

The management of gynecological hemoperitoneum found to be associated with a ruptured corpus luteum cyst

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Abstract Rupture of a corpus luteum cyst (RCLC) is the major cause of gynecological hemoperitoneum. RCLC is often difficult to diagnose on imaging and a standardized management is not defined. While mild cases of hemoperitoneum associated with RCLC require only observation and support, surgical intervention is necessary for severe cases or if the adnexal cyst in question is concerning for malignancy or torsion. Our study compares the outcomes of patients undergoing conservative and surgical management of gynecological hemoperitoneum found to be associated with RCLC. We performed a retrospective chart review of non-pregnant patients with a diagnosis of hemoperitoneum, corpus luteum cyst rupture, or follicular cyst rupture of the ovary between September 2007 and January 2013. The clinical characteristics, laboratory findings, and radiological findings of the women hospitalized and conservatively monitored or who underwent laparoscopy or laparotomy were reviewed for short-term and long-term adverse outcomes. Data were analyzed using Fisher's exact test or chi-square test for categorical data and the Mann-Whitney *U* test for continuous data between the comparison groups. Of 30 women appearing with gynecological hemoperitoneum associated with an adnexal cyst, 5 (17 %) underwent conservative management and 25 (83 %) underwent surgical management including laparotomy

($n = 11$, 37 %) and laparoscopy ($n = 14$, 47 %). Patients predominantly presented with pelvic or abdominal pain (93 % of patients). On imaging, RCLC (or ovarian mass) was visualized on the left side in 50 % of the cases. Women younger than 30 years old were more likely to be conservatively managed ($p = 0.045$) and all cases of radiological concern for malignancy were surgically managed. The correct diagnosis of RCLC was made preoperatively in only 40 % of surgically managed cases. No significant difference was seen in either short-term or long-term outcomes between the two groups. RCLC is a difficult diagnosis that can appear similar to torsion or malignancy on imaging and can prompt surgical management. Though our study size was small, there was no significant difference between conservative and surgical management options in terms of short and long-term adverse outcomes in the management of ruptured corpus luteum cyst-associated hemoperitoneum.

Keywords Hemoperitoneum · Ruptured corpus luteum cyst

Introduction

Appropriate evaluation of hemoperitoneum is an important clinical issue in gynecology practice because of the potential need for emergent surgical intervention. A ruptured corpus luteum cyst (RCLC) is the major cause of gynecological hemoperitoneum and can be a life-threatening surgical condition which can occur at all stages of a woman's reproductive life. The diagnosis is mainly based on high clinical suspicion, laboratory data, and ultrasound findings. Most ruptures are associated with unilateral lower abdominal pain, thought due to blood seeping into the ovary and stretching the ovarian cortex. Pain often begins during strenuous physical activity, such as exercise or sexual intercourse. Ectopic pregnancy,

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ruptured tubo-ovarian abscess, ovarian mass torsion, and other cystic ovarian disorders are the major differential diagnoses for RCLC [1].

Ultrasonography, computed tomography (CT), and magnetic resonance (MR) imaging can often aid in diagnosis and risk assessment. However, given the various sonographic and radiographic appearances for hemorrhagic corpus luteum cysts, they have been referred to as “the great imitator” and may not be easily or definitively diagnosed via imaging [2, 3].

