



Oncologic and reproductive outcomes of borderline ovarian tumors in Indian population

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ABSTRACT

Borderline ovarian tumor (BOT) is characterized by atypical epithelial proliferation without stromal invasion and majority are diagnosed at early stages and in women of reproductive age group. A retrospective review of medical records of patients diagnosed with BOT and on regular follow up at All India Institute of Medical Sciences New Delhi, during a five-year study period from March 2014 to March 2019 was performed. Surgical treatment was classified as radical, fertility sparing surgery (FSS) or cystectomy. Surgical staging was defined as complete, partial or unstaged. Median age of seventy-five women was 32 years. Follow up period ranged from 22 to 61 months (median 36 m). Radical surgery was done in 34 (45.3%), FSS in 32 (42.6%) and cystectomy in 9 (12.0%) women. Complete surgical staging was performed in 22 (29.3%), partial staging in 23 (30.6%) and 30 (40%) were unstaged. During the follow up period, 98.7% patients were alive and 90.7% were free of recurrence. Median time to recurrence was 35 months. Recurrence rate was 33.3% in cystectomy vs 6.2% in oophorectomy ($p = 0.03$). All seven recurrences were in unstaged (six) or partially staged patient (one). Six recurrences in ovary were salvaged by surgery and recurrent disease was of borderline histology. Spontaneous conception and live birth rate was 42.1%. FSS is a safe procedure and should be considered in a young patient with early stage disease and desirous of future fertility. Spontaneous conception and live birth rates after fertility sparing surgery in patients with BOT are modest.

1. Introduction

In 1929 Taylor HC suggested intermediate behavior of some epithelial ovarian tumors and referred them as “semi-malignant” (Taylor, 1929). Subsequently in 1971, the International Federation of Gynaecology and Obstetrics (FIGO) introduced the term “carcinoma of low malignant potential” and lastly World Health Organization (WHO) defined these mass lesions as “borderline ovarian tumor (BOT)” in 1973, which is used today.

Histologically they are characterized by atypical epithelial proliferation without stromal invasion (Seidman et al., 2002). They account for 10–15% of all epithelial ovarian tumors. Unlike invasive carcinoma, its prognosis is very good and 10-year survival rate is 99% for stage I, 98% for stage II, 96% for stage III, and 77% for stage IV. The majority of BOTs are diagnosed in early stage and 70–80% are diagnosed at stage I. The

main prognostic factors are the FIGO stage and type of peritoneal implants (with or without invasion) (Trimble et al., 2002).

Approximately one-third of women diagnosed with a borderline ovarian tumour are younger than 40 years of age and have pregnancy wishes (Skirnisdottir et al., 2008). This makes issues related to ovarian function and fertility preservation of increased importance. According to the National Comprehensive Cancer Network guideline, fertility sparing surgery (FSS), which preserves the uterus and at least one ovary, can be applied to patients with BOT across all stages (https://www.nccn.org/professionals/physician_gls/pdf/ovarian.pdf). In view of conflicting reports in the available literature data from different centers, we analyzed the outcomes at our institute. Also there is paucity of data from Indian subcontinent and majority of reported data is from developed nations. We wanted to review our data upon demography, clinicopathological characteristics, pattern of care, outcome of fertility sparing

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surgery and factors affecting long term outcome in this tumor in Indian population. We believe that the data retrieved from our study would shed more light on diverse opinions on the issue, especially concerning surgical treatment of these patients.

2. Method

2.1. Patient selection

A retrospective review of medical records of patients diagnosed with borderline ovarian tumor and on regular follow up in the Institute Rotary Cancer Hospital at All India Institute of Medical Sciences New Delhi, during a five-year study period from March 2014 to March 2019 was performed. Ethical approval was taken from the institute ethics committee vide reference number IECPG-187/20.05.2020. While 48 patients underwent a surgical procedure at our institution, 27 patients were referred to our institution for follow up or staging. The patients who were referred became eligible to be followed up in our department if central pathology review by expert gynaecologic pathologists confirm the diagnosis of borderline ovarian tumor. Detailed information regarding patient's characteristics (age, menopausal status, parity, comorbidities, presenting symptom, symptom duration, performance status, BMI, clinical exam findings) was extracted from the medical record.

