The risk factors of rupture and abortion of tubal pregnancy—a retrospective study based on 2280 tubal pregnancy cases

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Research

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Abstract

Objective: The morbidity of ectopic pregnancy is about 1%~2%, and it accounts for about 10% of maternal death. Tubal rupture and tubal abortion can both lead to massive hemorrhage, but their risk factors are lack of study. Through studying the ectopic cases at the third affiliated hospital of Sun Yat-Sen University, the study aims to analyze the risk factors of tubal rupture and tubal abortion.

Methods: To collect the ectopic pregnancy cases undergoing surgeries from the year 2011 to the year 2019 retrospectively, divide them into ruptured group, aborted group, and unruptured and unaborted group. T-test, Mann–Whitney–Wilcoxon test and Pearson’s chi-square, and Fisher’s exact test were applied for univariate analysis. Multivariate logistic regression analysis was used to identify the risk factors of tubal rupture and tubal abortion (variables with a \( P \) value < 0.1 by univariate analysis were entered into the multivariate analysis).

Results: Abdominal pain (OR: 3.101, 95%CI: 1.812–5.306, \( P < 0.001 \)), cervical lifting pain (OR: 2.942, 95%CI: 2.046–4.231, \( P < 0.001 \)), the mass diameter ≥ 4cm (OR: 2.874, 95%CI: 2.095–3.941, \( P < 0.001 \)), HCG ≥ 5000U/L (OR: 2.588, 95%CI: 1.900–3.526, \( P < 0.001 \)), adnexal tenderness (OR: 1.893, 95%CI: 1.296–2.764, \( P = 0.001 \)), age ≥ 35 (OR: 1.781, 95%CI: 1.232–2.573, \( P = 0.002 \)), aspirating blood during culdocentesis (OR: 1.497, 95%CI: 1.081–2.074, \( P = 0.015 \)) are the risk factors of tubal rupture, while vaginal bleeding (OR: 0.271, 95%CI: 0.196–0.375, \( P < 0.001 \)) is the protective factor of tubal rupture. HCG < 2000U/L (OR: 3.554, 95%CI: 2.401–5.260, \( P < 0.001 \)) and mass diameter ≥ 4cm (OR: 2.732, 95%CI: 1.900–3.929, \( P < 0.001 \)) are the risk factors of tubal abortion.

Conclusions: When facing an ectopic pregnancy patient considering pelvic bleeding happens, if HCG ≥ 5000U/L, it’s more likely to be tubal rupture, if HCG < 2000U/L, it’s more likely to be tubal abortion.

1. Introduction

Ectopic pregnancy happens when fertilized ovum implants outside the endometrium of uterine cavity, which is a life-threatening disease and is an important cause of pregnancy-related mortality [1]. Tubal pregnancy is the most common type of ectopic pregnancy.

Tubal rupture happens because of the infiltration of trophoblastic tissue into the tubal wall. The fallopian tube is not intact. Tubal abortion is characterized by the extrusion of pregnancy tissue implanted in the fallopian tube entering into the peritoneal cavity through the fimbriae of uterine tube. It can be either complete or incomplete [2] and the fallopian tube is intact. The rupture and abortion of tubal pregnancy can both lead to severe bleeding, even hemorrhagic shock and death.

The rupture and abortion of tubal pregnancy can show similar clinical manifestations and signs, including amenorrhea, abdominal pain, vaginal bleeding, syncope, shock, adnexal mass, adnexal tenderness, cervical lifting pain, hysterauxesis and aspirating blood during culdocentesis. But the
treatment strategy can be different. Tubal abortion allows for conservative treatment [2] while tubal rupture always needs surgery.

It is well-investigated that higher HCG is associated with a higher possibility of tubal rupture [3][4], but there are still different opinions about the risk factors of tubal rupture, and few studies are about the risk factors of tubal abortion. I undertook this study to investigate the risk factors of tubal rupture and tubal abortion.