The clinical presentation of RCLC is variable, ranging from a benign asymptomatic state to clinical shock. While mild cases of RCLC require only clinical observation and support, surgical intervention is necessary for severe cases of RCLC with hemodynamic instability. A standardized management of RCLC is not defined in relatively stable cases [4]. RCLC can be defined as either uncomplicated or complicated. RCLC is uncomplicated in the absence of hypotension, tachycardia, fever, signs of an acute abdomen, leukocytosis, or sonographic evidence of an enlarging hemoperitoneum. Prior studies have indicated that uncomplicated cases can be managed conservatively with oral analgesia given as needed or with observation [5]. RCLC is complicated when vital signs become abnormal and significant hemoperitoneum is suspected either by clinical, laboratory, or radiological findings. Complicated RCLC patients should be hospitalized with fluid replacement, frequent vital signs, serial hematocrit levels, and repeated imaging to monitor bleeding. If the patient’s clinical condition is unstable or deteriorating, surgery should be performed to control hemorrhage [6]. Generally, surgical intervention happens in a majority of the cases and can be as high as 80 % of cases involving RCLC [7] given the appearance of RCLC can be similar to malignancy. Laparoscopic management of gynecologic hemoperitoneum has become a preferred choice of surgical treatment over laparotomy with shorter hospital stays, shorter operative times, improved wound care, and less postoperative pain [1, 7].

The aim of this study was to assess the long-term and short-term complications of conservative versus surgical management of stable hemoperitoneum associated with RCLC. Another aim of this study was to better define clinical characteristics, laboratory findings, and radiological findings that are associated with conservative versus surgical management of gynecological hemoperitoneum found to be associated with RCLC.

Materials and methods

Charts of patients treated at Magee-Womens Hospital (Pittsburgh, PA) with the diagnosis of “hemoperitoneum,” “corpus luteum cyst,” or “follicular cyst of the ovary”

between January 2007 and January 2013 were identified using diagnosis codes via the inpatient electronic medical record system. Inclusion criteria included women with gynecological hemoperitoneum who were admitted inpatient and conservatively managed or underwent laparoscopy/laparotomy for management of the gynecological hemoperitoneum associated with adnexal cyst. Additionally, cyst diagnosis had to be very likely or confirmed RCLC as diagnosed by intraoperative evaluation (if the patient underwent surgery) for the patient case to be included. Exclusion criteria included pregnancy and intraoperative findings inconsistent with RCLC (i.e., malignancy, ruptured appendix, ruptured ectopic, follicular cyst, or endometrioma).

The demographic, clinical, and radiological data of eligible patients were collected. Radiological reports were reviewed rather than radiological images. Demographics included age, parity, race, marital status, body mass index, past medical, and surgical history. Clinical characteristics included initial hemoglobin level, side of rupture, physical exam findings, recent anticoagulation or oral contraceptive use, fluid volume seen on ultrasonography, and cyst size (largest dimension noted on imaging). Other details included mean hematocrit, hemoglobin, and white blood cell change during admission, transfusion rate, mean hospital stay, surgical method chosen, as well as conversion rate (laparoscopy to laparotomy).

Short-term complications were defined as transfusion, postoperative bleeding, visceral organ injury, re-operation, re-hospitalization, and infections requiring treatment within 3 months of the original admission. Long-term complications were defined as complications occurring between 3 months and 2 years after surgery and included any fertility problems, pregnancies, abortions, and visits for menstrual irregularity and anemia following their surgery. These complications were compared between the conservatively and surgically managed patients. We used the electronic medical system to assess all patient outcomes in our inpatient and outpatient EMR for the full postoperative period of 2 years (ending in December 2014).

Descriptive statistics were reported using median with interquartile range for the continuous data and frequencies with percentages for the categorical data. Data were analyzed using Fisher’s exact test or chi-square test for the categorical data and the Mann-Whitney *U* test for the continuous data between the comparison groups. A *p* value <0.05 was considered significant. Multivariate analyses were not performed given the small sample size. Statistical analyses were performed with SPSS V21 by statisticians at the Clinical and Transitional Scientific Institute (CTSI). This study was approved and performed in accordance with the ethical standards of the University of Pittsburgh Institutional Review Board: IRB# PRO12010497.