2.2. Investigations

Preoperative tumor markers CA 125, CA 19.9 and CEA were documented. Ultrasonographic and CECT/MRI characteristics of the ovarian mass, size and other relevant findings were documented. Histological type was noted.

2.3. Treatment

Staging was in accordance with FIGO 2014 criteria. Date of surgery and center (if operated outside) were recorded. Surgical treatment was classified as radical, fertility sparing or cystectomy. Surgical staging was defined as complete, partial or unstaged. Radical surgery was defined as hysterectomy with bilateral salpingo-oophorectomy (Hys + BSO). Fertility sparing surgery (FSS) was defined as any surgery that preserved uterus and at least one ovary. Patients who underwent cystectomy were evaluated separately from those underwent oophorectomy as the reported recurrence rates are higher in the cystectomy group. Complete surgical staging included cytological washings, omentectomy or omental biopsy, random peritoneal biopsies, and lymph node evaluation (pelvic and/or para-aortic lymphadenectomy or sampling). Incomplete staging was defined as surgeries missing any of the above four steps. Patients with insufficient surgico-pathologic information or missing all the above four steps were classified as unstaged.

2.4. Follow up

Follow up of the patients included clinical examination, ultrasonography if indicated, and serum CA 125 levels every 3 months for the first two years following surgery and every 6 months for next 3 years, and yearly from then on. Follow up duration was obtained. Interval and site of recurrence and surgical management at recurrence was documented. Recurrence free survival and overall survival was calculated. Recurrence free survival was defined as the time from surgical resection to date of recurrence or death from any cause. Overall survival was defined as the time from surgical resection to death from any cause.

2.5. Reproductive outcome

Among patients who underwent FSS and had a desire for future fertility, reproductive outcomes were assessed e.g. time to regain

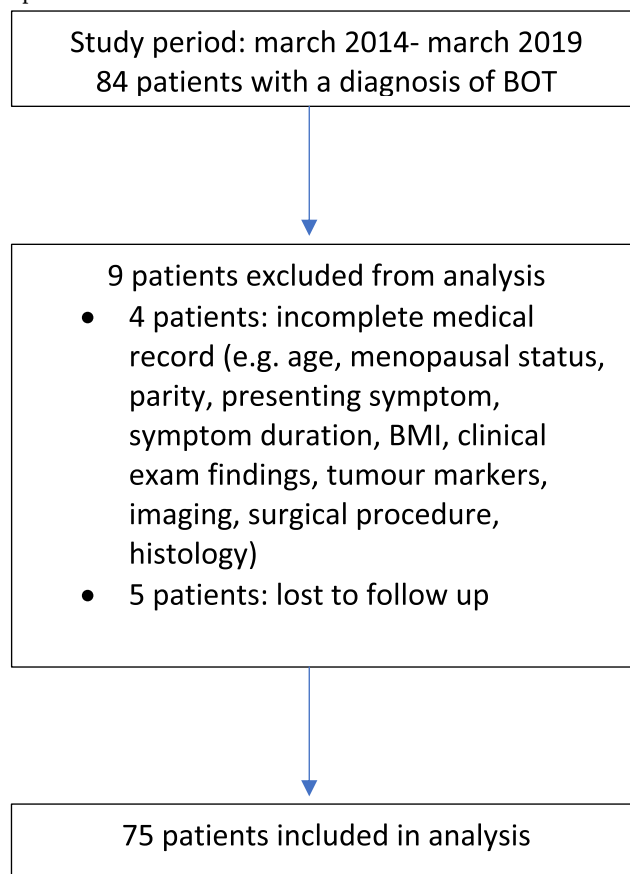
menses, time to spontaneous conception, number of abortions, number of term pregnancies, proportion of cases with infertility and their current management. We confirmed this information and status of patients by direct telephone interview.

2.6. Statistical analysis

Data was analyzed using SPSS software (version 18.0, SPSS, inc, Chicago, IL) and included descriptive statistic. Chi-square and Fisher exact tests were used as appropriate to evaluate proportions for statistical significance. Survival analysis was done using Kaplan Meier method. The cut-off for statistical significance was set at $p < 0.05$.

3. Results

Total 75 patients were included in the analysis. The selection criteria is depicted in the flow chart below.



