

Rare Ectopic Pregnancies – A Literature Review for the Period 2007–2019 on Locations Outside the Uterus and Fallopian Tubes

Seltene extrauterine Schwangerschaften – eine Literaturübersicht 2007–2019 zu Lokalisationen außerhalb von Uterus und Tuben



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ABSTRACT

The majority of ectopic pregnancies (EP) are tubal pregnancies, but other implantation sites outside the uterus and tubes are also found. These rare EP locations present a particular diagnostic and therapeutic challenge. We present an overview of potential very rare locations of ectopic pregnancies, their symptoms, diagnosis and treatment, based on a systematic analysis of case reports. A literature review of the databases

PubMed, Livivo and Google Scholar for the period 2007 to 2019 was carried out. A total of 113 publications were included in our review. These studies describe EP implantations in the posterior cul-de-sac, on the uterine serosa and uterine ligaments, in the vicinity of almost all intraperitoneal organs, on the abdominal wall as well as in retroperitoneal sites. The most common presenting symptom was abdominal pain occurring in different locations. The diagnostic procedures included various imaging procedures and/or explorative surgery at different advanced stages of pregnancy. The most common and preferred option was laparotomy for surgical treatment. The placenta was successfully resected in the majority of cases. A rare EP location should be considered when making a differential diagnosis in patients of child-bearing age with abdominal pain.

ZUSAMMENFASSUNG

Das Gros extrauteriner Schwangerschaften (EUG) sind Tubar graviditäten, doch auch andere Implantationsstellen außerhalb des Uterus und der Adnexe kommen vor. Diese seltenen Lokalisationen einer EUG stellen eine besondere diagnostische und therapeutische Herausforderung dar. Anhand einer systematischen Analyse von Fallberichten wird eine Übersicht zu möglichen sehr seltenen Lokalisationen ektopter Schwangerschaften, deren Symptomatik, Diagnostik und Therapie gegeben. Dazu wurde eine Literaturrecherche in den Datenbanken PubMed, Livivo und Google Scholar für den Zeitraum 2007 bis 2019 durchgeführt. Insgesamt wurden 113 Publikationen eingeschlossen. Diese Studien beschrieben EUG-Implantationen im Douglas-Raum, an der Uterusserosa und dem uterinen Bandapparat, im Bereich nahezu aller intraperitonealer Organe, der Bauchwand sowie retroperitoneale Lokalisationen. Das häufigste Symptom war der variabel lokalisierte abdominale Schmerz. Die diagnostischen Maßnahmen umfassten unterschiedliche Bildgebungsverfahren und/oder explorative Operationen in verschieden weit fortgeschrittenem Schwangerschaftsalter. Als häufigste Therapieoption wurde die operative Befundsanierung per Laparotomie gewählt. Die Plazenta konnte in der Mehrheit der Fälle erfolgreich reseziert werden. Eine EUG seltener Lokalisation sollte

als mögliche Differenzialdiagnose bei Patientinnen im reproduktionsfähigen Alter mit abdominellen Beschwerden beachtet werden.

Introduction

The frequency of ectopic pregnancies (EP) is estimated as 11 ectopic per 1000 (eutopic) pregnancies [1]. Despite improvements in diagnosis and treatment options, EP is still associated with a high risk of mortality and accounts for around 6–13% of all pregnancy-related deaths in the first trimester of pregnancy [2]. Tubal pregnancies are the most common form of EP with an incidence of 95%, followed by implantation sites in the cervix, the ovary and the abdominal cavity [3]. Non-tubal EP are reported to have a 7–8 times higher risk of maternal mortality compared to tubal pregnancies [4, 5].

Known risk factors for non-tubal ectopic pregnancies include a previous history of EP, minor pelvic infections, pregnancy by assisted reproductive technology, and smoking [3]. Typical leading clinical symptoms of a ruptured EP are progressive pain in the lower abdomen, often accompanied by pronounced peritonism, shoulder area pain if hemoperitoneum is present, and acyclic vaginal bleeding, as well as dizziness, faintness and nausea [6]. As abdominal bleeding may be quite heavy, ectopic pregnancy is a real gynecological emergency because of the rapid onset of hemorrhagic shock. Vaginal ultrasound scan is usually carried out in patients with a positive pregnancy test to obtain the correct diagnosis as quickly as possible. In cases with EP, imaging will show a thickened endometrium but no intrauterine gestational sac or only a pseudo-gestational sac with no yolk sac [1]. In some cases, the implantation site in the adnexal area and fluid in the pouch of Douglas can be identified on imaging. The implantation site and the extent of symptoms determine the type of treatment and urgency of treatment. Particularly in cases with advanced abdominal EP, the question is often whether the ectopic placenta can be resected with limited bleeding or whether it can be left in situ. There are currently no guidelines by the AWMF (the Association of the Scientific Medical Societies in Germany) or the DGGG (the German Society for Gynecology and Obstetrics) on the appropriate approach to treat EP. Guidelines are planned and their completion has been announced for 2020 [7].

To obtain a rapid and correct diagnosis of an ectopic pregnancy in a rare location, it is important to be aware of the potential sites of implantation. Locations outside the uterus, tubes and ovaries are of particular interest, as they present a significant diagnostic challenge in emergency gynecological medicine because of the number of different potential implantation sites [8]. In 2007, Molinaro and Barnhart published a study “Ectopic pregnancies in unusual locations” [6]; in 2014 the Cochrane Foundation initiated a protocol for a not yet published systematic review [8]; and in 2016, Parker and Srinivas summarized the approaches for the management of non-tubal ectopic pregnancies [3]. These publications were almost exclusively based on case reports. We were unable to find a review which collected and summarized the known cases of non-tubal and non-ovarian EP. Case reports

on rare locations were therefore collected for this review. As a review of the literature already existed [6], we selected the year 2007 as our chronological starting point. The aim of our literature search was to provide a comprehensive summary of the publications published since 2007 on rare locations of extrauterine pregnancies, their presenting symptoms, diagnosis and treatment.