Results

We reviewed 419 charts with the diagnosis of “hemoperitoneum,” “corpus luteum cyst,” or “follicular cyst of the ovary.” Using our inclusion and exclusion criteria, 30 patients were selected from the chart review. Among the 30 patients selected, 5 patients (17 %) were conservatively managed and 25 patients (83 %) underwent surgical management including laparoscopy ($n = 14$, 46.6 %) or laparotomy ($n = 11$, 36.6 %). Laparoscopy numbers include 1 patient who underwent initial diagnostic laparoscopy which resulted in a mini-laparotomy due to lack of visualization and difficulty with pneumoperitoneum. This accounted for a 7 % ($n = 1$) conversion rate from laparoscopy to laparotomy. Laparotomy numbers include 1 patient who was initially conservatively managed for RCLC but then converted to surgical management due to increasing pain and concern for possible malignancy (this case was analyzed with the surgical management group).

The two groups (conservative and surgical management groups) were found to be similar when comparing demographic and reproductive characteristics (BMI, race, marital status, obstetrical history). Younger age (<30 years old) was significantly associated with conservative treatment ($p = 0.045$) (Table 1).

Notably, 93 % of the patients presented with abdominal or pelvic pain and the suspected rupture was on the left side in 63 % of the patients on physical examination. Although the antecedents of pain were rarely documented ($n = 8$), sexual intercourse ($n = 5$, 63 %) and exercise ($n = 3$, 37 %) were found to be two major antecedents of pain. There was no statistically significant difference between those who were conservatively or surgically managed when evaluating any association with their presenting characteristics including abdominal pain, pelvic pain, shoulder tenderness, lightheadedness, nausea or vomiting, rebound tenderness, or cervical pain. There was also no association between initial hemoglobin, hematocrit, or white blood cell count levels of the surgically versus conservatively managed RCLC cases. The menstrual cycle status was known only in four of the patients, and all of which were at the luteal phase at the time of clinical presentation with pain.

Out of the 5 cases managed conservatively, 1 case was evaluated by ultrasound (US), 1 case evaluated by CT scan, and 3 cases evaluated by a combination of US and CT scan. Out of the 25 cases managed surgically, 6 cases were evaluated by US alone, 8 cases were evaluated by CT alone, 8 cases were evaluated by both US and CT scan, and 2 cases were evaluated by US in combination with MRI. There was 1 case managed surgically that was evaluated by outside imaging of unknown type. During the assessment of effect of radiologic findings on management options, there appeared to be an association between

larger cyst size and preference of surgical management (conservative management mean cyst size 3.1 cm (SD 0.97 cm) versus surgical management mean cyst size 5.5 cm (SD 5.2 cm)) though the association was not statistically significant ($p = 0.33$). The 5 patient cases with radiological readings concerning for malignancy were all managed surgically (4 via laparotomy, 1 via laparoscopy). The comparison of other radiological findings (fluid volume, fluid location in abdomen) did not reveal a statistically significant association between the conservatively and surgically managed groups (Table 2). Based on radiologic interpretations, 50 % of possible RCLC/ovarian masses were noted to be on the left side.

Approximately 45 % of surgical procedures ($n = 5$) were performed by gynecological oncology surgeons due to concerns regarding possible malignancy on imaging. With regard to the other cases managed by laparotomy, 1 was done due to extensive prior surgery and anticipated difficulty with adhesions, 1 was done due concern for torsion, and the remaining 5 were done due to surgeon preference. Please note that laparoscopy is the standard of care at our hospital for first choice management of a ruptured hemorrhagic corpus luteum; however, some surgeons still prefer to start with laparotomy due to comfort with that method and if they are concerned about a diagnosis other than RCLC. The correct diagnosis of RCLC was made preoperatively in only 40 % of surgically managed cases (8 out of 14 laparoscopic cases (57 %), 2 out of 11 laparotomy cases (18 %, with leading preoperative diagnoses being “complex adnexal mass,” “adnexal mass,” or “hemoperitoneum”). RCLC was the diagnosis in 100 % of the 5 conservatively managed cases (though these diagnoses were not surgically confirmed).

