Review Article

Successful Management of a Noncommunicating Rudimentary Uterine Horn Pregnancy by Laparoscopic Surgery: A Case Report and Literature Review

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Abstract

Pregnancy in a noncommunicating rudimentary horn is extremely rare but can cause serious clinical complications, such as uterine rupture. The standard treatment is excision of the rudimentary horn, and recently, in some cases, laparoscopic resection has been performed in the first trimester of gestation. Herein, we present a case of noncommunicating rudimentary horn pregnancy (NCRHP), which was diagnosed by magnetic resonance imaging at 6 weeks of gestation and treated by laparoscopic surgery. However, we have also found some rare cases in which patients could obtain live newborn babies. Since management is affected by the different levels of obstetric medical care and diagnostic tools, we also performed a review and analysis of NCRHP. A PubMed search yielded 103 cases reported in the English literature. Correct diagnosis and laparoscopic treatment were achieved more frequently in developed countries, especially in the first trimester of gestation. On the other hand, symptoms, including abdominal pain and hypovolemic shock, tended to occur in the second trimester of gestation. This period was also found to be a risk factor for uterine rupture. Among 18 patients at the third trimester of gestation, 13 obtained live neonatal infants. Therefore, detailed information about this disease is crucial for proper treatments.

Keywords: Country, gestational age, laparoscopic surgery, noncommunicating rudimentary horn pregnancy, uterine rupture

Introduction

A unicornuate uterus with a rudimentary horn results from arrested development of one of the Müllerian ducts,[1] and the great majority of rudimentary horns do not communicate with the cavity.[2-4] Moreover, the incidence of noncommunicating rudimentary horn pregnancy (NCRHP) is extremely rare and is estimated at 1:76,000–1:160,000 pregnancies,[5-9] since fertilization is thought to occur via intraperitoneal transmigration of sperm or a fertilized ovum.[2] In a significant number of cases, a correct diagnosis can be achieved only after uterine rupture with life-threatening heavy bleeding[5,9] because uterine rupture usually occurs before the third trimester of pregnancy in NCRHP.[5,10] To treat these cases, emergency laparotomy is performed. Apart from detecting hypovolemic shock,[11-17] patients frequently have abdominal pain,[7,11,13-16,18-43] but some reports have indicated that only 8% of rudimentary horn pregnancies (RHPs) are diagnosed before the symptoms appear.[44] Sufficient knowledge seems necessary to detect NCRHP during early obstetric screening. Especially when detecting NCRHP in the first trimester of pregnancy, this disease can be managed by minimally invasive laparoscopic surgeries.[10,21,27,31,33,41,43,45-55] In some cases, laparoscopic surgeries are performed even in the second trimester of gestation.[10,43] Magnetic resonance imaging (MRI) seems to be particularly important for performing a prompt and correct diagnosis before

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laparoscopic treatment.[56] However, a large review, which collected RHPs in the 20th century, found that in 6.5% of all RHP cases, patients could obtain live newborn babies.[5] In addition, in the 21st century, there are some cases in which patients could achieve live newborn babies by cesarean section,[11,23,26,35,44,57-64] although those situations may be extremely rare in the current developed countries. Thus, various situations should be considered when encountering NCRHP because its management would be affected by the different levels of obstetric medical care and diagnostic tools derived from individual countries, communities, or institutions. For this reason, a comprehensive review of separate case reports in the 21st century would be useful. We compared the actual management of our case to the results of the review. Herein is a case report of NCRHP diagnosed at 6 weeks of gestation and treated completely by laparoscopic surgery, along with a review of the literature reporting NCRHP. The purpose of this study was to evaluate data on patient characteristics, presenting the symptoms, diagnostic methods, and therapeutic management of RHP for the periods of 2000–2020.

Methods

Data collection

In the management of our patient with NCRHP, several published cases were referenced. After treatment, we performed a systematic review reporting NCRHP cases to identify the characteristics and assess our management. A PubMed search was performed on November 30, 2020, using the two combinations of terms included in titles/abstracts: "noncommunicating and pregnancy" or "noncommunicating and pregnancy." This search yielded 110 papers, and among them, we obtained 81 English-language references reporting noncommunicating RHPs. Nine reports were excluded: two reports due to the presence of other uterine abnormalities, three reports due to the presence of tubal pregnancy, and four reports due to insufficient data. Finally, 72 reports were selected for our analysis.[7,10-55,58-82] Most of the articles were case reports, and we found 103 cases published from January 2000 to November 2020. Two reviewers (W.I. and A.T.) independently reviewed all articles. We extracted some epidemiologic factors based on the following seven classifications: (1) gestational age, (2) patient characteristics, (3) symptoms, (4) diagnostic methods, (5) treatment methods, (6) diagnosis, and (7) blood loss. Since these clinical factors were extracted from the description of published reports, the data were partly insufficient in some cases.