Flow chart depicting the selection process

3.1. Clinical characteristics

The median age of seventy-five women was 32 years (range 17–67 years). Follow up period ranged from 22 to 61 months with a median of 36 months. Fifty-nine women (79%) were premenopausal and sixteen (21%) postmenopausal. Of the 59 premenopausal women, 17 were unmarried. Of the rest 42 premenopausal women, 15 nullipara and 4 primipara had future fertility wishes. Only 24 (32%) patients had a normal BMI and rest 51 (68%) were overweight or obese. Abdominal pain was the most common presenting symptom in 23 (32%) followed by abdominal distension in 10 (13%) patients. Median symptom duration was of four months (range 1–60 months). Clinically the mass was cystic in 35 (47%), cystic to firm in 19 (25%), firm in 2 (3%) and hard in 1 (1%) patient. Radiologically the ovarian mass ranged from 2 to 28 cm in size with a median of 13 cm in long axis. Complex ovarian mass was the

Table 1
Clinical and histopathological characteristics of patients with borderline ovarian tumor treated by surgery.

	Alive with NED	Recurrence treated by surgery	Died of recurrent disease	Total
Number of patients	68	6	1	75
Histological type				
Mucinous	32	3	1	36 (48%)
Serous	33	2		35 (46%)
(a) With invasive implants	3			
(b) With noninvasive implants	2	1		
Seromucinous	4 (5%)			4 (5%)
Stage				
IA	51	4 (unstaged)	1 (unstaged)	56 (74.6%)
IB	5	1 (unstaged)		6 (8.0%)
IIIA	3			3 (4.0%)
IIIB	3	1 (partial staged)		4 (5.3%)
IIIC	2			2 (2.6%)
Surgical procedure				
Radical	33	1		34 (45.3%)
FSS	29	2	1	32 (42.6%)
Cystectomy	6	3		9 (12.0%)
Staging Laparotomy				
Unstaged	24	5		30 (40%)
Partial staging	22	1		23 (30.6%)
Complete staging	22			22 (29.3%)

NED = no evidence of disease, FSS = fertility sparing surgery.

common radiological finding in all patients with omental deposits in two and enlarged pelvic nodes in one patient. Serum tumor marker CA 125 was raised >35 U/ml in only 46 (61%) patients, median value reached was 61 U/ml (range 4–100,000 U/ml). Median values of CEA and CA19.9 were 1.5 ng/ml (range 1–4900 ng/ml) and 12.9 U/ml (range 0–254 U/ml). Intraoperative appearance of mass was solid cystic in 27

Table 2
Characteristics of patients with recurrence.

Pt	Age at diagnosis	Parity	FIGO stage	Histology	Initial surgery	Interval to recurrence (months)	Recurrence site	Salvage surgery	Follow up (months)
1	21	NA (unmarried)	Unstaged	BST	B/L cystectomy	32	Ovary	Hys + BSO + PLND	110
2	24	NA (unmarried)	Unstaged	BMT	USO	12	Abdominal cavity leading to carcinomatosis ileus	–	12 Expired
3	38	Multipara	Unstaged	BST (Noninvasive implants at salvage surgery)	USO	102	Ovary	Hys + USO + ICO	139
4	46	Multipara	IIIB Partial staging	BST	PWC + hys + USO + ICO	136	Ovary	USO + PLND	16
5	27	Multipara	Unstaged	BMT	Cystectomy	37	Ovary	USO	85
6	49	Primipara	Unstaged	BMT	USO	35	Ovary	Hys + USO + ICO + PLND	51
7	21	NA (unmarried)	Unstaged	BMT	Cystectomy	11	Ovary	USO + PLND + ICO	23

NA = not applicable, BST = borderline serous tumour, BMT = borderline mucinous tumour, B/L = bilateral, USO = unilateral salpingo-oophorectomy, ICO = infracolic omentectomy, PLND = pelvic lymph node dissection.

(36%) followed by presence of papillae in 20 (27%), multi-loculated cyst in 14 (19%) and rest 14 (19%) were cyst with thin septae.

3.2. Oncologic outcomes

3.2.1. Stage and recurrence

Fifty six (74.6%) patients were stage 1A, six (8%) IB, three (4%) IIIA, four (5.3%) IIIB and two (2.6%) were IIIC. Of the six salvaged recurrences four were in patients with stage IA, one stage IB and one stage IIIB disease. These findings are depicted in [Tables 1 and 2](#).