Methods

Inclusion and exclusion criteria

A systematic search was carried out in the three online databases PubMed, Livivo and Google Scholar. English-language and German-language case reports from January 2007 onward which described an ectopic pregnancy in an unusual location were included in our review. Reports about uterine implantation sites (cervical and intramural pregnancies as well as scar pregnancies) were excluded as were ampullary, isthmic and interstitial tubal pregnancies and ovarian pregnancies. Pregnancies which occurred after hysterectomy and heterotopic pregnancies were not included.

Search strategy

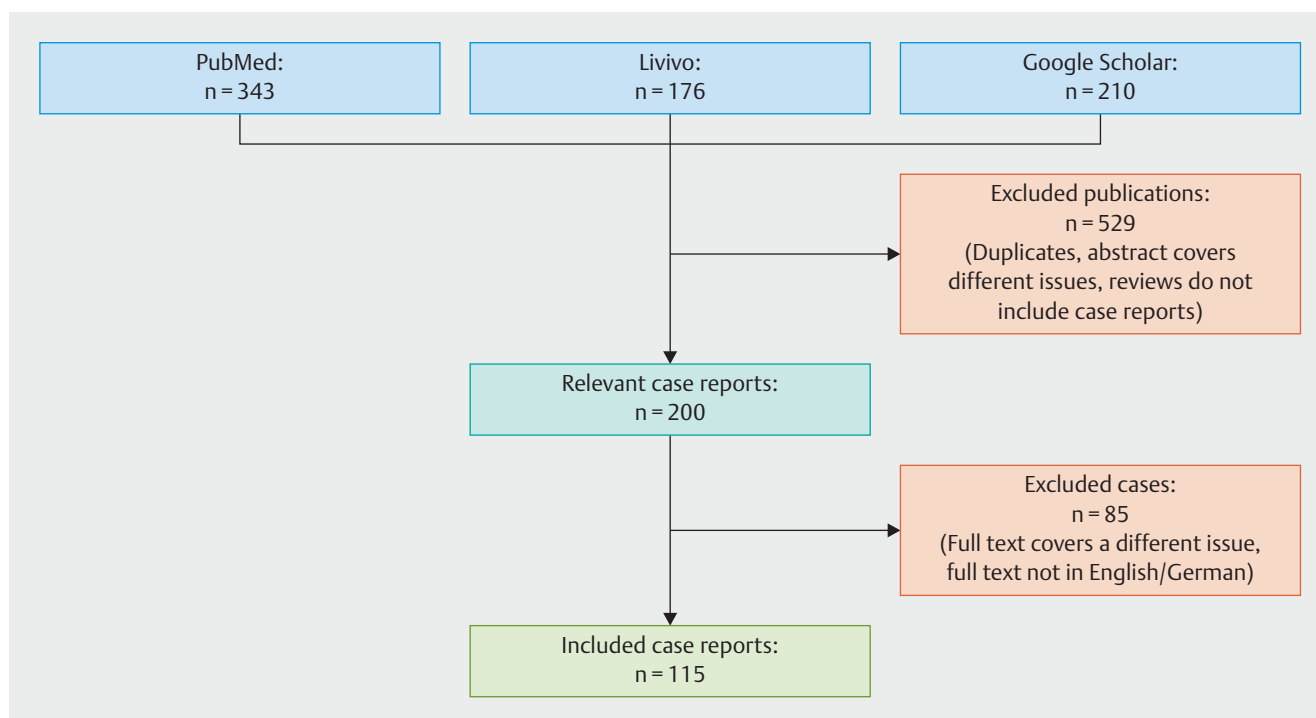
The search was carried out in June 2019 for the period 2007–2019 using the MeSH terms “ectopic pregnancy” and “case report” and a filter for German-language and English-language publications. The subcategories “tubal pregnancy,” “cornual pregnancy,” “angular pregnancy,” “ovarian pregnancy” and “scar pregnancy” were excluded from the search results using the operator “NOT.”

This study complies with the statute of the Charité on ensuring good scientific practice.

Results

After carrying out a systematic literature search, a total of 115 suitable case reports from 113 publications were included in the study and their full text was analyzed (► **Fig. 1**). Based on anatomical sites and pathophysiology, cases were divided into intraperitoneal and extraperitoneal EP locations. Intraperitoneal implantation sites included all locations on the uterine serosa, the uterine ligaments, the liver, spleen, and bowel including the mesentery and the peritoneum of the pelvic wall, the diaphragm and the inguinal canal. Reported extraperitoneal sites of EP implantation included sites on the large arteries, in the area of the pancreas and the kidneys, in rectovaginal and paravesical spaces and in the obturator foramen.

As regards the pathogenesis of intraperitoneal EP, it is important to distinguish between primary and secondary abdominal pregnancy. With *primary* abdominal pregnancy, it is assumed that fertilization and implantation of the ovum occurs in the peritoneal space as a result of the anatomical conditions at the open distal



► **Fig. 1** Flow chart showing the process and results of the literature search in the three databases.

portion of the uterine tube. In the case of *secondary* abdominal pregnancies, it is assumed that a secondary implantation in the peritoneal cavity occurs after rupture of a primary tubal pregnancy [3]. The pathogenesis of retroperitoneal EP, however, has not been conclusively established. Peritoneal fistulas following surgery [9] and lymphatic pathways [10] have been postulated as possible routes.

Presenting symptoms, diagnosis and treatment are summarized below, with cases grouped according to the location of the implantation site.