Statistical analysis

First, we divided 103 patients into two groups by developed countries and other countries or into three groups by gestational age, including the first trimester (0–13 weeks), second trimester (14–26 weeks), and third trimester (27–40 weeks). Among these two or three groups, we compared the ratio of patients with each clinical factor. To detect differences, a Chi-square test was performed, and $P < 0.05$ was considered statistically significant.

Second, we assessed the influence of the following ten clinical factors on the possibility of uterine rupture: (1) "developed country," defined referring to the definition of the Organization for Economic Cooperation and Development; (2) "over 30 years old;" (3) "multiparity;" (4) "past abortion history;" (5) "abdominal pain", defined as patients with symptoms of abdominal pain; (6) "hypovolemic shock", defined as patients who had abnormal vital signs caused by bleeding; (7) "vaginal bleeding," defined as patients with symptoms of vaginal bleeding; (8) "vomiting", defined as patients with symptoms of vomiting; (9) "right-sided NCRHP," defined as patients who had right-sided NCRHP; and (10) "second trimester," defined referring to the classification of gestational age. To control for confounding factors, we divided the patients into two groups according to the presence or absence of each factor and performed a multivariate logistic regression analysis. These statistical analyses were performed using JMP version 12 for Windows (SAS Institute, Inc., Tokyo, Japan). The number of patients with each factor, the odds ratios (ORs) and 95% confidence intervals (CIs) for the occurrence of uterine rupture, and the P values were calculated. $P < 0.05$ was considered statistically significant.

Results

Case report

An asymptomatic 30-year-old G1P0 female was referred to our hospital in the 6-week, 2-day period of gestation with a suspected diagnosis of ectopic pregnancy. She had received a diagnosis of an absent right kidney by abdominal computed tomography scan in 2010. Blood testing showed a beta-human chorionic gonadotropin (β-HCG) concentration of 25,250 IU/l with no abnormality, and vital signs were normal.

Transvaginal ultrasound (TVUS) demonstrated an empty-appearing uterus [Figure 1a] and the presence of a 16.6 mm gestational sac with a clear yolk sac and no fetal heart beat near the right adnexa [Figure 1b and c]. However, unlike a typical tubal ectopic pregnancy, a thick myometrial wall surrounding the gestational sac was detected [Figure 1c-e]. Due to these findings, the patient was immediately hospitalized for pelvic MRI and operation planning. MRI, performed 2 days after hospitalization, showed an asymmetrical didelphys uterus, namely, type III Müllerian duct anomalies (MDA) classified