2. Materials And Methods

From 2001 to 2019, 3915 ectopic pregnancy patients visited the third affiliated hospital of Sun Yat-Sen University. Among them, 3316 cases were considered tubal pregnancy. 2700 cases of tubal pregnancy underwent surgeries. The operation notes of tubal pregnancy cases undergoing surgeries were reviewed to divide cases into ruptured group, aborted group and unruptured and unaborted group. The criterion of ruptured group is the rupture of fallopian tube could be seen during surgery, while the criterion of aborted group is gestational sac could be found in the abdomen or could be seen at fimbria. 396 cases were considered as tubal rupture, 472 cases were considered as tubal abortion, while 1832 cases were considered as tubal pregnancy without rupture or abortion.

Detailed information about age, gestational age, gestational history, pelvic disease history, pelvic surgery history, assisted reproductive history, birth control history, clinical manifestations, signs, HCG, progesterone and diameter of mass were obtained from medical records. Cases with information loss were excluded. At last, 285 cases were included in the ruptured group, 414 cases were included in the aborted group, 1581 cases were included in the unruptured and unaborted group.

T-test and Mann–Whitney–Wilcoxon test were applied for independent samples, Pearson's chi-square and Fisher's exact test were applied for comparison of groups where appropriate. Multivariate logistic regression analysis was used to identify the risk factors of tubal rupture and tubal abortion (variables with a $P$ value < 0.1 by univariate analysis were entered into the multivariate analysis). A $P$ value < 0.05 was considered significant. Statistical analysis was performed with SPSS 25 statistical software.

3. Results

3.1 Risk factors of tubal rupture
Table 1
The comparison of characteristics of ruptured group and unruptured and unaborted group in univariate analysis