A) Implantation in the uterine serosa and the pouch of Douglas ► Table 1)

Presenting symptoms

- Abdominal pain (14/32 cases), particularly in the lower abdomen; abdominal pain and respiratory problems (1/32); abdominal pain and vomiting (2/32); abdominal pain and back pain (1/32)
- Asymptomatic (10/32)
- Vaginal bleeding (2/32)
- Respiratory problems (1/32)
- Not specified (1/32)

Diagnosis and diagnostic procedures

- Earliest diagnosis made in the 5th week of gestation (GW) post last menstrual period, latest diagnosis in the 41st GW
- Diagnosed by ultrasound scan (11/32), exploratory laparoscopy (6/32), exploratory laparotomy (8/32), MRI (6/32) or at autopsy (1/21)

Intervention

- Surgical treatment with laparotomy (25/32), with additional administration of MTX in one case
- Surgical treatment with laparoscopy (6/32) with additional administration of MTX in 2 cases
- Not specified (2/32)

Placental management

- Resection of the placenta (23/32), with additional organ removal in 7 cases
- Placenta left in situ (7/32), with re-laparotomy with resection additionally performed in 2 cases
- Not specified (1/32) (autopsy)

It is worth noting that in many cases the pregnancy was already far advanced at diagnosis and many of the patients were asymptomatic. In 14/32 cases, a live infant was delivered by laparotomy. The most common site of implantation was the posterior uterine wall.

► **Table 1** Implantation in the uterine serosa and the pouch of Douglas.

No.	Source	Age	GP score	GW	β-HCG	Symptoms	Diagnostic procedure	Intervention	Placental management	Previous medical history
1	Abdelrahman, 2017, South Sudan [15]	25	G2P0	35	–	AbP	exLtm	Ltm, live birth	Partial resection	–
2	Bhoil, 2016, India [16]	29	G2P2	34	–	AbP	MRI	Ltm, live birth	Resection	–
3	Bohiltea, 2015, Romania [17]	23	G0P0	23	–	AbP	exLtm	Ltm	Resection, uterine wedge resection	IVF
4	Cho, 2015, Taiwan [18]	31	G0P0	–	40 100	VB	Sono	Lap, MTX	Left in situ	–
5	Dabiri, 2014, USA [19]	27	G2P01	33	–	AbP	exLtm	Ltm, live birth	Resection, hysterectomy	–
6	Dassah, 2009, Ghana [20]	21	G0P0	22	–	LABP	Sono	Ltm	Resection	–
7	Gayer 2012, USA [21]	30	G2P1	19	–	X	MRI	Ltm	–	–
8	Gidiri, 2015, Zimbabwe [22]	40	G4P3	21	–	LABP, BP	Sono	Ltm	Resection	–
9	Gidiri, 2015, Zimbabwe [22]	37	G2P0 + 1	35	–	AbP	Sono	Ltm, live birth	Left in situ	Myomec-tomy
10	Hailu, 2017, Ethiopia [4]	26	G4P2	37	–	AbP, Vom.	exLtm	Ltm, live birth	Resection	–
11	Hishikawa, 2016, Japan [23]	32	G3P1	–	120,60	AbP	exLap	Lap	Resection	–
12	Isah, 2008, Nigeria [24]	30	G0P0	39	–	VB	Sono	Ltm, live birth	Resection	–
13	Kim, 2013, Korea [25]	28	G1P0	18	–	X	Sono	Ltm (34th GW) live birth	Resection	Previous EP
14	Marcelin, 2018, France [26]	25	G2P0	27	–	–	MRI	Ltm	Left in situ, embolization, Lap because of abscess formation	–
15	Miyauchi, 2015, Japan [5]	36	G1P1	5	2 050	LABP	exLap	Ltm	Resection	–
16	Mengistu, 2015, Ethiopia [27]	32	G3P2	36	–	Resp.	MRI	Ltm, live birth	Resection, hysterectomy	–
17	Muehlparzer, 2011, Austria [28]	26	–	34	–	LABP	exLtm	Ltm with live birth	Resection, hysterectomy, salpingectomy	–
18	Nassali, 2016, Botswana [29]	26	G0P0	41	–	AbP	exLtm	Ltm with live birth	Resection	–
19	Nkusu, 2008, Cameroon [30]	30	G5P5	at term	–	AbP	Sono	Ltm	Resection	–
20	Panagiotakis, 2009, USA [31]	24	G0P0	7	–	AbP	exLap	Lap, MTX	Left in situ	–
21	Parekh, 2008, India [32]	31	–	15	–	LABP	Sono	Ltm	Resection, hemostasis	–
22	Patel, 2016, USA [33]	26	G0P0	16	–	LABP	MRI	Ltm, MTX	Left in situ, re-Ltm with resection	–
23	Pieh-Holder, 2012, USA [34]	39	G1P0	25	–	X	MRI	Ltm, live birth	Left in situ, embolization	Myomec-tomy

Continued next page

► **Table 1** Implantation in the uterine serosa and the pouch of Douglas. (Continued)

No.	Source	Age	GP score	GW	β-HCG	Symptoms	Diagnostic procedure	Intervention	Placental management	Previous medical history
24	Pradhan, 2013, India [35]	35	G0P0	26	–	AbP, Resp.	Autopsy	–	–	–
25	Promsonthi, 2007, Thailand [36]	41	G2P2	40	–	X	exLtm	Ltm, live birth	Left in situ, abscess formation, Ltm, hysterectomy, salpingo-oophorectomy	–
26	Rohilla, 2018, India [37]	27	Multipara	40	–	X	Sono	Ltm, live birth	Resection, salpingo-oophorectomy	–
27	Sib, 2018, Burkina Faso [38]	22	G4P2	at term	–	X	Sono	Ltm	Resection, salpingectomy	–
28	Shih, 2007, Taiwan [39]	33	G0P0	20 days post ET	901	X	Sono	Lap	Resection by Ltm	IVF-ET
29	Tucker, 2017, USA [40]	28	G2P1	22	–	X	exLap	Ltm	Resection	–
30	Yanaihara, 2017, Japan [41]	37	P0	6	–	X	exLap	Lap	Resection	ICSI
31	Yoder, 2016, USA [42]	30	G2P1	33 days post ET	12 400 pg/mL	X	exLap	Lap	Resection	IVF-ET
32	Zhang, 2008, China [43]	30	G3P1	38	–	AbP, Vom.	exLtm	Ltm, live birth	Resection, hysterectomy	–