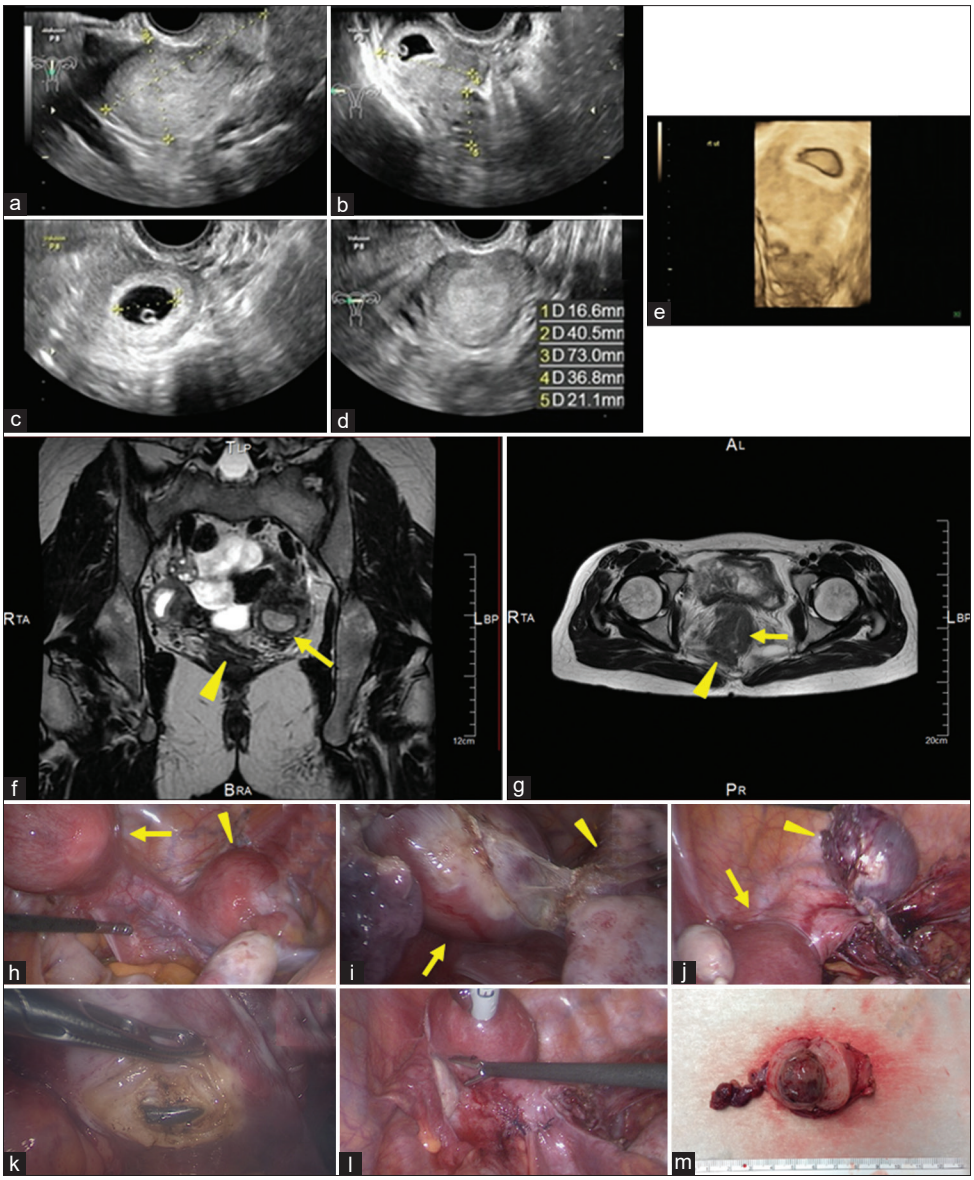

Figure 1: Clinical images. (a) The dominant left uterine horn. (b) Gestational sac with a yolk sac was detected near the right adnexa. (c-e) The thick myometrium. (f-g) Magnetic resonance imaging images. Coronal view (f). Axial view (g). (h-l) Laparoscopic surgery images. The process of resecting the fibromuscular band tissue between the left hemi-uterus (arrow) and the right rudimentary horn (arrowhead) (h-j). The resected specimen was retrieved from the small hole of the vaginal wall (k). (l) The dominant uterine horn and normal bilateral ovaries. (m) Gestational sac-like tissue in the resected specimen

by the American Society for Reproductive Medicine, with an extremely thin right vaginal portion of the cervix [Figure 1f and g]. A pregnancy was detected in this right uterine horn. Three days after reaching this diagnosis, a fetal heart beat was detected by TVUS, and we recommended operative treatment to prevent the high risk of future uterine rupture.

Two days after consent for the laparoscopic operation was obtained from the patient and her husband, we performed laparoscopic resection of the rudimentary horn of the uterus with the right fallopian tube. (Written informed consent was also obtained from the patient and her husband for publication of this case report.) During the operation, a noncommunicating rudimentary right horn and a right fallopian tube arising from this horn were grossly detected, and we diagnosed type II-B MDA [Figure 1h]. Bilateral ovaries and a left fallopian tube were connected in a normal fashion to the dominant left uterine horn. The pregnancy was located in the markedly swollen noncommunicating rudimentary right horn [Figure 1i]. Small pelvic endometriosis was also detected. The rudimentary horn was excised together with the right fallopian tube [Figure 1i and j], and this excised specimen was retrieved vaginally through a small incision of Douglas' pouch [Figure 1k, l and m]. The postoperative recovery was uneventful, and the patient was discharged

on the third postoperative day. The postoperative blood test showed a β-HCG concentration of 3,899 IU/l, and it became negative 3 weeks after the operation. Histological examination of the excised tissue confirmed a pregnancy inside a noncommunicating rudimentary uterine horn.