Surgical management involved total abdominal hysterectomy/bilateral salpingo-oophorectomy (BSO) in 3 cases (all performed by oncologists given concern for malignancy), 1 case of BSO, 4 cases of unilateral salpingo-oophorectomy, 2 cases of salpingectomy, and 10 cases of diagnostic laparoscopy or laparotomy +/- evacuation of hemoperitoneum and +/- cautery of cyst bed. Four cases involved ovarian cystectomy and 1 surgical case resulted in a prophylactic appendectomy (joint case with general surgery). The average hemoperitoneum volume as noted on operative report was 650 cm³ (SD 439 cm³, $n = 9$) for laparoscopy and 783 cm³ (SD 711 cm³, $n = 6$) for laparotomy procedures. The discrepancy in sample sizes for hemoperitoneum volume is because many operative notes did not include an estimate. Average surgical time for laparoscopy cases was 70 mins (SD 37 min, $n = 12$) and laparotomy cases was 77 mins (SD 55 min, $n = 11$).

There were no significant differences in short-term complications (transfusion, postoperative bleeding, visceral organ injury, re-operation, re-hospitalization, and infection) between RCLC that was conservatively or surgically managed. Three

Table 1 Demographics and reproductive characteristics of conservative versus surgical management of RCLC

	Conservative (n, %) N = 5	Surgical (n, %) N = 25	p value
Age			
≤30 years	5 (100)	11 (44)	
>30 years	0 (0)	14 (56)	0.045
BMI			
≤25	3 (60)	15 (60)	
25–30	1 (20)	3 (12)	
>30	1 (20)	7 (28)	1.000
Race ^a			
Caucasian	5 (100)	21 (88)	
African American	0 (0)	3 (12)	1.000
Sexual activity ^a			
Sexually active	2 (67)	11 (85)	
Not sexually active	1 (33)	2 (15)	0.489
Marital status			
Married	1 (20)	11 (44)	
Not married	4 (80)	14 (56)	0.622
Obstetrical history ^a			
Nulliparous	3 (60)	7 (32)	
Parous	2 (40)	15 (68)	0.326
Surgical history ^a			
No surgical history (abdominal or ovarian)	4 (80)	10 (53)	
Abdominal or ovarian surgery history	1 (20)	9 (47)	0.358
Oral contraceptives ^a			
No	4 (80)	22 (92)	
Yes	1 (20)	2 (8)	0.446
Anticoagulation ^a			
No	5 (100)	23 (96)	
Yes	0 (0)	1 (4)	1.000

^a Indicates missing data from some subjects' records; total N does not equal to 30

cases of infection were noted, including 1 PID treatment in conservative group, 1 wound cellulitis, and 1 suspected wound infection in surgery group. There were also no significant differences in long-term complications (fertility problems, pregnancies, abortions, and visits for menstrual irregularity and anemia) between RCLC that was conservatively or surgically managed. (Table 3) The three readmissions within 3 months of the initial admission were due to an episode of pyelonephritis, poor pain control, and a wound infection, respectively. There were 2 re-hospitalizations at greater than 3 months of initial admission that involved a case of recurrent hemorrhagic cyst rupture and pelvic pain associated with endometriosis and a case of a cystectomy for a benign ovarian cyst. There was no significant difference RCLC between the hemoglobin, hematocrit, or white blood cell changes in the postoperative course between the two groups.

Conclusion

In the literature regarding the management of RCLC and hemoperitoneum, we did not find a standardized management algorithm and noted a paucity of data in regard to the topic. We have found in our retrospective chart review that RCLC is truly a “great imitator” and difficult to diagnose with certainty on initial presentation and with imaging. We found the management is often dependent upon initial diagnosis and that a RCLC can be often confused with torsion or malignancy therefore making surgical management more likely.