3.2.2. Surgical treatment and recurrence

Radical surgery (Hys + BSO) was done in 34 (45.3%), Fertility sparing surgery (sparing uterus and at least one ovary) in 32 (42.6%) and cystectomy in 9 (12.0%) women. Of them one patient in radical surgery, two in FSS and three in cystectomy group had recurrence which was salvaged by surgery. One patient in FSS group expired due to recurrent disease.

Complete surgical staging was performed in 22 (29.3%), partial staging in 23 (30.6%) and 30 (40%) were unstaged. One patient who expired from recurrent disease was unstaged. Five recurrences were observed in unstaged disease and one in partial staging. These findings are depicted in [Tables 1 and 2](#).

3.2.3. Histology and recurrence

Mucinous type was most common in 36 (48%) women followed by serous in 35 (46%) and sero-mucinous in 4 (5%). Other histological types were not observed. Among the serous type, implants were identified in 6 cases (17.1%). Half of the implants were invasive and other half were noninvasive. Of the seven recurrent cases, four (57.1%) was seen in mucinous type and three (42.8%) in serous variety. One mortality due to recurrent disease was observed in the case with mucinous histology. Of the six salvaged recurrences, 3 was in mucinous, 2 in serous with invasive implants and 1 with noninvasive implants. These findings are depicted in [Tables 1 and 2](#).

3.2.4. Follow up and survival

Median duration of follow up was 36 months (range 22–61 months). Seventy-four patients were alive and free of disease at the end of follow-up giving an overall survival of 98.7% in the study cohort. Out of 75 patients one (1.3%) patient experienced death and the overall restricted mean survival time (95% confidence limits) was 133 (95% CI 133–141) months. Since only one event (death) had occurred at 12 months, which was less than median follow-up duration, median survival time could

Table 3
Surgical procedure performed in 75 cases.

Complete staging ¹	22 (29.3)
Partial staging ²	23 (30.6)
• No cytological washings	6
• No omental biopsy/omentectomy	5
• No peritoneal biopsies	2
• No lymph node evaluation	10
Unstaged ³	30 (40.0)

Note: FSS/ Radical surgery not included as a component of staging and has been evaluated separately.

¹ Cytological washings, omentectomy or omental biopsy, random peritoneal biopsies, and lymph node evaluation (pelvic and/or para-aortic lymphadenectomy or sampling).

² Missing any of the above four steps.

³ Missing all of the above four steps.

not be calculated.

Survival without recurrences were observed in sixty-eight patients at the end of follow-up giving a recurrence free survival of 90.7% for the study cohort. Out of 75 patients followed 7 (9.3%) had recurrence of the diseases. Of the 68 patients who were followed restricted mean (95% CI) recurrence free survival was 116 (95% CI: 98–133) months. Median survival time with lower limit of 95% CI were 139 and 85 months respectively. Upper limit of median survival time could not be obtained due to the follow-up time limitation. However, estimated 5 years recurrence free survival was about 85% and 10 years recurrence free survival was about 53%.

3.2.5. Pattern of recurrence

Median time to recurrence was 35 months (range 11–136 months). Recurrences were more common in the cystectomy group as compared to oophorectomy. Recurrence rate was 33.3% in cystectomy compared to 6.2% in oophorectomy ($p = 0.03$).

All seven recurrences were in unstaged (six) and partially staged patient (one). Interval to recurrence was between 11 and 136 months. Four patients recurred in mucinous and three in serous histology. Site of recurrence was ovary in six patients and peritoneal cavity in one patient who presented with carcinomatosis ileus at twelve month and expired. All six recurrences in ovary were salvaged by surgery and patients were alive at follow up (range 16–139 months). Recurrent disease was of borderline histology in all six operated patients.

3.3. Reproductive outcomes

Among all women who underwent FSS or cystectomy ($n = 41$), median time to regain menses was one month (range 1–5 months). Of the 42 premenopausal (reproductive age) women, 15 nullipara and 4 primipara were desirous of future fertility. Of them eight (42.1%) conceived spontaneously between four to twenty four months and gave birth to healthy babies. Of the rest eleven women, three were not trying to conceive, henceforth infertility was present in eight women (42.1%) and three of them were taking ovulation inducing drugs to become pregnant at last follow up.