|                                | Ruptured group (n = 285) | Unruptured and unaborted group (n = 1581) | P    |
|--------------------------------|--------------------------|------------------------------------------|------|
| **Age (y)**                    |                          |                                          |      |
| < 20                           | 4(1.40%)                 | 24(15.18%)                               | 0.571|
| 20–29                          | 110(38.60%)              | 781(49.40%)                              | < 0.001|
| 30–39                          | 146(51.23%)              | 695(43.96%)                              | 0.014|
| ≥ 40                           | 25(8.77%)                | 81(5.12%)                                | 0.013|
| Mean ± SD                      | 31.02 ± 5.86             | 29.85 ± 5.32                             | 0.001|
| **Gestational age (weeks)**    |                          |                                          |      |
| < 6                            | 84(29.47%)               | 448(28.34%)                              | 0.372|
| 6–8                            | 135(47.37%)              | 858(54.27%)                              | < 0.001|
| ≥ 8                            | 66(23.16%)               | 275(17.40%)                              | 0.014|
| Mean ± SD                      | 6.38 ± 2.05              | 6.30 ± 1.59                              | 0.480|
| **Gestation history**          |                          |                                          |      |
| Childbearing history           | 183(64.21%)              | 875(55.34%)                              | 0.003|
| Abortion history               | 156(54.74%)              | 893(56.48%)                              | 0.314|
| Ectopic pregnancy history      | 35(12.28%)               | 258(16.32%)                              | 0.048|
| **Pelvic disease history**     | 8(2.81%)                 | 65(4.11%)                                | 0.192|
| **Pelvic surgery history**     | 114(40.00%)              | 602(38.08%)                              | 0.291|
| **Assisted reproductive history** | 3(1.05%)              | 35(2.21%)                                | 0.145|
| **Birth control history**      | 34(11.93%)               | 131(8.29%)                               | 0.033|
| Intrauterine contraceptive device | 17(5.96%)              | 69(4.36%)                                | 0.151|
| Oral contraceptive            | 8(2.81%)                 | 50(3.16%)                                | 0.463|
| Ligation operation            | 9(3.16%)                 | 12(0.76%)                                | 0.003|
| **Clinical manifestations**    |                          |                                          |      |
| Amenorrhea                     | 268(94.04%)              | 1531(96.84%)                             | 0.020|
|                          | Ruptured group (n = 285) | Unruptured and unaborted group (n = 1581) | \( P \) |
|--------------------------|--------------------------|------------------------------------------|--------|
| Abdominal pain           | 267 (93.68%)             | 1003 (63.44%)                            | < 0.001 |
| Vaginal bleeding         | 162 (56.84%)             | 1312 (82.99%)                            | < 0.001 |
| Syncope                  | 2 (0.70%)                | 0 (0.00%)                                | 0.023  |
| Shock                    | 7 (2.46%)                | 1 (0.06%)                                | < 0.001 |
| **Signs**                |                          |                                          |        |
| Adnexal mass             | 100 (35.09%)             | 525 (33.21%)                             | 0.290  |
| Adnexal tenderness       | 230 (80.70%)             | 755 (47.75%)                             | < 0.001 |
| Cervical lifting pain    | 219 (76.84%)             | 533 (33.71%)                             | < 0.001 |
| Hysterauxesis            | 14 (4.91%)               | 92 (5.82%)                               | 0.328  |
| Aspirating blood during culdocentesis | 153 (53.68%) | 368 (23.28%)                             | < 0.001 |
| **HCG (U/L)**            |                          |                                          |        |
| HCG < 2000               | 61 (21.40%)              | 701 (44.34%)                             | < 0.001 |
| 2000 \( \leq \) HCG < 5000 | 74 (25.96%)             | 358 (22.64%)                             | 0.126  |
| HCG \( \geq \) 5000     | 150 (52.63%)             | 522 (33.02%)                             | < 0.001 |
| **Progesterone (nmol/L)** |                          |                                          |        |
| \( P < 15 \)            | 98 (34.39%)              | 545 (34.47%)                             | 0.518  |
| \( 15 \leq P < 60 \)   | 169 (59.30%)             | 881 (55.72%)                             | 0.146  |
| \( P \geq 60 \)         | 18 (6.32%)               | 155 (9.80%)                              | 0.035  |
| **Diameter of mass (cm)**|                          |                                          |        |
| \( D < 2 \)             | 17 (5.96%)               | 360 (22.77%)                             | < 0.001 |
| \( 2 \leq D < 4 \)     | 78 (27.37%)              | 740 (46.81%)                             | < 0.001 |
| \( D \geq 4 \)          | 190 (66.67%)             | 481 (30.42%)                             | < 0.001 |
The \( P \) value of age, childbearing history, ectopic pregnancy history, ligation operation, HCG and mass diameter is less than 0.1, and the \( P \) value of all clinical manifestations and signs except adnexal mass and hysterauxesis is less than 0.1. Because there is only small quantity of cases with ligation operation, syncope and shock, they were not brought into the multivariate logistic regression analysis.

From former studies, age \( \geq 35 \) and \( \text{HCG} \geq 5000 \text{U/L} \) are always seen as the risk factors of tubal rupture, while the mass diameter of ruptured group is mostly \( \geq 4 \text{cm} \). Age, HCG and mass diameter were transferred into ranked data to be brought into multivariate logistic regression analysis.

### Table 2

| Characteristics                          | \( P \)   | OR     | 95\% CI         |
|------------------------------------------|----------|--------|-----------------|
| Age \( \geq 35 \)                        | 0.002    | 1.781  | 1.232–2.573     |
| Childbearing history                     | 0.784    | 1.047  | 0.755–1.451     |
| Ectopic pregnancy history                | 0.776    | 0.776  | 0.497–1.211     |
| Amenorrhea                               | 0.887    | 1.052  | 0.523–2.117     |
| Abdominal pain                           | < 0.001  | 3.101  | 1.812–5.306     |
| Vaginal bleeding                         | < 0.001  | 0.271  | 0.196–0.375     |
| Adnexal tenderness                       | 0.001    | 1.893  | 1.296–2.764     |
| Cervical lifting pain                    | < 0.001  | 2.942  | 2.046–4.231     |
| Aspirating blood during culdocentesis    | 0.015    | 1.497  | 1.081–2.074     |
| \( \text{HCG} \geq 5000 \text{U/L} \)  | < 0.001  | 2.588  | 1.900–3.526     |
| Diameter of mass \( \geq 4 \text{cm} \) | < 0.001  | 2.874  | 2.095–3.941     |