General recommendations for RCLC include conservative management of stable hemoperitoneum/uncomplicated RCLC and surgical management of complicated RCLC involving abnormal vital signs, significant hemoperitoneum by clinical or radiological exam, or abnormal laboratory values. Other surgical indications include cysts greater than

Table 2 Radiologic findings with conservative versus surgical management of RCLC

	Conservative (<i>n</i> , %) <i>N</i> = 5	Surgical (<i>n</i> , %) <i>N</i> = 25	<i>p</i> value
Laterality ^a			
Right	1 (20)	9 (39)	
Left	3 (60)	12 (52)	
Bilateral	1 (20)	2 (9)	0.647
Radiologic possibility ^a			
Hemorrhagic cyst	2 (40)	15 (65)	
Malignancy	0 (0)	5 (22)	
All others (dermoid vs. endometrioma vs. torsion)	3 (60)	3 (13)	0.103
Fluid volume ^{a, b}			
Minimal-trace (% by ROW)	2 (50)	2 (50)	
Moderate	1 (20)	4 (80)	
Large	2 (40)	3 (60)	0.800
Fluid location ^a			
Cul de sac			
Yes	1 (20)	9 (38)	
No	4 (80)	15 (62)	0.633
Morison's pouch			
Yes	4 (80)	16 (67)	
No	1 (20)	8 (33)	1.000

^a Indicates missing data from some subjects' records; total *N* does not equal to 30

^b Fluid volume noted was either free fluid or hemoperitoneum as interpreted by radiologist

5 cm in diameter, a failure of a cyst to resolve or decrease in size spontaneously, complex or solid cysts indicative of suspected malignancy, history of anticoagulation therapy, severe persistent abdominal pain, and complications such as ovarian torsion, active hemorrhage, or infarction [8–10]. In our study, we noted surgical management was associated with concern for malignancy on imaging or if the preoperative diagnosis of the adnexal cyst was uncertain.

In our study, we found that younger women, aged less than 30 years old, were more likely to be conservatively managed. This is not unexpected given they are women who are less likely to be at risk for malignancy and more likely have not had prior surgery, common factors for providers to hesitate to proceed with surgery. We also found that cysts of a larger size, on average 5 cm in largest dimension radiologically, tended to be associated with surgical management, though results were not statistically significant. This result is likely due to concern for larger cysts being more concerning for malignancy and to cause patient symptoms. A prior study had shown that hemorrhagic corpus luteum cysts can vary greatly in size, from 2.5 to 10 cm [11], with one reported mean 5.12 ± 1.33 cm [12].

Prior literature with a select group of patients that specifically presented with hemoperitoneum secondary to ruptured corpus luteum cysts had reported an 80 % surgical management rate which was similar in our study. Interestingly, in a recent study by Kim et al., 80 % of the patients presenting with

RCLC and hemoperitoneum were managed conservatively. In their study, they found that low diastolic and systolic blood pressures and large hemoperitoneum (measured as depth of total pelvic fluid collection on CT) were significantly associated with surgical management [13]. Again, a confounder in our study involves the appearance of the RCLC being frequently concerning for malignancy, thus prompting surgical management (20 % of those surgically managed were operated on by oncology surgeons). There is no literature addressing whether concern for possible malignancy is a common reason for surgical management of RCLC. However, there has been research regarding better delineating RCLC from malignancy. Patel et al. have examined whether RCLC may have miscellaneous US features which can differentiate it from ovarian neoplasms and may be useful in avoiding unnecessary surgery. They found that RCLC are more likely to have fibrin strands or a retracting clot (90%) compared to malignancy [12].