Patient characteristics

This review included 103 cases of NCRHP, and these cases included 38 cases with a first trimester of gestation, 47 cases with a second trimester of gestation, and 18 cases with a third trimester of gestation. Of the nine rare cases with multiple pregnancies, one patient had triplets, and eight patients had twins. In total, we extracted 28 factors related to this disease and collected the number of cases with each factor [Table 1], although the factors were not necessarily described in all reports. These cases were derived from 73 studies that were reported in 29 countries. Among them, 41 cases were derived from developed countries, and 62 cases were from other countries. Since in all cases, pregnancy was established spontaneously and no patient used infertility treatments, the patient age was relatively young, 26.1 ± 5.1 (range 16–39) years old. The main symptoms included abdominal pain (42.7% of all cases) and hypovolemic shock (10.7%), but many patients had no symptoms (40.8%). In these 103 cases, a correct diagnosis before surgery could be performed in 48 cases (46.6%), and uterine rupture occurred in 36 cases (35.0%). In most cases, the rudimentary horn was removed by laparotomic surgery, but 20 cases were treated laparoscopically. Almost all 20 cases with laparoscopic surgeries were performed in developed countries, and only 2 cases were treated laparoscopically in developing countries, both in India. These laparoscopic surgeries were mainly performed during the first trimester of gestation (18/20 cases), but two cases were performed during the second trimester. Similarly, among 16 cases with MRI performed for diagnosis, 13 were reported in developed countries. In all 16 cases, a correct diagnosis of NCRHP was achieved before surgery. However, we could detect no cases in which MRI was used during the third trimester of gestation, and all 16 cases were in the first (11 cases) or second (5 cases) trimesters. We found only one case in which the patient reached the third trimester of gestation in a developed country, and the other 17 cases were detected in another country [Table 2]. Among these 18 cases, we detected 13 cases in which patients could achieve live neonatal babies. After performing these general observations of 103 cases, we identified the possibility that both the diagnosis and treatment of NCRHP seemed to largely depend on the country and gestational age.

Country-specific differences

To detect country-specific factors affecting the diagnosis and treatment of NCRHP, we compared the frequency of 19 factors by dividing 103 cases into two groups, which were classified by developed countries and other countries [Figure 2]. Although there was no difference in the frequency of symptoms, we detected significant differences in the categories of gestational age, diagnosis, treatment, and complications. Remarkably, only one case with third trimester of gestation was detected in developed countries. The number of cases with "MRI use," "correct diagnosis," or "laparoscopic surgery" was significantly higher. On the other hand, in the other countries, we detected significantly higher numbers of cases with "suspected intrauterine fetus," "emergency surgery," "uterine rupture," or "massive blood loss." These results possibly indicated the presence of differences in diagnostic and treatment ability, especially in the first trimester of gestation.

Table 1: Ratio of each factor

Factors	Number	Ratio (%)
Gestational age		
First trimester	38	36.9
Second trimester	47	45.6
Third trimester	18	17.5
Patient characteristics		
Developed country	41	39.8
Multiparity	44	42.7
Past abortion history	30	29.1
Past cesarean section history	10	9.7
Past diagnosed uterine abnormality	7	6.8
Multiple pregnancy	9	8.7
Symptoms		
Abdominal pain	44	42.7
Hypovolemic shock	11	10.7
Vaginal bleeding	8	7.8
Vomiting	6	5.8
No symptoms	42	40.8
Diagnostic methods		
MRI use	16	15.5
3D ultrasound use	7	6.8
Diagnostic laparoscopy	6	5.8
Treatment methods		
Laparoscopy	20	19.4
Emergency surgery	17	16.5
Pregnancy termination before surgery (1*)	25	24.3
Diagnosis		
Right-sided NCRHP	60	58.3
Correct diagnosis	48	46.6
Suspected intrauterine fetus	26	25.2
Uterine rupture	36	35.0
Pregnancy after the operation	10	9.7
Urinary tract abnormality (2**)	3	2.9
Blood loss		
Massive blood loss	34	33.0
Blood transfusion	23	22.3

*1: Two cases with surgical abortion, 9 cases with the injection of methotrexate, 1 case with the injection of potassium chloride, 13 cases with labor induction, **2: The urinary tract screening test was performed in 13 of the 103 cases. MRI: Magnetic resonance imaging, NCRHP: Noncommunicating rudimentary horn pregnancy