Abbreviations: GP score = gravidity and parity score [14], GW = week of gestation at the time of diagnosis, β-HCG in mIU/mL, if not stated otherwise, Diagnostic procedure = final procedure carried out to obtain the diagnosis, (L)AbP = (lower) abdominal pain, VB = vaginal bleeding, X = asymptomatic, BP = back pain, Vom. = vomiting, Resp. = respiratory problems, exLap/Ltm = exploratory laparoscopy/laparotomy, Sono = abdominal/transvaginal ultrasound scan, MRI = magnetic resonance imaging, Lap/Ltm = surgical treatment with laparoscopy/laparotomy, MTX = methotrexate, IVF(-ET) = in vitro fertilization (with embryo transfer), ICSI = intracytoplasmic sperm injection

B) Implantation on the broad ligament of uterus (► Table 2)

Presenting symptoms

- Abdominal pain (6/18), particularly in the lower abdomen
- Abdominal pain and vaginal bleeding (4/18)
- Asymptomatic (8/18)

Diagnosis and diagnostic procedures

- Earliest diagnosis made in the 5th GW, latest diagnosis in the 39th GW with the birth of a healthy neonate
- Diagnosed by ultrasound scan (11/18), exploratory laparotomy (5/18), MRI (1/18) or exploratory laparoscopy (1/18)

Intervention

- Surgical treatment with laparotomy (13/18), with additional administration of MTX in 2 cases
- Surgical treatment with laparoscopy (5/18), with additional administration of MTX in 1 case

Placental management

- Placental resection (15/18), combined with organ removal in 9 cases
- Placenta left in situ (3/18)

Some cases required a salpingectomy to remove the placenta and/or achieve hemostasis. It should be noted that some ectopic pregnancies were continued almost to term, with delivery of a live infant (6/18).

C) Implantation in and on the liver (► Table 3)

Presenting symptoms

- Abdominal pain (4/14), particularly in the right upper quadrant
- Abdominal pain radiating into the right shoulder (3/14)
- Abdominal pain and vaginal bleeding (2/14)
- Vaginal bleeding (1/14)
- Asymptomatic (3/14)
- Abdominal swelling (1/14)

Diagnosis and diagnostic procedures

- Earliest diagnosis made in the 5th GW, latest diagnosis in the 37th GW with the birth of a healthy neonate
- Diagnosed by MRI (5/14), ultrasound scan (4/14), exploratory laparotomy (2/14), exploratory laparoscopy (1/14), CT (1/14) or PET-CT scan (1/14)

Intervention

- Surgical treatment with laparotomy (10/14), with additional administration of MTX in one case

► **Table 2** Implantation in and on the broad ligament of uterus.

No.	Source	Age	GP score	GW	β-HCG	Symptoms	Diagnostic procedure	Intervention	Placental management	Previous medical history
1	Abdul, 2008, Nigeria [44]	29	G7P6	22	–	X	Sono	Ltm	Resection, salpingo-oophorectomy	–
2	Abdul, 2008, Nigeria [44]	33	G7P6	20	–	X	Sono	Ltm	Resection, salpingo-oophorectomy	–
3	Akhtar, 2011, Pakistan [45]	35	G3P2	37	–	AbP	Sono	Ltm, live birth, MTX	Left in situ	–
4	Atis, 2014, Turkey [46]	34	Multipara	8	10290	LABP, VB	Sono	Ltm	Resection	–
5	Cosentino, 2017, Italy [47]	35	G3P1	12	–	X	Sono	Lap	Resection, salpingo-oophorectomy	–
6	Dahab, 2011, Saudi Arabia [48]	23	G0P0	40	75 542	LABP, Dys.	Sono	Ltm, live birth	Resection	–
7	Gudu, 2015, Ethiopia [49]	35	P2	37	–	AbP, VB	Sono	Ltm, live birth	Resection, salpingectomy	–
8	Kar 2011, India [50]	31	G0P0	8	9470	X	Sono	MTX + Lap	Resection	IUI, endometriosis
9	Kim, 2016, Tanzania [51]	27	G3P2	13	–	AbP	MRI	Ltm	Resection, salpingo-oophorectomy, partial omentectomy	HIV positive
10	Nayar, 2016, Portugal [52]	25	G0P0	6	24719	AbP, VB	Sono	Lap	Resection, salpingectomy	–
11	Parulekar, 2011, India [53]	22	G2P1	5	1250	LABP	exLap	Lap	Resection	Lost IUD
12	Phupong, 2016, Thailand [54]	27	G2P1	37	–	X	exLtm	Ltm, live birth	Resection, hysterectomy, salpingo-oophorectomy	–
13	Rama, 2015, India [55]	23	G2P1	12	–	AbP, VB, Vom.	exLtm	Ltm	Resection, salpingo-oophorectomy	–
14	Sassi, 2017, Tunisia [56]	32	G2P1	5	26784	LABP	Sono	Lap	Resection	–
15	Seckin, 2011, Turkey [57]	28	G0P0	39	–	AbP	exLtm	Ltm, live birth	Left in situ, re-Ltm because of abscess formation	–
16	Shamaash, 2017, Egypt [58]	25	G2P0+1	17	–	X	exLtm	Ltm	Resection, salpingectomy	–
17	Sheethal, 2017, India [59]	28	G0P0	37	–	X	exLtm	Ltm, live birth	Resection	–
18	Yasutake, 2013, Japan [60]	34	G2P1	8	13 195	X	Sono	Lap → Ltm, MTX	Left in situ	–

Abbreviations: GP score = gravidity and parity score, GW = week of gestation at diagnosis, β-HCG in mIU/mL, Diagnostic procedure = final procedure carried out to obtain the diagnosis, (L)AbP = (lower) abdominal pain, VB = vaginal bleeding, X = asymptomatic, Dys. = dysuria, Vom. = vomiting, exLap/Ltm = exploratory laparoscopy/laparotomy, Sono = abdominal/transvaginal ultrasound scan, MRI = magnetic resonance imaging, Lap/Ltm = surgical treatment with laparoscopy/laparotomy, MTX = methotrexate, IUI = intrauterine insemination, IUD = intrauterine device

- Surgical treatment with laparoscopy (2/14), with additional administration of MTX in both cases
- Feticide with potassium chloride (1/14) and administration of MTX
- Only administration of MTX (1/14)

Placental management

- Placental resection (7/14), combined with partial organ resection in 1 case
- Placenta left in situ (5/14)
- Not specified (2/14)

► **Table 3** Implantation in and on the liver.