From Table 2, age \( \geq 35 \), abdominal pain, adnexal tenderness, cervical lifting pain, aspirating blood during culdocentesis, \( \text{HCG} \geq 5000 \text{U/L} \), mass diameter \( \geq 4 \text{cm} \) are the risk factors of rupture, the rank of risk degree is abdominal pain, cervical lifting pain, mass diameter \( \geq 4 \text{cm} \), \( \text{HCG} \geq 5000 \text{U/L} \), adnexal tenderness, age \( \geq 35 \), aspirating blood during culdocentesis. Vaginal bleeding is the protective factor of rupture.

To include the risk factors of tubal rupture into the construction of nomogram. The C-index of nomogram is 0.835. The predictive ability of tubal rupture is good.

### 3.2 Risk factors of tubal abortion
Table 3
The comparison of characteristics of aborted group and unruptured and unaborted group in univariate analysis

|                      | Aborted group (n = 414) | Unruptured and unaborted group (n = 1581) | P      |
|----------------------|-------------------------|------------------------------------------|--------|
| **Age (y)**          |                         |                                          |        |
| < 20                 | 11 (2.66%)              | 24 (15.18%)                              | 0.091  |
| 20-29                | 226 (54.59%)            | 781 (49.40%)                             | 0.034  |
| 30-39                | 154 (37.20%)            | 695 (43.96%)                             | 0.008  |
| ≥ 40                 | 23 (5.56%)              | 81 (5.12%)                               | 0.402  |
| Mean ± SD            | 29.14 ± 5.64            | 29.85 ± 5.32                             | 0.019  |
| **Gestational age (weeks)** |                     |                                          |        |
| < 6                  | 142 (34.30%)            | 448 (28.34%)                             | 0.011  |
| 6-8                  | 206 (49.76%)            | 858 (54.27%)                             | 0.057  |
| ≥ 8                  | 66 (15.94%)             | 275 (17.40%)                             | 0.268  |
| Mean ± SD            | 6.10 ± 1.60             | 6.30 ± 1.59                              | 0.023  |
| **Gestation history**|                        |                                          |        |
| Childbearing history | 226 (54.59%)            | 875 (55.34%)                             | 0.413  |
| Abortion history     | 230 (55.56%)            | 893 (56.48%)                             | 0.388  |
| Ectopic pregnancy history | 50 (12.08%)          | 258 (16.32%)                             | 0.018  |
| **Pelvic disease history** |                  |                                          |        |
| Pelvic disease history | 8 (1.93%)             | 65 (4.11%)                               | 0.020  |
| Pelvic surgery history | 137 (33.09%)          | 602 (38.08%)                             | 0.324  |
| **Assisted reproductive history** |            |                                          |        |
| Assisted reproductive history | 1 (0.24%)         | 35 (2.21%)                               | 0.002  |
| **Birth control history** |                     |                                          |        |
| Birth control history | 47 (11.35%)            | 131 (8.29%)                              | 0.034  |
| Intrauterine contraceptive device | 25 (6.04%)       | 69 (4.36%)                               | 0.099  |
| Oral contraceptive   | 14 (3.38%)             | 50 (3.16%)                               | 0.461  |
| Ligation operation   | 8 (1.93%)              | 12 (0.76%)                               | 0.039  |
| **Clinical manifestations** |                    |                                          |        |
| Amenorrhea            | 396 (95.65%)            | 1531 (96.84%)                            | 0.151  |
| Abdominal pain        | 351 (84.78%)            | 1003 (63.44%)                            | < 0.001|
|                                | Aborted group(n = 414) | Unruptured and un aborted group(n = 1581) |   |
|--------------------------------|------------------------|--------------------------------------------|---|
| **Vaginal bleeding**           | 340(82.13%)            | 1312(82.99%)                               | 0.364 |
| **Syncope**                    | 2(0.48%)               | 0(0.00%)                                   | 0.043 |
| **Shock**                      | 1(0.24%)               | 1(0.06%)                                   | 0.372 |
| **Signs**                      |                        |                                            |    |
| Adnexal mass                   | 142(34.30%)            | 525(33.21%)                                | 0.358 |
| Adnexal tenderness             | 285(68.84%)            | 755(47.75%)                                | <0.001 |
| Cervical lifting pain          | 241(58.21%)            | 533(33.71%)                                | <0.001 |
| Hysterauxesis                  | 13(3.14%)              | 92(5.82%)                                  | 0.016 |
| Aspirating blood during culdocentesis | 187(45.17%)          | 368(23.28%)                                | <0.001 |
| **HCG(U/L)**                   |                        |                                            |    |
| HCG < 2000                     | 231(55.80%)            | 701(44.34%)                                | <0.001 |
| 2000 ≤ HCG < 5000              | 97(23.43%)             | 358(22.64%)                                | 0.390 |
| HCG ≥ 5000                     | 86(20.77%)             | 522(33.02%)                                | <0.001 |
| **Progesterone(nmol/L)**       |                        |                                            |    |
| P < 15                         | 164(39.61%)            | 545(34.47%)                                | 0.030 |
| 15 ≤ P < 60                    | 234(56.52%)            | 881(55.72%)                                | 0.407 |
| P ≥ 60                         | 16(3.86%)              | 155(9.80%)                                 | <0.001 |
| **Diameter of mass(cm)**       |                        |                                            |    |
| D < 2                          | 35(8.45%)              | 360(22.77%)                                | <0.001 |
| 2 ≤ D < 4                      | 137(33.09%)            | 740(46.81%)                                | <0.001 |
| D ≥ 4                          | 242(58.45%)            | 481(30.42%)                                | <0.001 |