Almost two-thirds of patient population was unstaged or incompletely staged. Table 3 depicts the surgical procedure performed in all cases. Among the twenty-three cases who were partially staged, cytological washings was missing in six cases, omental biopsy/omentectomy was missing in five cases, peritoneal biopsies was missing in two cases and lymph node evaluation (pelvic and/or para-aortic lymphadenectomy or sampling) was missing in ten cases. Thirty cases were unstaged and they had no record of undergoing above four staging procedures.

4. Discussion

In young women, borderline tumors are more common than invasive

ovarian tumors. Approximately half of these tumors are diagnosed in women younger than 40 years (Skirnisdottir et al., 2008). In our series, the median age was 32 years and more than two third, i.e. fifty-nine women (79.0%) were premenopausal. This is similar to other reported studies (Morris et al., 2000; Morice et al., 2001). Clinical presentation is same as that of other adnexal masses and usually there is pain or distension. In our study, pain abdomen was the most common symptom in 23 (32%) of patients. CA 125 does not appear to be useful in the detection of a borderline ovarian tumor as it was raised >35 U/ml in only 46 (61%) patients and median value reached was 61 U/ml. In a retrospective series of over 1000 women, half of all had a normal CA 125, and less than 25% had levels >100 units/mL (Ochiai et al., 1998). The sonographic appearance of borderline ovarian tumors range from unilocular cysts to masses with both solid and cystic components and papilla are a common finding (Exacoustos et al., 2005). In our study all the masses were having a complex morphology on ultrasound. The gross appearance of a borderline tumor includes papillary excrescences which were present in 27% of our cases.

The majority of cases are either serous or mucinous. Rarely endometrioid, clear cell, or transitional cell (Brenner) types are found (Trimble and Trimble, 2003). In current study mucinous type was most common in 36 (48%) women followed by serous in 35 (46%) and seromucinous in 4 (5%).

The majority of cases are diagnosed at stage I. In our study also fifty-six (74.6%) patients were stage IA, six (8%) IB, three (4%) IIIA, four (5.3%) IIIB and two (2.6%) were IIIC. In a literature review of 948 cases, 70% presented as stage I, 10% as stage II, 19% as stage III, and less than 1% presented as stage IV (Tinelli et al., 2006).

4.1. Role of staging

FIGO staging is the same as that of invasive ovarian tumors and was last revised in 2014. Advantages of complete staging includes upstaging and detection of advanced disease, and better prognostication of disease (Gershenson, 2002). Higher stage disease is the major risk factor associated with recurrence and prognosis (Trimble et al., 2002). In one study of presumed stage I serous borderline tumor, comprehensive staging procedure performed after an initial non-staging procedure, upstaging was seen in 12–47% cases (Fauvet et al., 2004). In our study complete surgical staging was performed in 22 (29.3%), partial staging in 23 (30.6%) and 30 (40%) were unstaged. Among our patients, there were seven recurrences which included one mortality. Of six salvaged recurrences four were in patients with apparent stage IA, one stage IB and one stage IIIB disease. Of note five of them were unstaged and the one in stage IIIB was only partially staged. In the five unstaged cases, the site of recurrence was ovary of which three had undergone cystectomy and two underwent USO. In the patient with stage IIIB disease who was partially staged (missing lymph node evaluation), the site of recurrence was ovary. This depicts that the commonest site of recurrence is ovary and patients undergoing cystectomy or FSS need to be carefully counselled. However all the recurrences in ovary were salvaged by surgery. Patient who expired from recurrent disease was unstaged and had undergone USO and peritoneal cavity was the site of recurrence however no conclusion can be drawn from one case. Camatte et al. compared early stage borderline ovarian tumors with incomplete and complete peritoneal staging. Eight percent recurrence was observed in incompletely staged group and none in completely staged group (Camatte et al., 2004). These findings might suggest a need for complete staging adapted to clinical situation in these patients.

4.2. Cystectomy vs oophorectomy

We observed a recurrence rate of 33.3% in cystectomy (3 out of 9) compared to 6.2% (4 out of 65) in oophorectomy ($p = 0.03$). USO appears to be an option for women with unilateral disease (Boran et al., 2005; Morice et al., 2001; Suh-Burgmann, 2006). The overall risk of

Table 4

Published studies in the last two decades with a large sample size (>50 cases) comparing the oncologic and reproductive outcome in BOT.

