

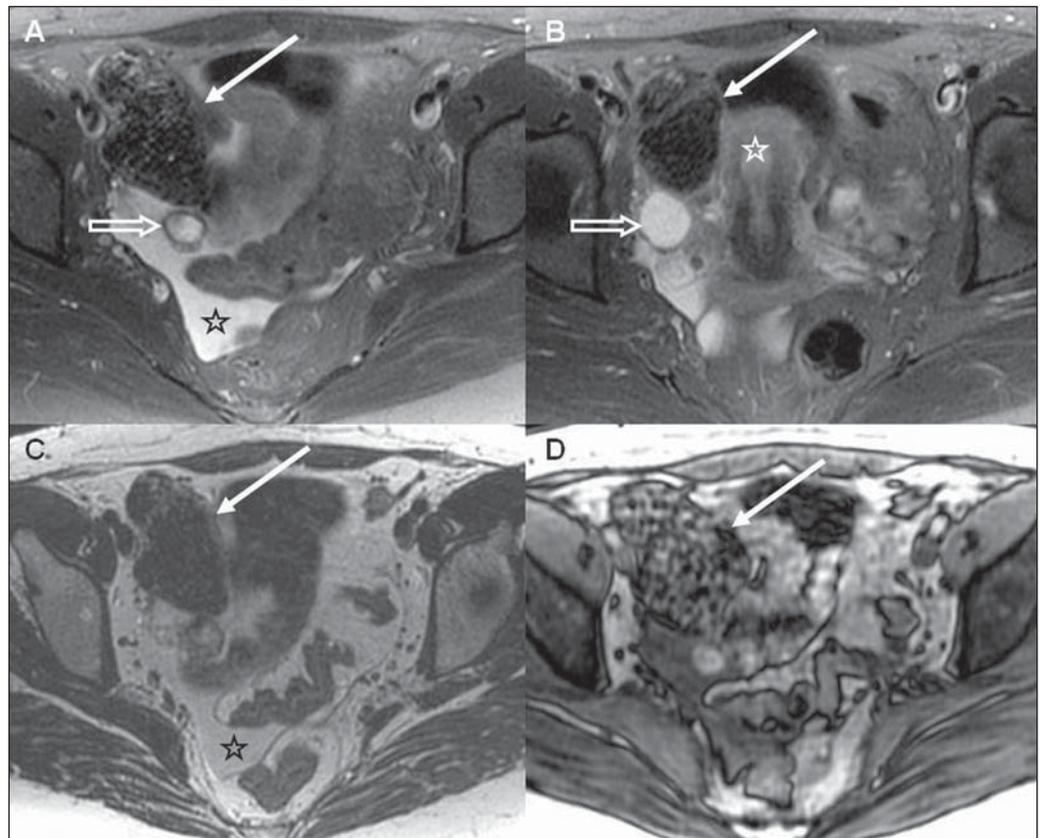
In the present study, the authors have sought to illustrate the main CT and MRI findings of ectopic pregnancy. Such con-