No.	Source	Age	GP score	GW	β-HCG	Symptoms	Diagnostic procedure	Intervention	Placental management	Previous medical history
1	Brouard, 2015, USA [61]	20	G4P4	37	–	X	exLtm	Ltm, live birth	Left in situ	–
2	Chin, 2010, Singapore [62]	30	G2P1	5	1 292	EgP, syncope, RSP	exLap	Lap, MTX	Resection	–
3	Guo, 2016, China [63]	31	–	–	81 418	abd. swelling	MRI	Ltm	Resection	–
4	Hao, 2016, China [64]	31	G2P1	6		AbP, abd. swelling	PET-CT	Ltm	–	–
5	Hu, 2014, China [65]	32	G3P2	8		EgP	MRI	Ltm	–	–
6	Kuai, 2013, China [66]	33	G4P2	6	186	RUAP, RSP	MRI	Ltm	Resection	–
7	Ma, 2013, China [67]	31	G6P2	8	23 824	RUAP	exLtm	Ltm, MTX	Left in situ, embolization	–
8	Moore, 2010*, UK [68]	23	G1P0	12	–	RUAP, RSP	Sono	KCl, MTX	Left in situ	–
9	Qiao, 2013, China [69]	31	G3P2	10	95 700	X	MRI	Ltm	Resection, partial resection of the liver	Tubal ligation
10	Ramphal, 2010, South Africa [70]	18	–	19	–	X	Sono	Ltm in the 34th GW, live birth	Left in situ	–
11	Sibetchu, 2017, Cameroon [71]	24	G4P1	8	3 000	RUAP, VB	Sono	MTX	Left in situ	–
12	Wang, 2012, Japan [72]	33	G0P0	7	8 988	AbP, VB	CT	Ltm	Resection	–
13	Yadav, 2012, India [73]	25	G2P1	18		RUAP, Vom.	Sono	Ltm	Resection, embolization, unsuccessful hemostasis	–
14	Zhao, 2017, China [74]	21	G0	14	135 755	VB	MRI	MTX, Lap	Resection	–

Abbreviations: GP score = gravidity and parity score, GW = week of gestation at diagnosis, β-HCG in mIU/mL, Diagnostic procedure = final procedure carried out to obtain the diagnosis, * = in the subhepatic space adjoining the gallbladder, (L)AbP = (lower) abdominal pain, EgP = epigastric pain, RUAP = right upper abdominal pain, RSP = right shoulder pain, VB = vaginal bleeding, Vom. = vomiting, exLap/Ltm = exploratory laparoscopy/laparotomy, Sono = abdominal/transvaginal ultrasound scan, CT = computed tomography scan, MRI = magnetic resonance imaging, Lap/Ltm = surgical treatment with laparoscopy/laparotomy

MRI and abdominal ultrasound were essential for diagnosis in those cases where the site of implantation was in the liver. In some cases, a live infant was delivered by laparotomy.

D) Implantation on the greater omentum (► Table 4)

Presenting symptoms

- Abdominal pain (10/12), often located in the lower abdomen, in one case with syncope
- Abdominal pain and vaginal bleeding with syncope (1/12)
- Not specified (1/12)

Diagnosis and diagnostic procedures

- Earliest diagnosis made in the 4th GW, latest diagnosis in the 14th GW
- Diagnosed by exploratory laparoscopy (5/12), ultrasound scan (4/12), MRI (1/12), exploratory laparotomy (1/12), or CT (1/12).

Intervention

- Surgical treatment with laparoscopy (7/12)
- Exploratory treatment with laparotomy (5/12)

► **Table 4** Implantation on the greater omentum.

No.	Source	Age	GP score	GW	β-HCG	Symptoms	Diagnostic procedure	Intervention	Placental management	Previous medical history
1	Allen, 2007, UK [75]	31	G2P0+1	14	–	EgP, Vom., diarrhea	Sono	Ltm	Resection	Chlamydia
2	Bajis, 2018, Australia [76]	37	G2P2	4	1480	LAbP, VB, syncope	Sono	Lap × 2	Resection	–
3	Behjati, 2009, UK [77]	27	G2P1	–	12709	LAbP, syncope	exLap	Ltm	Resection, partial omentectomy	–
4	Chen, 2015, China [78]	18	G0P0	6	460	LAbP	CT	Lap	Resection, partial omentectomy	–
5	Chopra, 2009, India [79]	29	G4P3	6	–	AbP	Sono	Ltm	Resection	–
6	da Silva, 2008, Brazil [80]	36	G3P3	13	–	LAbP	exLtm	Ltm	Resection, partial omentectomy	–
7	Maiorana, 2014, Italy [81]	24	G1P0	8	8047	LAbP	exLap	Lap	Resection	–
8	Seol, 2010, Korea [82]	26	G2P0	–	–	LAbP	exLap	Lap	Resection, partial omentectomy	–
9	Srinivasan, 2014, USA [83]	20	G2P1	8	1057	LAbP	exLap	Lap	Resection, partial omentectomy	–
10	Takeda, 2016, Japan [84]	34	G2P0	8	–	–	MRI	Lap	Resection, partial omentectomy	–
11	Tanase, 2013, Japan [85]	32	G1P0	5	–	LAbP	exLap	Lap	Resection, partial omentectomy	Pelv OP
12	Yip, 2016, Singapore [86]	31	–	6	11803	EGP	Sono	Lap → Ltm	Resection	–

Abbreviations: GP score = gravidity and parity score, GW = week of gestation at diagnosis, β-HCG in mIU/mL, Diagnostic procedure = final procedure carried out to obtain the diagnosis, (L)AbP = (lower) abdominal pain, EgP = epigastric pain, VB = vaginal bleeding, Vom. = vomiting, exLap/Ltm = exploratory laparoscopy/laparotomy, Sono = abdominal/transvaginal ultrasound scan, CT = computed tomography scan, MRI = magnetic resonance imaging, Lap/Ltm = surgical treatment with laparoscopy/laparotomy, Pelv OP = prior history of pelvic surgery

Placental management

- Placental resection 12/12, combined with partial omentectomy in 7 cases.