Table 2: List of 18 cases in third trimesters

Reference	Country	Age	*P*	GW	Main symptom	Preoperative diagnosis	Rupture	Side	Status	Birth weight (g)	APGAR
11	Turkey	24	2	38	No symptoms	Placenta previa		Left	Live		
11	Turkey	32	1	30	No symptoms	Placenta previa, IUFD		Right	Dead		
15	India	29	0	34	Abdominal pain	Placenta previa		Left	Dead		
15	India	24	1	34	No symptoms	Uterine rupture	Rupture	Right	Dead		
17	India	31	1	29	Shock	Ectopic pregnancy	Rupture	Right	Dead	620	
23	India	26	2	36	Abdominal pain	Bicornuate, placenta previa		Right	Live	2500	5/7
26	Nepal	30	0	39	No symptoms	Normal pregnancy			Live	2600	Normal
35	India	23	0	36	Abdominal pain	IUGR		Left	Live	1800	8/9
44	China	23	0	37	No symptoms	Didelphys		Right	Live	2550	Normal
58	Cameroon	29	0	42	No symptoms	Ectopic pregnancy		Right	Live	2300	0/10
59	India	24	0	37	Fetal distress	Low lying placenta	Rupture	Right	Live	2300	7/9
60	Nigeria	32	0	38	Vaginal bleeding	Low lying placenta		Left	Live	2200	Normal
61	India	20	0	35	Preeclampsia	Normal pregnancy (twin)		Left	Live	2700, 1900	Normal
62	Turkey	27	0	37	IUGR	RHP		Right	Live	1370	7 (1 min)
63	India	25	2	37	IUGR	Placenta previa		Left	Live	2700	9
64	Korea	27	0	34	IUGR	IUGR		Right	Live	1670	5/8
68	Brazil	22	0	44	Fetal distress	IUFD		Right	Dead		
77	India	25	1	41	Fetal distress	RHP		Right	Live	1600	Died on the 4th day

P: Para, GW: Gestational week, APGAR: Apgar score, IUFD: Intrauterine fetal death, RHP: Rudimentary horn pregnancy, IUGR: Intrauterine growth retardation

Differences between three trimesters

Next, to detect the relationship between the three trimesters of gestation and patient characteristics, symptoms, and management of NCRHP, we compared the frequency of 17 factors by dividing 103 cases into three groups, which were classified by first, second, and third trimesters of gestation [Figure 2]. A clear reduction in frequency along with increased gestational age was detected for some factors, including "developed country," "past abortion history," "MRI use," "correct diagnosis," and "laparoscopic surgery." Conversely, the frequencies of "suspected intrauterine fetus" and "emergency surgery" were higher in the third trimester. In the second trimester, we detected a high frequency of symptoms, including "abdominal pain" and "hypovolemic shock," and adverse events, including "uterine rupture" and "massive blood loss."

Influential factors of uterine rupture

Since the most severe adverse event of NCRHP was thought to be uterine rupture, which we actually detected in 36 out of 103 cases, we tried to detect the significant factors affecting the possibility of uterine rupture. For that purpose, we extracted the 11 representative factors that were predicted to have some influence and performed a multivariate analysis [Table 3]. According to the analysis, the following four factors affected the rate of uterine rupture: (1) "developed country" (OR = 0.13, $P < 0.01$); (2) "abdominal pain" (OR = 11.16, $P < 0.01$); (3) "shock" (OR = 25.38, $P < 0.01$); and (4) "second trimester" (OR = 8.84, $P < 0.05$). Remarkably, patients with a second trimester of gestation had a high possibility of uterine rupture (72.7%, 24/33 cases) in the other countries.

Discussion

Since NCRHP is an extremely rare disease, it is difficult to understand its characteristics. This lack of knowledge may lead to the high possibility of a life-threatening condition, namely, rudimentary uterine horn rupture.[5,11,57] On the other hand, when a prompt and accurate diagnosis is achieved, NCRHP can be treated less invasively by laparoscopic surgeries.[10,83-85] Since laparoscopic techniques have progressed considerably in the last few decades, especially in developed countries, the treatment methods have dramatically changed. Therefore, we performed this study to uncover detailed information about the etiological characteristics of NCRHP that occurred during the 21st century. Although there were some limitations in the search methods and, for example, we could not capture the rare cases in which words relating to NCRHP did not appear in the abstracts, in total, we collected 103 cases from 72 publications that retrieved by the PubMed search system. The locations extended to 29 countries, and the cases included 38 in the first trimester, 47 in the second trimester, and 18 cases in the third trimester of gestation [Table 1]. In comparison with the 20th century worldwide review of 588 cases,[5] the cases in the first trimester seemed to increase and the possibility of uterine rupture seemed to decrease. Since we could predict that these factors had an important influence on the diagnosis and treatment of NCRHP, detailed analyses were performed along with each country or gestational age.