Author (year)	Type of study	Sample size (n)	Radical surgery (n)	FSS (n)	Median follow up (month)	USO (n)	Cys (n)	Oncologic outcomes					Fertility outcomes		
								Recurrence (%)	Recurrence USO (n)	Recurrence cys (n)	Death (n)	Survival	Willing for pregnancy (n)	Pregnant (n)	Rate (%)
Morris et al. (2000)	Retrospective	518	475	43	5.7 years	31	12	33	7, 23%	7, 58%	1	–	24	12	50
Morice et al. (2001)	Retrospective	179	135	44	–	33	11	29.5 Radical- 5.7	15.1%	36.3%	0	–	14	12	86
Zanetta et al. (2001)	Prospective	339	150	189	70	–	–	FSS-18.5 Radical-4.6 Invasive disease- 2	–	–	DOD-2 Other causes- 10	DFS Stage I-99.6% Stage II-95.8% Stage III-89%	–	–	–
Prat and Nictolis (2002)	Retrospective	137	90	21	7 years	–	–	FSS-9.5 Radical-8.8	–	–	4	–	–	–	–
Camatte et al. (2002)	Retrospective	68	–	68	71	47	21	16	11%	21%	0	–	29	19	60
Maneo et al. (2004)	Retrospective	479	417	62	77	28	34	27	3	8	–	–	–	–	–
Boran et al. (2005)	Retrospective	142	80	62	44	40	22	FSS-7	1	3	0	–	25	10	40
Longacre et al. (2005)	Retrospective	276	223	53	>5 years	–	–	FSS-17 Invasive disease-6.8	–	–	0	OS-95% DFS-78%	–	–	–
Fauvet et al. (2005)	Retrospective	360	198	162	–	–	–	17	–	–	0	–	62	31	32
Suh-Burgmann (2006)	Retrospective	193	–	193	6.4 years	143	46	11 Invasive disease-1	7	23	1	–	–	–	–
Romagnolo et al. (2006)	Retrospective	113	60	53	44	32	21	11.5	7	6	1	DFS- 87%	12	7	58
Yokoyama et al. (2006)	Retrospective	111	68	43	57	35	8	0.7	3	3	0	10-year DFS radical-89.1% Conservative-57.4%	–	–	–
Yinon et al. (2007)	Retrospective	62	–	62	88	40	22	26	11	5	0	–	–	25	40
Wong et al. (2007)	Retrospective	247	131	116	21	78	38	2.4 FSS-3.3 Radical-1.6 Invasive disease-1.5	2	2	3	–	–	–	–
De Iaco et al. (2009)	Retrospective	168	83	85	–	50	35	FSS-26 Radical-6	10	12	0	PFS- Cystectomy-60% USO-78.4% Radical-93.5%	–	–	–
Park et al. (2009)	Retrospective	360	176	184	70	128	56	Radical-5.1 FSS-4.9	3	6	1	–	31	27	73
Kanat-Pektas et al. (2011)	Retrospective	55	–	55	61	36	19	5	1	2	0	–	44	23	52
Koskas et al. (2011)	Retrospective	74	–	74	59	47	27	15	3	8	3	–	31	12	38
Song et al. (2011)	Retrospective	155	–	155	56	117	38	8	7	5	0	–	51	45	88
Du Bois et al. (2013)	Retrospective	950	784	166	41	200	41	7.8	–	–	43	–	–	–	–
Romeo et al. (2016)	Retrospective	46	–	–	5.4 years	–	–	10.9	–	–	3	–	–	–	–
Delle Marchette et al. (2019)	Retrospective	535	–	–	13.5 years	271	264	–	23%	31%	–	–	252	213	84.6
Current study	Retrospective	75	34	41	36	32	9	9.3	4	3	1	OS-98.7% DFS-90.7%	19	8	42.1

FSS – fertility sparing surgery, USO – unilateral salpingo-oophorectomy, Cys – cystectomy, DOD – died of disease, DFS – disease free survival, OS – overall survival.

recurrence after USO ranges from 7 to 30% (Boran et al., 2005), and recurrence typically shows borderline histology (Morice et al., 2001). A systematic review and meta-analysis of 120 retrospective studies (Darai et al., 2013) showed that in women with stage I BOT treated with either USO or ovarian cystectomy, and with average follow up of three to six years, recurrence rate was 13%, malignant histology was seen in 1.6%, and death rate was 0.5%. Findings from this study were limited due to combined data for USO and cystectomy. In a retrospective series of 193 patients, recurrence rate was higher and recurrence occurred sooner after cystectomy. For USO, 10 of 146 (7%) women had recurrences and the median time to recurrence was 4.8 years (range 1.7–7.2 years) compared to cystectomy, where 11 of 47 (23%) women recurred and the median time to recurrence was 2.6 years (range, 0.3 to 14 years) (Suh-Burgmann, 2006).