Notably 50 % of patients presented with imaging concerning for RCLC or ovarian masses on the left side which is different from prior literature indicating a dextrapreponderance of cyst rupture [14]. Ninety-three percent of our patients presented with abdominal or pelvic pain in accordance with prior studies associating RCLC with sharp and sudden onset abdominal or pelvic pain [10, 15]. Though antecedents to pain were infrequently documented in our study EMR, we found that there was an

Table 3. Complications in conservative versus surgical management of RCLC

	Conservative (<i>N</i> , %)	Surgical (<i>N</i> , %)	<i>p</i> value
Hospital stay			
≤2 days	4 (80)	17 (68)	
≥3 days	1 (20)	8 (32)	1.000
Antibiotic administration			
No	3 (60)	17 (68)	
Yes	2 (40)	8 (32)	1.000
Short-term complications			
Transfusion			
No	4 (80)	19 (75)	
Yes	1 (20)	6 (25)	1.000
Readmission			
No	4 (80)	23 (92)	
Yes	1 (20)	2 (8)	0.446
Infection			
No	4 (80)	23 (92)	
Yes	1 (20)	2 (8)	0.446
Long-term complications			
Menstrual irregularity			
No	5 (100)	22 (84)	
Yes	0 (0)	3 (16)	1.000
Readmission			
No	5 (100)	23 (90)	
Yes	0 (0)	2 (10)	1.000
Subsequent childbirth			
No	4 (80)	21 (84)	
Yes	1 (20)	4 (16)	1.000

association of RCLC with history of recent sexual intercourse, similar to prior studies [7, 10]. We also found an association of RCLC with recent exercise. We noted an association of onset of RCLC and symptoms during the second half of the menstrual cycle which has been previously noted in the literature [7]. Unfortunately, our sample sizes for these observations were not large given a majority of history and physicals did not have this data for our review. This is particularly interesting as details regarding the onset of pelvic pain and date of last menstrual period are considered important parts of a gynecological history.

In our study, there appeared to be no significant statistical difference noted in terms of adverse outcomes (short term or long term) in the management of stable hemoperitoneum between conservative versus surgical management options.

One strength of this study is that our institution is a high volume tertiary care center where many cases are referred. These cases reflect a good sample size for the condition of gynecological hemoperitoneum associated with RCLC and encompass a broad patient demographic. In addition, for all the patients, we had access in our EMR to review any long-term complications for up to 2 years after the initial admission.

Limitations of this study include the study size and the cases being limited to one institution. Additionally, because our institution is a tertiary care center where cases are referred, it is possible that patients who had postoperative complications, short-term or long-term, may not have presented back to our hospital system. We were only able to identify 30 cases in the 6-year period involving RCLC and a hospital admission without proof of pregnancy. It is possible there were patients who were applicable to this study that were never admitted and managed conservatively on an outpatient basis. Another limitation is the variability of imaging technique used to determine size of cyst and extent of hemoperitoneum, with modalities ranging from ultrasound to CT scan and MRI. Thus, there was no standardized form of measurement of cyst size. We are also limited by retrospective nature of this review and that the correct diagnosis of RCLC was made preoperatively in only 40 % of surgically managed cases; thus, management styles were not specific to a uniform initial or preoperative diagnosis. Finally, some patients were transferred from an outside hospital system and may have resumed care after discharge at an outside hospital system; thus, the follow-up information available in our EMR may be limited.

Additional research of gynecological hemoperitoneum associated with RCLC in both outpatient and inpatient settings is needed to further assess whether conservative management is similar in outcome to surgical management. Areas for further research could include comparison of admission vital signs between those that were conservatively and surgically managed as well as further research into whether concern for possible malignancy (usually prompted to be characteristics found on imaging) is a risk factor for a majority of surgically managed cases.

In conclusion, we found that there is considerable variability on initial diagnosis for RCLC and that concern for other diagnoses, particularly malignancy, can prompt surgical management rather than conservative management. There appears to be no significant adverse outcomes when managing stable hemoperitoneum associated with RCLC with conservative management versus surgical management though our study size was small. We would recommend providers to carefully consider patient history, age, and imaging details when deciding whether to take a patient to surgery. We urge providers to consider conservative management as the first line option even with large cyst size and hemoperitoneum as long as the clinical picture is stable.

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Authors contribution JK Lee is responsible for project development, data analysis, and manuscript writing.