The P value of age, gestational age, ectopic pregnancy history, pelvic disease history, assisted reproductive history, intrauterine contraceptive device, ligation operation, abdominal pain, syncope,
adnexal tenderness, cervical lifting pain, hysterauxesis, aspirating blood during culdocentesis, HCG, progesterone and mass diameter is less than 0.1, and the \( P \) value of all clinical manifestations and signs except adnexal mass and hysterauxesis is less than 0.1. Because there is small quantity of the cases with assisted reproductive history, ligation operation and syncope, they will not be brought into the multivariate logistic regression analysis.

Former studies always focus on the influence of age \( \geq 35 \) to ectopic pregnancy, age is transferred to ranked data. In addition, HCG, progesterone and mass diameter are transferred into ranked data to be brought into multivariate logistic regression analysis.

|                                | \( P \) | OR   | 95% CI        |
|--------------------------------|--------|------|---------------|
| Age \( \geq 35 \)             | 0.956  | 1.013| 0.646–1.588   |
| Gestational age < 6 weeks      | 0.595  | 0.904| 0.622–1.313   |
| Ectopic pregnancy history      | 0.435  | 0.800| 0.458–1.399   |
| Pelvic disease history         | 0.993  | 0.000| 0.000         |
| Intrauterine contraceptive device | 0.952 | 0.978| 0.469–2.041   |
| Abdominal pain                 | 0.223  | 1.325| 0.843–2.084   |
| Adnexal tenderness             | 0.137  | 1.356| 0.908–2.026   |
| Cervical lifting pain          | 0.102  | 1.397| 0.936–2.085   |
| Hysterauxesis                  | 0.211  | 0.512| 0.179–1.462   |
| Aspirating blood during culdocentesis | 0.633 | 1.100| 0.744–1.626   |
| HCG < 2000U/L                  | < 0.001| 3.554| 2.401–5.260   |
| Progesterone < 15nmol/L        | 0.990  | 0.000| 0.000         |
| Diameter of mass \( \geq 4 \) cm | < 0.001| 2.732| 1.900–3.929   |

From Table 4, the risk factors of tubal abortion are HCG < 2000U/L and mass diameter \( \geq 4 \) cm.