4.3. Management of recurrence

The optimal approach to management of recurrent disease has not been determined, but appears to be surgical cytoreduction, which is associated with improved survival in observational series (Zang et al., 2005). In a retrospective series of 21 patients with recurrent serous borderline tumors reported median overall survival was 61 months with optimal resection versus 26 months with suboptimal resection (Zang et al., 2005). All seven recurrences in our study were in six unstaged and one partially staged patient. Interval to recurrence was between 11 and 136 months. Site of recurrence was ovary in six and peritoneal cavity in one patient who presented with carcinomatosis ileus and expired. All six recurrences in ovary were salvaged by surgery and patients were alive at follow up (range 16–139 months).

4.4. Reproductive outcome

There is no evidence that women who undergo fertility sparing surgery are at increased risk of mortality from disease progression (Morice et al., 2001). Fertility treatments, such as ovulation induction, also appear to be safe. A systematic review of 120 studies reported a 54% pregnancy rate at three to six years in women treated conservatively for borderline tumors (Darai et al., 2013). In our study there were eight spontaneous conceptions resulting in term delivery without evidence of disease progression. Pregnancy rate was 42.1% (8/19) at two years. Infertility was present in eight women (42.1%) and three of them were taking ovulation inducing drugs to become pregnant at the time of last follow up.

Table 4 depicts the review of oncologic and reproductive outcomes of published studies in last two decades with a large sample size (>50 cases). Recurrences were seen in 9.3% of patients at the end of follow up period in our study whereas it has ranged from 0.7% to 33.0% across published studies. Recurrence rate was 33.3% in the cystectomy group and 6.2% in the oophorectomy group. Across published studies it has ranged from 21.0% to 58.0% in the cystectomy group. Pregnancy rate was 42.1% in our study whereas it has ranged from 32.0% to 88.0% across published studies.

4.5. Survival

Median time to recurrence was 35 months (range 11–136 months). Median duration of follow up was 36 months (range 22–61 months) and seventy-four patients were alive and free of disease at the end of follow-up giving an overall survival of 98.7% in the study cohort. Survival without recurrences were observed in sixty eight patients at the end of follow-up giving a recurrence free survival of 90.7% for the study cohort. In a retrospective series of 193 patients, median time to recurrence was 4.8 years (range 1.7–7.2 years) (Suh-Burgmann, 2006). In a long term follow-up study, 10 year survival rate was 99% for stage I, 98% for stage II, 96% for stage III, and 77% for stage IV (Trimble et al., 2002).

4.6. Strengths and limitations

Major limitation of this study is its retrospective nature. Complete surgical staging was performed only in 22 (29.3%) patients. Median duration of follow up was 36 months (range 22–61 months) which might not be ideal to draw conclusions due to propensity of late recurrences in these patients. A longer-term prospective study is ideal. However, it is likely infeasible because of the rarity of disease. Strengths of the study include central pathology review by expert gynaecologic pathologists, strict inclusion criteria excluding all cases with incomplete medical records and incomplete follow-up data from analysis.

5. Conclusion

In a young patient with a unilateral mass adjacent to normal ovarian tissue, ovarian cystectomy can be considered but with higher rates of recurrence explained to patient. Complete surgical staging adapted to the situation (pre or postmenopausal women) should be performed. Even in patients with stage II, III, or IV BOT, if the patient has not completed childbearing, FSS should be considered by leaving uterus and at least a portion of normal ovary. Longer duration of follow up is necessary due to propensity for late recurrences.

Author contribution

Sarita Kumari collected clinical and follow up data and wrote the initial draft of the manuscript with input of all authors. Sunesh Kumar and Neerja Bhatla helped in analysis and critical review of all clinical details as well as numerical calculations. Sandeep Mathur performed central pathology review of all cases. Sanjay Thulkar provided feedback and helped shape the research. Lalit Kumar designed the project, revised the data and manuscript.

All authors were actively involved at all stages of the study.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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