First, since there were differences in obstetric medical care between countries,[86,87] we divided the 103 cases between

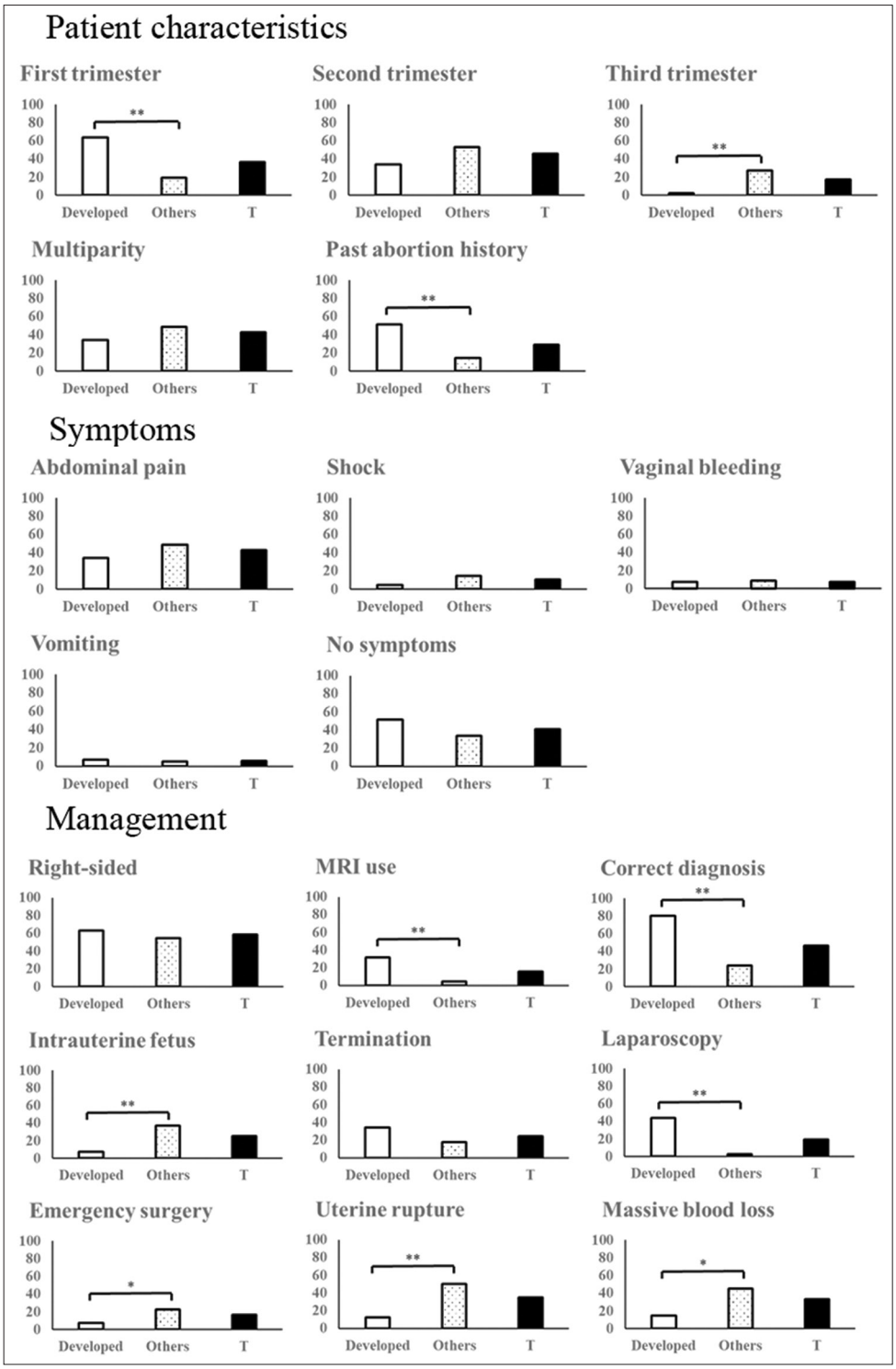

Figure 2: Country-specific differences. Developed: Developed countries, Others: Countries other than developed countries, T: Total, Shock: Hypovolemic shock, Right-sided: Right-sided noncommunicating rudimentary horn pregnancy, Intrauterine fetus: Diagnosis of suspected intrauterine fetus, Termination: Pregnancy termination, Laparoscopy: Laparoscopic surgery. *$P < 0.05$, **$P < 0.01$

developed countries and other countries. As expected, regarding developed countries, we detected a high possibility that prompt and accurate diagnosis could be performed in the first trimester of gestation, and consequently, the frequencies of emergency surgery and uterine rupture were significantly low [Figure 3]. These differences were probably caused by the relatively frequent pregnancy follow-up and detailed ultrasound examination conducted in the first trimester.[80,88] When searching for the risk of uterine rupture by multivariate analysis of ten representative factors, we also detected that