To include the risk factors of tubal abortion into the construction of nomogram. The C-index of nomogram is 0.660. The predictive ability of tubal abortion is limited.

The amount of pelvic blood volume is also recorded as below.
Table 5
The comparison of pelvic blood volume of ruptured group, aborted group and unruptured and unaborted group

| pelvic blood volume(ml) | ruptured group(n = 414) | aborted group(n = 285) | unruptured and unaborted group(n = 1581) | P     |
|-------------------------|-------------------------|------------------------|------------------------------------------|-------|
| 0–500                   | 88(30.88%)              | 297(71.74%)            | 1470(92.98%)                             | < 0.001|
| 500–1000                | 67(23.51%)              | 74(17.87%)             | 90(5.69%)                                | < 0.001|
| 1000–2000               | 87(30.53%)              | 28(6.76%)              | 17(1.08%)                                | < 0.001|
| ≥ 2000                  | 43(15.09%)              | 15(3.62%)              | 4(0.25%)                                 | < 0.001|

The tubal rupture patients are most likely to happen massive hemorrhage among three groups. Tubal abortion patients may also happen massive hemorrhage, but the possibility is lower than tubal rupture patients. Patients without abortion or rupture have a small possibility of massive hemorrhage.

4. Discussion

Tubal rupture happens because of the infiltration of the trophoblastic tissue into the tubal wall. The fallopian tube is not intact. It is common at the isthmus of fallopian tube. Tubal abortion is characterized by the extrusion of an ectopic product of conception implanted in the fallopian tube entering into the peritoneal cavity through the abdominal ostium. It is common at the ampulla of fallopian tube. It can be either complete or incomplete [2] and the fallopian tube is intact. The villus of complete tubal abortion patients may grow at abdomen, leading to abdominal pregnancy. The rupture and abortion of tubal pregnancy can both lead to severe bleeding, even hemorrhagic shock and death.

According to former studies, the rupture rate of tubal pregnancy is about 28.75%–65%. According to the study of Nina A. Bickell [5], the rupture rate is 32%. According to Michael Sindos [6], the rupture rate is 65%. From the study of Pasquale Berlingieri [7], the rupture rate is 29.5%. The study of abortion rate is rare. According to Lijuan Li [13], among 181 tubal pregnancy patients, tubal abortion happens in 57 cases, the abortion rate is about 31.49%. The rupture rate is 17.48% and the abortion rate is 14.67% in my hospital, which is obviously lower than the data of former studies. It might be related to the rise of health awareness in China and the more active management and guardianship of ectopic pregnancy. When women get pregnant, they will go to hospital for an ultrasound test, which leads to the rise of the early detection rate of ectopic pregnancy. Ectopic pregnancy can be treated before rupture or abortion.