S Bodur is responsible for project development and manuscript editing.

R Guido is responsible for project development, data analysis, and manuscript writing.

Compliance with ethical standards

Conflict of interest Jessica K. Lee and Serkan Bodur report no conflict of interest. Richard Guido is currently affiliated with Gynesonics for which he is a local PI on the Sonata Trial.

Ethical approval This study was performed in accordance with the ethical standards of the University of Pittsburgh Institutional Review Board: IRB# PRO12010497 was approved on June 13, 2012.

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References

1. Teng SW, Tseng JY, Chang CK, Li CT, Chen YJ, Wang PH (2003) Comparison of laparoscopy and laparotomy in managing hemodynamically stable patients with ruptured corpus luteum with hemoperitoneum. *The Journal of the American Association of Gynecologic Laparoscopists* 10(4):474–477
2. Yoffe N, Bronshtein M, Brandes J, Blumenfeld Z (1991) Hemorrhagic ovarian cyst detection by transvaginal sonography: the great imitator. *Gynecological endocrinology: the official journal of the International Society of Gynecological Endocrinology* 5(2): 123–129
3. Swire MN, Castro-Aragon I, Levine D (2004) Various sonographic appearances of the hemorrhagic corpus luteum cyst. *Ultrasound quarterly* 20(2):45–58
4. Canis M, Bassil S, Wattiez A, Pouly JL, Manhes H, Mage G, Bruhat MA (1992) Fertility following laparoscopic management of benign adnexal cysts. *Hum Reprod* 7(4):529–531
5. Razieli A, Ron-El R, Pansky M, Arieli S, Bukovsky I, Caspi E (1993) Current management of ruptured corpus luteum. *Eur J Obstet Gynecol Reprod Biol* 50(1):77–81
6. Barnes A (2005) Nonsurgical management of a large hemoperitoneum from a ruptured corpus luteum: a 15-year study. *The Female Patient* 30(29)
7. Ho WK, Wang YF, Wu HH, Tsai HD, Chen TH, Chen M (2009) Ruptured corpus luteum with hemoperitoneum: case characteristics and demographic changes over time. *Taiwanese journal of obstetrics & gynecology* 48(2):108–112. doi:10.1016/S1028-4559(09)60267-9
8. S. Creighton DMB, D. Mervyn Griffiths, H.A. Steinbrecher (2005) *Pediatric and adolescent gynaecology, vol Paediatric Surgery (2nd ed.)*.
9. Valla JS (2006) *Gonadal tumors. Cambridge University Press, Paediatric Surgery and Urology: Long Term Outcome*
10. Jamal A, Mesdaghinia S (2002) Ruptured corpus luteum cysts and anticoagulant therapy. *International journal of gynaecology and obstetrics: the official organ of the International Federation of Gynaecology and Obstetrics* 76(3):319–320
11. Jain KA (2002) Sonographic spectrum of hemorrhagic ovarian cysts. *Journal of ultrasound in medicine: official journal of the American Institute of Ultrasound in Medicine* 21(8):879–886
12. Ding Z, Zhang D, Ying W, Wang J (2010) Sonographic value in diagnosis of hemorrhagic ovarian cysts. *Eur J Gynaecol Oncol* 31(1):87–89
13. Kim JH, Lee SM, Lee JH, Jo YR, Moon MH, Shin J, Kim BJ, Hwang KR, Lee TS, Bai KB, Jeon HW (2014) Successful conservative management of ruptured ovarian cysts with hemoperitoneum in healthy women. *PLoS One* 9(3):e91171. doi:10.1371/journal.pone.0091171
14. Tang LC, Cho HK, Chan SY, Wong VC (1985) Dextro-preponderance of corpus luteum rupture. A clinical study. *The Journal of reproductive medicine* 30(10):764–768
15. Hibbard LT (1979) Corpus Luteum surgery. *Am J Obstet Gynecol* 135(5):666–670