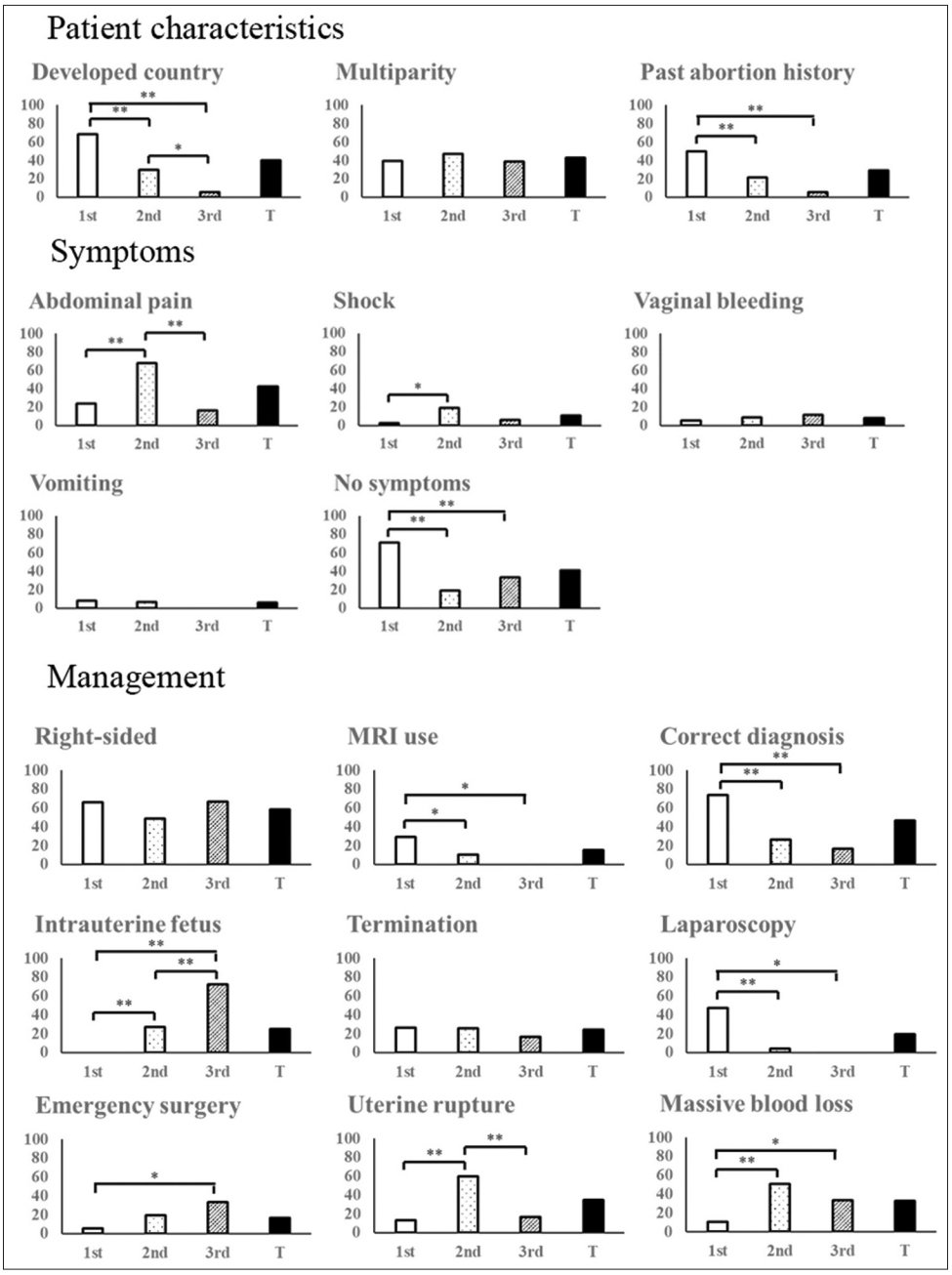

Figure 3: Differences between three trimesters. 1st: First trimester of gestation, 2nd: Second trimester of gestation, 3rd: Third trimester of gestation, T: Total, Shock: Hypovolemic shock, Right-sided: Right-sided noncommunicating rudimentary horn pregnancy, Intrauterine fetus: Diagnosis of suspected intrauterine fetus, Termination: Pregnancy termination, Laparoscopy: Laparoscopic surgery $*P < 0.05$, $**P < 0.01$