There are controversial opinions of the risk factors of tubal rupture. According to Pasquale [7], the patients with age > 35 and isthmus pregnancy have higher rupture risks than others. With the detailed
analysis of symptoms from the study of Cyrille Huchon [8], vomiting during pain, diffuse abdominal pain, acute pain for longer than 30 minutes, and flashing pain are the risk factors of tubal rupture. According to B. Pınar Cilesiz Goksedef [9], higher HCG level and higher gestational age seem to be significant risk factors for rupture of an ectopic pregnancy. The mean gestational age of ruptured ectopic pregnancy is 7.8 weeks; the mean HCG is 8735.3U/L. While the mean gestational age of ruptured ectopic pregnancy is 6.4 weeks; the mean HCG is 4506U/L. Logistic regression analysis revealed that weeks of amenorrhoea > 8 weeks (OR: 46.46; 95% CI: 14.20–152.05) and HCG level > 5000 IU/ml (OR: 4.40; 95% CI: 1.69–11.46) were the significant risk factors for tubal rupture. Michael [6] conducted a study about past history, the patients with ectopic pregnancy history and childbearing history have a higher risk to rupture. According to the study of Gregory Latchaw [4], HCG ≥ 5000U/L and ectopic pregnancy history are the risk factors of rupture.

After analyzed the risk factors from case history, clinical manifestations, signs and tests, abdominal pain(OR:3.101, 95%CI:1.812–5.306, P< 0.001), cervical lifting pain(OR:2.942, 95%CI:2.046–4.231, P< 0.001), mass diameter ≥ 4cm(OR:2.874, 95%CI: 2.095–3.941, P< 0.001), HCG ≥ 5000U/L(OR:2.588, 95%CI:1.900-3.526, P< 0.001), adnexal tenderness(OR:1.893, 95%CI:1.296–2.764, P= 0.001), age ≥ 35(OR:1.781, 95%CI:1.232–2.573, P= 0.002), aspirating blood during culdocentesis (OR:1.497, 95%CI:1.081–2.074, P= 0.015) are the risk factors of tubal rupture, while vaginal bleeding(OR:0.271, 95%CI:0.196–0.375, P< 0.001) is the protective factor of tubal rupture. Patients with these risk factors should be treated more actively.

HCG and mass diameter are the criterion of surgery or conservative treatment. According to the ACOG guide [10], the indication of conservative treatment is HCG < 5000 and mass diameter < 4cm. According to my study, the risk of rupture of patients with HCG ≥ 5000U/L is 2.588 times than the patients with HCG < 5000U/L (95%CI:1.900-3.526, P< 0.001). The risk of rupture of the patients with mass diameter ≥ 4cm is 2.874 times than the patients with mass diameter < 4cm (95%CI:1.900-3.526, P< 0.001). The data supports that the indication of conservative treatment is HCG < 5000 and mass diameter < 4cm.

A few scholars put forward the opinion that age ≥ 35 is the risk factor of tubal rupture, and they all agree that it should be further studied [7]. It may be related to the higher health awareness of young patients. They are more willing to go to hospital when amenorrhea, abdominal pain and vaginal bleeding happens, which leads to the higher early detective rate of ectopic pregnancy, to reduce the rupture rate.

There are few studies about the risk factors of tubal abortion, most of which are case reports. For aborted ectopic pregnancy patients, they may show the manifestation of low HCG and the decrease of HCG during the course of disease [5]. According to Lijuan Li [13], tubal rupture patients’ possibility of massive hemorrhage is higher than tubal abortion patients and much higher than ectopic pregnancy patients without rupture or abortion. In addition, the HCG of patients without rupture or abortion is higher than tubal abortion patients and lower than tubal rupture patients.

According to my study, HCG < 2000U/L (OR:3.554, 95%CI:2.401–5.260, P< 0.001) and mass diameter ≥ 4cm (OR:2.732, 95%CI:1.900-3.929, P< 0.001) are the risk factors of tubal abortion. The patients with
tubal abortion can also be treated by expectant treatment. The indication of expectant treatment is: the condition of patient is stable without abdominal pain or with slight abdominal pain, without obvious intra-abdominal hemorrhage; HCG < 1000–2000U/L; mass diameter < 30mm without fetal heartbeat [11]. As the risk factors of tubal abortion are HCG < 2000U/L and mass diameter ≥ 4cm, and as the HCG of tubal abortion patients can reduce to normal spontaneously, I proposed that although mass diameter ≥ 4cm is not the indication of expectant treatment, for patients with HCG < 2000U/L and mass diameter ≥ 4cm, after their informed consent, they could be treated by expectant treatment and HCG should be tested constantly.