E) Implantation on the bowel and mesenteries (► Table 5)

Presenting symptoms

- Abdominal pain (4/9)
- Abdominal pain and vaginal bleeding (3/9)
- Hematochezia (1/9)
- Abdominal swelling (1/9)

Diagnosis and diagnostic procedure

- Earliest diagnosis made in the 6th GW, latest diagnosis in the 38th GW with the birth of a neonate
- Diagnosed by exploratory laparotomy (5/9), ultrasound scan (2/9), exploratory laparoscopy (1/9) or MRI (1/9).

Intervention

- Surgical treatment with laparotomy (8/9), with additional administration of MTX in two cases
- Surgical treatment with laparoscopy and administration of MTX (1/9)

Placental management

- Placenta left in situ (5/9)
- Placental resection (4/9), with additional removal of organs in 3 cases

In the three cases who were delivered of a live infant, in addition to implanting on the bowel and its mesenteries, the placenta was also connected to the uterine serosa [11–13].

F) Implantation on and in the spleen (► Table 6)

Presenting symptoms

- Abdominal pain (5/9), particularly in the left upper abdomen
- Abdominal pain and vaginal bleeding (3/9)
- Asymptomatic (1/9)

► **Table 5** Implantation on the bowel and mesenteries.

No.	Source	Age	GP score	GW	β-HCG	Symptoms	Diagnostic procedure	Intervention	Placental management	Previous medical history
1	Anozie, 2016, Nigeria [11]	35	G6P5	at term	–	AbP, Resp.	Sono	Ltm, live birth, MTX	Left in situ	–
2	Baffoe, 2011, Ghana [12]	31	G3P1	38	–	AbP, VB	exLtm	Ltm, live birth	Left in situ	–
3	Demendi, 2011, Hungary [87]	28	G3P2	17		LAbP	Sono	Ltm, MTX	Left in situ, embolization	
4	Pichaichanlert, 2017, Thailand [88]	32	G1P1	15	–	blutiger Stuhl	exLtm	Ltm	Resection, partial bowel resection, re-anastomosis	Pelv OP, PID
5	Salathiel, 2016, Chad [89]	30	G8L5	19	–	AbP, VB	exLtm	Ltm	Resection, hysterectomy	–
6	Thompson, 2011, UK [90]	27	–	8	–	LAbP	exLtm	Ltm	Resection, appendectomy	–
7	Tolefac, 2017, Cameroon [13]	22	G3P0	25	–	abd. swelling	exLtm	Ltm, live birth	Left in situ	
8	Trail, 2018, UK [91]	26	G4P2	6	1 647	LAbP, SP	exLap	Lap, MTX	Left in situ	
9	Yildizhan, 2009, Turkey [92]	34	G2P1	13	–	AbP, BP, VB	MRI	Ltm	Resection	–

Abbreviations: GP score = gravidity and parity score, GW = week of gestation at diagnosis, β-HCG in mIU/mL, Diagnostic procedure = final procedure carried out to obtain the diagnosis, (L)AbP = (lower) abdominal pain, BP = back pain, SP = shoulder pain, VB = vaginal bleeding, Resp. = respiratory problems, exLap/Ltm = exploratory laparoscopy/laparotomy, Sono = abdominal/transvaginal ultrasound scan, MRI = magnetic resonance imaging, Lap/Ltm = surgical treatment with laparoscopy/laparotomy, Pelv OP = prior history of pelvic surgery, PID = pelvic inflammatory disease

► **Table 6** Implantation on and in the spleen.

No.	Source	Age	GP score	GW	β-HCG	Symptoms	Diagnostic procedure	Intervention	Placental management	Previous medical history
1	Biolchini, 2010, Italy [93]	41	G3P-	4	8980	LUAP	CT	Lap	Resection, splenectomy	–
2	Gao, 2017, China [94]	27	G0P0	8	119027	AbP, VB, dizziness	Sono	Ltm	Resection, splenectomy	–
3	Greenbaum, 2016, USA [95]	27	G2P2	4	1 865	LUAP, Vom.	exLap	Ltm	Resection, splenectomy	–
4	Klang, 2016, Israel [96]	35	G3P1	–	71 000	X	CT	KCl, MTX	Left in situ	GA, PCOS
5	Perez 2008*, USA [97]	36	G1P0	–	–	LAbP	exLap	Lap	Resection	Unicornuate uterus, renal agenesis
6	Python, 2016, USA [98]	21	G1	5	8476	AbP, VB	CT	MTX	Left in situ	–
7	Rathore, 2017, Turkey [99]	23	G1P1	4	6565	LUAP, Vom.	exLtm	Ltm	Resection, splenectomy	–
8	Wu, 2017, Japan [100]	27	G1P0	8	119027	AbP	Sono	Ltm	Resection, splenectomy	–
9	Wu, 2018, China [101]	29	G3P2	8	16 669	VB, AbP	Sono	Ltm	Resection, splenectomy	

Abbreviations: GP score = gravidity and parity score, GW = week of gestation at diagnosis, β-HCG in mIU/mL, Diagnostic procedure = final procedure carried out to obtain the diagnosis, * = subsplenic, (L)AbP = (lower) abdominal pain, LUAP = left upper abdominal pain, VB = vaginal bleeding, Vom. = vomiting, X = asymptomatic, exLap/Ltm = exploratory laparoscopy/laparotomy, Sono = abdominal/transvaginal ultrasound scan, CT = computed tomography scan, Lap/Ltm = surgical treatment with laparoscopy/laparotomy, MTX = methotrexate, GA = gonadotropin analogs, PCOS = polycystic ovary syndrome

► **Table 7** Other rare intraperitoneal implantation sites.