"developed country" was associated with a significantly low risk [Table 3]. In addition, "second trimester" showed a significantly high risk, apart from some symptoms. From a technical viewpoint, the frequencies of MRI use and laparoscopic surgery were obviously higher in developed countries. Although not the majority, 13 out of 41 patients were diagnosed via MRI in developed countries, but we detected only three similar cases in other countries. Among these 13 cases, seven patients were treated by laparoscopic surgeries. These results possibly indicated that if there is no technical limitation, such as in developed countries, laparoscopy could be used in unruptured cases after achieving a prompt and accurate diagnosis, since MRI has become the gold standard for the evaluation of congenital MDA.[1] On the other hand, some cases of NCRHP were diagnosed in the third trimester of gestation, frequently in developing countries, possibly because the misdiagnosis of intrauterine pregnancy was caused by the insufficient pregnancy follow-up. Paradoxically, these data indicated another possibility for developed countries. Although there was a possibility that fatal cases were not always reported,

Table 3: Influential factors of uterine rupture

	Number	OR (95% CI)	*P*
Patient characteristics			
Developed country	41	0.13 (0.05-0.39)	<0.01
Over 30 years old	28	0.09 (0.02-0.42)	NS
Multiparity	44	1.33 (0.59-3.00)	NS
Past abortion history	30	0.36 (0.13-0.98)	NS
Symptoms			
Abdominal pain	44	11.16 (4.25-29.31)	<0.01
Hypovolemic shock	11	25.38 (3.0.9-208.37)	<0.01
Vaginal bleeding	8	1.12 (0.25-5.00)	NS
Vomiting	6	4.06 (0.71-23.36)	NS
Disease characteristics			
Right-sided NCRHP	60	0.84 (0.37-1.91)	NS
Second trimester	47	8.84 (3.42-22.83)	<0.05

NS: Not significant, OR: Odds ratio, CI: Confidence interval, NCRHP: Noncommunicating rudimentary horn pregnancy

among these cases, a certain number of patients could obtain live newborn babies [Table 3]. These infants derived from NCRHP are scarcely seen in developed countries, and we could detect only one case in Korea.[64]

Second, the different clinical conditions of NCRHP were predicted to largely depend on the gestational age, and we divided the 103 cases into three groups by the three trimesters of gestation [Figure 3]. This analysis indicated the two important results. One finding was that the ratio of cases with the following factors, including "developed country," "MRI use," "correct diagnosis," and "laparoscopic surgery," decreased with an increase in gestational age. Conversely, the number of cases with an "intrauterine fetus" increased. The other finding was that symptoms and adverse events were frequently detected in the second trimester of gestation, and these included "abdominal pain," "hypovolemic shock," "uterine rupture," and "massive blood loss." These tendencies were coincident with past reviews to some extent, in which researchers concluded that rupture occurs in 80%–90% of cases in the midtrimester and that only <10% of cases reach term, with a fetal salvage rate of <5%.[5,89] When combining the results of patients in the third trimester of gestation shown in Table 2 with these tendencies, that is, severe complications occurring most frequently in the second trimester of gestation, patients could possibly obtain live newborn babies after undergoing strict observations during the first and second trimesters of gestation. From this viewpoint, this study may be able to offer some information that can be explained to a new patient, even though it was impracticable to select follow-up observations when detecting NCRHP.

Conclusion

In the 21st century, since laparoscopic treatments for NCRHP appeared more generally in developed countries and were mainly performed in the first trimester of gestation, the tendencies detected in both of their characteristics and management were remarkably affected by the country and gestational age. In our analysis, safe and minimally invasive treatments may be concluded to depend on a prompt and accurate diagnosis, probably led by detailed pregnancy follow-up and in some cases, using MRI. On the other hand, we could detect some cases in which live newborn babies were obtained, especially in developing countries. Therefore, in-depth knowledge and detailed explanations are needed for managing NCRHP.

Ethics approval

This study was approved by the Institutional Review Board of Teikyo University. The study registry number, registry name, and registration date are as follows: 20-094, Clinical outcomes, and postoperative complications of laparoscopic surgeries for gynecological diseases: A retrospective analysis, 2020/7/17.

Informed consent

Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

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Conflicts of interest

There are no conflicts of interest.

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