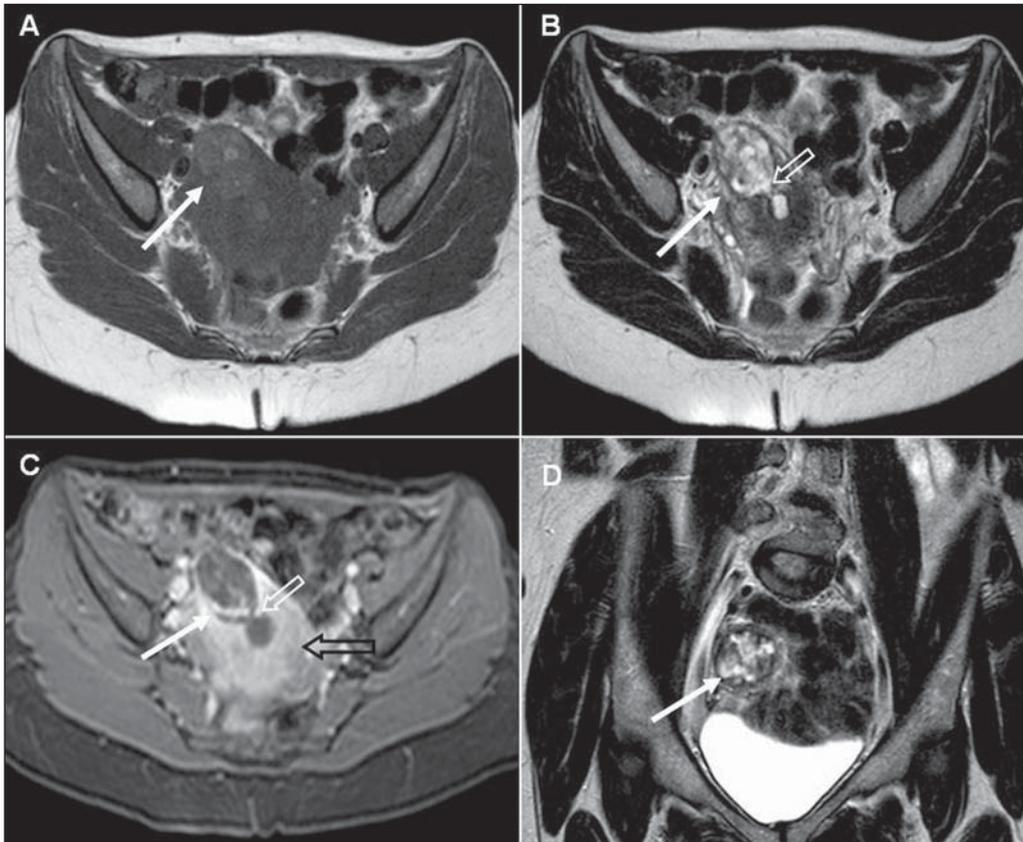
**Figure 1.** Ectopic pregnancy. Abdominal/pelvic CT. Image compatible with gestational sac in the left adnexal region (arrow on **A**), separated from the uterine image (stars on **A** and **B**) and from the ipsilateral ovary identified by visualization of the corpus luteum (hollow arrow on **B**). Also, note the presence moderate amount of fluid in the peritoneal cavity with foci of high density characterizing hematic content (L). (**A,B**: contrast-enhanced axial sections in the portal phase).



**Figure 2.** Ectopic pregnancy. Pelvic MRI. The presence of a gestational sac is observed in the left adnexal region (arrows on **A** and **B**), in association with a heterogeneous mass (arrow on **C**). Note the uterine and ovarian images (stars on **A** and **D**) separated from the adnexal mass, as well as the presence of placenta showing contrast enhancement (hollow arrow on **D**). (**A**: axial T2-weighted; **B**: coronal T2-weighted; **C**: sagittal T2-weighted; **D**: post-contrast axial T1-weighted images).



**Figure 3.** Ectopic pregnancy. Pelvic MRI. Expansile, heterogeneous mass in the right adnexal region (arrows on **A** to **D**), separated from the uterine (star on **B**) and ovarian (hollow arrows on **A** and **B**) images. Also, note the presence of moderate amount of free fluid in the pelvis, with intermediate signal intensity on T1-weighted images, suggesting hematic contents (stars on **A** and **C**). (**A**,**B**: axial T2-weighted image with fat saturation; **C**,**D**: axial T1-weighted, in-phase and out-phase images).



**Figure 4.** Cornual ectopic pregnancy. Pelvic MRI. The presence of a heterogeneous mass is observed in the cornual segment of the left uterine tube (white arrows on **A** to **D**). Note the communication with the uterine cavity (white hollow arrows on **B** and **C**). The myometrium is indicated by the black hollow arrow on **C**. (**A,B**: axial T1-weighted and T2-weighted images, respectively; **C**: post-contrast, axial T1-weighted image with fat saturation; **D**: coronal T2-weighted image).

dition represents an important differential diagnosis for causes of abdominal pain of other origins, particularly in women of childbearing age. Thus, the increasing role played by CT and MRI in the evaluation of patients with acute abdomen of gynecologic origin raises the necessity for knowledge of findings of ectopic pregnancy by means of sectional imaging methods.

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