No.	Source	Age	GP score	GW	β-HCG	Symptoms	Diagnostic procedure	Intervention	Placental management	Previous medical history
Abdominal wall										
1	Anderson, 2009, USA [102]	26	G4P1	3	8 979	AbP, VB	CT	MTX	Left in situ	–
2	Borton, 2015, UK [103]	38	G2P0	7	2 208	AbP, VB	exLap	MTX	Left in situ	PID, endometriosis
3	Gorry, 2012, UK [104]	32		8	–	AbP, VB	exLap	Lap	Left in situ	–
4	Irani, 2016, USA [105]	36	G0P0	4	998	AbP	exLap	Lap	Resection	IVF
5	Lee, 2015, Cameroon [106]	21	G2P2	36	–	LAbP	Sono	Ltm, MTX	Left in situ, re-Ltm because of abscess formation	–
Diaphragm										
1	Chen, 2019, China [107]	33	G–P1	12	3 129	RUAP, RSP	CT	Lap	Resection	–
Inguinal canal										
1	Noguchi, 2014, Japan [108]	45	G5P4	8	3 090	Swelling and pain in the right groin	Sono	Ltm	Resection	Endometriosis

Abbreviations: GP score = gravidity and parity score, GW = week of gestation at diagnosis, β-HCG in mIU/mL, Diagnostic procedure = final procedure carried out to obtain the diagnosis, (L)AbP = (lower) abdominal pain, RUAP = right upper abdominal pain, RSP = right shoulder pain, VB = vaginal bleeding, exLap/Ltm = exploratory laparoscopy/laparotomy, Sono = abdominal/transvaginal ultrasound scan, CT = computed tomography scan, Lap/Ltm = surgical treatment with laparoscopy/laparotomy, MTX = methotrexate

Diagnosis and diagnostic procedures

- Earliest diagnosis made in the 4th GW, latest diagnosis in the 8th GW
- Diagnosed by ultrasound scan (3/9), CT scan (3/9), exploratory laparoscopy (2/9), or exploratory laparotomy (1/9)

Intervention

- Surgical treatment with laparotomy (5/9)
- Surgical treatment with laparoscopy (2/9)
- Feticide with potassium chloride and administration of MTX (1/9)
- Only administration of MTX (1/9)

Placental management

- Placental resection (7/9), combined with splenectomy in 6 cases
- Placenta left in situ (2/9)

G) Implantation on the peritoneum of the abdominal/pelvic wall (► Table 7)

Presenting symptoms

- Abdominal pain (2/5)
- Abdominal pain and vaginal bleeding (3/5)

Diagnosis and diagnostic procedures

- Earliest diagnosis made in the 3rd GW, latest diagnosis in the 36th GW with the delivery of a dead infant
- Diagnosed by exploratory laparoscopy (3/5), ultrasound scan (1/5) or CT scan (1/5)

Treatment

- Surgical treatment with laparoscopy (2/5)
- Surgical treatment with laparotomy and the administration of MTX (1/5)
- In 2 cases only administration of MTX

Placental management

- Placenta left in situ (4/5); one of these cases required re-laparotomy because of abscess formation
- Placental resection (1/5)

H) Implantation in the paraaortic/paracaval retroperitoneal space (► Table 8)

Presenting symptoms

- Abdominal pain (4/7)
- Abdominal pain and vaginal bleeding (1/7)
- Asymptomatic (2/7)

► **Table 8** Extraperitoneal implantation sites.

No.	Source	Age	GP score	GW	β-HCG	Symptoms	Diagnostic procedure	Intervention	Placental management	Previous medical history
Paraaortic and paracaval										
1	Iwama, 2008, Japan [109]	31	G1P0	10	45 369	AbP	MRI	MTX, Ltm	Resection	EP, IVF, salpingectomy
2	Jiang, 2014, China [110]	33	G3P2	7	–	AbP	MRI	MTX, Ltm	Resection	
3	Ouassour, 2017, Morocco [111]	35	G4P2	7	29 386	X	Sono	Ltm	Resection	EP, salpingectomy
4	Pak, 2018, USA [112]	30	G4P3	8	40 532	AbP	exLtm	Ltm	Resection	–
5	Wang, 2017, China [9]	32	G4P1	5	10 652	X	CT	Lap	Resection	Salpingectomy
6	Yang, 2018, China [113]	34	G2P0	7	6 803	AbP, VB	CT	Ltm	Resection	–
7	Zhang, 2018, China [114]	29		9	16 453	LABP	Sono	Emb., MTX, Ltm	Resection	–
Rectovaginal space										
1	Martinez, 2011, Spain [115]	37	G2P1	29 days after IUI	7 787	LABP	Sono	Lap, MTX	Resection	IUI
2	Yang, 2017, China [116]	32	G5P1	6	1 880	LABP	exLap	Lap	Resection	–
Obturator foramen										
1	Lin, 2008, China [117]	19	G1P0	7	267	LABP, VB	exLap	Ltm	Resection	
2	Persson, 2010, Sweden [10]	33	G3P1	27 days after ET	18 032	VB	Sono	Lap × 2	Resection	EP, ET
Renal fascia										
1	Chishima, 2013, Japan [118]	33	G3P2	7	3 100	AbP	CT	Ltm	Resection	–
Pancreas										
1	Guan, 2015, China [119]	30	G1P0	5	2 500	EgP	MRI	MTX, Lap	Resection pancreatectomy, splenectomy	–
Paravesical space										
1	Meire, 2007, Netherlands [120]	30	G3P1	20	–	LABP	exLtm	MTX, Ltm	Resection	–