The patients of tubal rupture and tubal abortion have similar clinical manifestations and signs, for example, abdominal pain, adnexal tenderness, cervical lifting pain, aspirating blood during culdocentesis. Tubal rupture patients are more likely to happen massive hemorrhage. The pelvic blood volume of 30.53% tubal rupture patients is 1000 ~ 2000ml, the pelvic blood volume of 15.09% tubal rupture patients is more than 2000ml. While the possibility of massive hemorrhage of tubal abortion patients is much lower than tubal rupture patients. For tubal abortion patients with slight intra-abdominal hemorrhage, it is possible that they may be treated by expectant treatment [12]. But tubal rupture patients always need to be treated by surgery. It is important to differentiate tubal rupture and tubal abortion for a better treatment strategy. According to my study, the point of differentiating tubal rupture and tubal abortion is the HCG. The mean HCG of tubal abortion patients and tubal rupture patients is 4412.98U/L and 11441.85U/L, the mean HCG of patients without abortion or rupture is 6812.26U/L. The HCG of each group is statistically different. It may be related to the difference of villus activity. Higher HCG means higher villus activity, which leads to a higher possibility of rupture. While the embryo death always happens in tubal abortion patients, which leads to the loss of villus activity and the decease of HCG synthesis and secretion [13].

Combined with the results that HCG ≥ 5000U/L is the risk factor of tubal rupture and HCG < 2000U/L is the risk factor of tubal abortion, when facing an ectopic pregnancy patient with intra-abdominal hemorrhage, if HCG ≥ 5000U/L, it is more likely to be tubal rupture. If HCG < 2000U/L, it is more likely to be tubal abortion, we should observe her clinical manifestation and test HCG frequently.

5. Conclusions

Abdominal pain(OR:3.101, 95%CI:1.812–5.306, P<0.001), cervical lifting pain(OR:2.942, 95%CI:2.046–4.231, P<0.001), mass diameter ≥ 4cm(OR:2.874, 95%CI:2.095–3.941, P<0.001), HCG ≥ 5000U/L(OR:2.588, 95%CI:1.900-3.526, P<0.001), adnexal tenderness(OR:1.893, 95%CI:1.296–2.764, P=0.001), age ≥ 35(OR:1.781, 95%CI:1.232–2.573, P=0.002), aspirating blood during culdocentesis(OR:1.497, 95%CI:1.081–2.074, P=0.015) are the risk factors of tubal rupture, while vaginal bleeding(OR:0.271, 95%CI:0.196–0.375, P<0.001) is the protective factor of tubal rupture. HCG < 2000U/L (OR:3.554, 95%CI:2.401–5.260, P<0.001) and the diameter of mass ≥ 4cm (OR:2.732, 95%CI:1.900-3.929, P<0.001) are the risk factors of tubal abortion. When facing an ectopic pregnancy patient considering pelvic bleeding happens, if HCG ≥ 5000U/L, it's more likely to be tubal rupture, if HCG < 2000U/L, it's more likely to be tubal abortion.
Declarations

Ethics approval and consent to participate
The approval was waived.

Consent for publication
Not applicable.

Availability of data and materials
The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests
The authors declare that they have no competing interests.

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Authors' contributions
Panpan tang analyzed data and wrote the manuscript. Xiaomao Li and Wenwei Li were responsible for modifying and editing the manuscript. Yunhui Li and Yu Zhang collected data. Yuebo Yang conducting the research, provided case resources for the research and edited the manuscript. All authors read and approved the final manuscript.

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**Figures**
Figure 1

Nomogram of risk factors for tubal rupture. Annotation: For variables, 1="Yes", 0="No". ABDC=Aspirating blood during culdocentesis.
Figure 2

Nomogram of risk factors for tubal abortion Annotation: For variables, 1="Yes", 0="No".