Abbreviations: GP score = gravidity and parity score, GW = week of gestation at diagnosis, β-HCG in mIU/mL, Diagnostic procedure = final procedure carried out to obtain the diagnosis, (L)AbP = (lower) abdominal pain, VB = vaginal bleeding, X = asymptomatic, EgP = epigastric pain, exLap/Ltm = exploratory laparoscopy/laparotomy, Sono = abdominal/transvaginal ultrasound scan, CT = computed tomography scan, Lap/Ltm = surgical treatment with laparoscopy/laparotomy, MTX = methotrexate, IVF = in vitro fertilization, ET = embryo transfer, IUI = intrauterine insemination

Diagnosis and diagnostic procedures

- Earliest diagnosis made in the 5th GW, latest diagnosis in the 10th GW
- Diagnosed by ultrasound scan (2/7), CT scan (2/7), MRI (2/7), or exploratory laparotomy (1/7)

Treatment

- Surgical treatment with laparotomy (6/7), with additional administration of MTX in 3 cases
- Surgical treatment with laparoscopy (1/7)

Placental management

- Placental resection (7/7)

Implantation sites of retroperitoneal EP were often found in the paraaortic, paracaval or paravesicular space and usually required surgical resection by laparotomy.

Discussion

A total of 115 case reports from 113 publications were analyzed for this literature review. The most commonly reported EP implantation sites were the uterine serosa (32/115 or 27.8%), the broad ligament of uterus (18/115 or 15.7%), the liver (14/115 or 12.2%) and the greater omentum (12/115 or 10.4%). Other possible locations for peritoneal EP were the serosa of the bowel, spleen or abdominal wall. There are reports of individual cases with implantation on the diaphragm [107] and in the inguinal canal [108]. A number of retroperitoneal EP sites were found, particularly in the paraaortic and paracaval space but also in the rectovaginal space, on the obturator foramen, in the paravesical space or in the vicinity of the pancreas or kidney.

As regards rare EP implantation sites, their symptoms and the diagnostic procedures used to determine EP, these data largely correspond to the information collated by Molinaro and Barnhart [6]. However, the data on EP implantation sites in the liver and in the retroperitoneal space were not yet available to Molinaro and Barnhart [6] and have been added here. Various abdominal implantation sites were briefly cited in the above-mentioned review by Parker and Srinivas [3]. Our review added a summary of a number of additional case reports to their more limited data, including reports covering implantation on the diaphragm, in the inguinal canal, at the obturator foramen, on a renal capsule and on the pancreas.

For clinical practice, the symptoms of the affected patient are crucial. The most commonly reported symptom was abdominal pain, with fewer reports of vaginal bleeding. However, there are also a number of reports of abdominal ectopic pregnancies occurring in asymptomatic patients, with a total of 24/115 (20.9%) patients in our review reporting no symptoms. Abdominal symptoms and a β -HCG serum value of more than 1500 mU/mL with no intrauterine pregnancy visible on imaging are indications for an EP and must be immediately investigated further with additional diagnostic procedures or by exploratory laparoscopy [93]. The importance of carrying out laparoscopic inspection of both the lower and the upper abdominal region must be emphasized (comprehensive inspection) [98]. In the case reports which we found during our search, the most common intervention was surgical resection by laparotomy, particularly in cases of advanced pregnancy, surgery in the retroperitoneal space, and in countries with more limited medical resources. However, there are also reports of the successful management of specific cases of EP in rare locations [52, 62, 85, 93].

The appropriate strategy for placental management is disputed in the literature and decisions must be made on a case-by-case basis according to the individual implantation site, the risk of bleeding, the patient's clinical condition, the physician's surgical experience and the available medical resources [28, 62]. Implantations on the omentum, spleen or liver are associated with a higher risk of bleeding, while the risk of bleeding appears to be lower if the placenta is located on the uterine serosa [37]. According to some authors, the extent of placental adhesion can be determined preoperatively using MRI [121]. Provided that placental blood supply can be safely disrupted, then resection of the placenta is recommended [37, 40, 57]. Otherwise the placenta

can be left in situ, after the umbilical cord and fetal membranes have been removed [4]. A postoperative course of antibiotics to prevent infection combined with abdominal drainage to detect bleeding are recommended [87]. Imaging procedures and changes in β -HCG values can be used to monitor resorption of the placenta [22, 23, 30]. Varying doses of methotrexate were administered in some cases to hasten trophoblast degeneration [18, 31, 67, 87].

Reports of an abdominal EP resulting in the birth of a viable infant are rare in the literature. Their prevalence is estimated to be less than 0.01% of all hospital births [30]. Many authors refer to pregnancies after the 20th GW as *advanced* abdominal pregnancies; it has been suggested that conservative management could be considered in these cases after weighing up the maternal risk of bleeding [37]. In our case series, the majority of live infants were delivered to patients with placental implantation on the external serosa of the uterine wall. This was also observed by Rohilla et al. in her review of advanced abdominal pregnancies [37]. Individual cases who underwent planned conservative management of an abdominal EP with elective laparotomy and the birth of a healthy infant in the 34th GW have been described [25, 70].

Conclusion

This literature review makes it clear that in the event of a positive pregnancy test, an "empty" uterus, and abdominal pain with or without vaginal bleeding in women of childbearing age, it is important not only to investigate for tubal pregnancy as the most common ectopic pregnancy site but also to consider the possibility of ectopic pregnancies in rarer ectopic sites. At the same time, the relatively high percentage of asymptomatic patients and the often very late diagnosis highlight the importance of obtaining a detailed abdominal vaginal ultrasound scan. Abdominal CT or MRI imaging may provide additional useful information. While this is available in highly developed industrialized countries, CT imaging and MRI can be a problem in countries with more limited healthcare resources [13]. MRI is the best method of obtaining a diagnosis and planning the treatment of an EP located in the intra- or extraperitoneal space [3, 6, 65, 110]. The appropriate placental management strategy and the possibility of achieving a live birth must always be considered on case-by-case basis and weighed up after carefully assessing the maternal morbidity risk.

Future studies on rare EP locations should focus on previously unknown risk factors in this group of EP patients, using retrospective case-control studies. The pathogenesis of retroperitoneal implantation of ectopic pregnancy is still unknown and also merits further study.

Conflict of Interest

The authors declare that they have no conflict of interest.

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