

# Laparoscopic Management of Large Adnexal Masses

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## Research article

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# Abstract

**Background:** To report the surgical outcomes of laparoscopic resection of large adnexal masses ( $\geq 10$  cm).

**Methods:** In this cross-sectional study, we enrolled 126 patients with large adnexal masses ( $\geq 10$  cm), managed by laparoscopic surgery during 2013 to 2020. The rates of intraoperative complications, conversion to open surgery and incidence of cancer were assessed.

**Results:** Mean mass size was  $15.08 \pm 5.03$  in all participants without significant difference based on the tumor type ( $P = .624$ ). Mean age and operation time were higher in the malignant type compared to that of the benign type ( $P < .001$ ). Type of surgery and frequency of intra-operative complications were also different among patients with different tumor types ( $P < .001$  and  $.003$ , respectively).

**Conclusion:** Our study showed that large adnexal tumors can be operated by laparoscopic approach, while the most important factor for increased surgical complications and duration was malignancy.

## Background

Adnexal mass is one of the most common gynecologic diseases among women of all ages, especially during reproductive ages, with an estimated prevalence of 5–10% in different populations (1). The gold standard management for benign ovarian masses is laparoscopy with surgical outcomes similar to laparotomy and several benefits to laparotomy, such as faster recovery, less and shorter postoperative pain, reduced inpatient admission, and superior cosmetic outcomes (2). However, laparoscopic management of adnexal masses has some limitations, such as difficulty in inserting trocars and limited surgical field that inhibits the complete exploration of the abdominal cavity, as well as the risk of ovarian rupture and spread of cyst fluid into the abdominal cavity (3). Some suggest that the iatrogenic or accidental rupture and spillage of the malignant adnexal mass contents upgrades the tumor stage and decrease the overall survival (4), while some others suggest that it has no adverse prognostic significance (5). Although the laparoscopic operation would be much easier and faster after puncturing the benign cysts, the risk of spillage of malignant cells hinders the surgeons from puncturing the cyst for the ease of operation, which results in preference of open surgery (6). Meanwhile, it is not clear whether the risk of rupture differs based on the tumor type, which has to be further investigated.

Another important factor for the choice of laparoscopic or laparotomic management of adnexal masses is the size of the mass, and due to the technical difficulty of performing laparoscopy, limited surgical field, and the higher probability of malignant potential in adnexal masses, some suggest the use of laparotomy in large adnexal masses (7, 8). However, the cut-off level for the “giant”, “huge”, and “large” tumors are not clearly defined and no contraindications have been defined for the laparoscopic approach based on maximum tumor size (5, 9). Despite many restrictions for laparoscopic approach in large adnexal masses, recent literature has suggested that many of these adnexal masses can still be managed using laparoscopy (10). Some have also suggested that tumor size is not a predictor of perioperative complications (11). Due to the complications of laparotomy, it is worth to examine the applicability of laparoscopy in large adnexal masses. Considering the controversies regarding the treatment of large ovarian tumors with laparoscopic surgery, the present study aimed to report the surgical outcome of patients with large ( $\geq 10$  cm) adnexal masses undergoing laparoscopic surgery and factors associated with the surgical outcome.

## Methods

This cross-sectional study was conducted at Shohadaye-Tajrish Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran and all women with an adnexal mass of  $\geq 10$  cm based on preoperative ultrasonography and magnetic resonance imaging (MRI), who underwent laparoscopic surgery from July 2013 to January 2020 were enrolled into the study. The study was approved by the Ethics Committee of Shahid Beheshti University of Medical Sciences with the approval number SBMU.RETECH.REC1397.1032. Informed consent was acquired from all participants for participation into the study and conversion to laparotomy, in case of unexpected complications or incidental malignancy finding. A total of 126 participants who had the inclusion criteria were enrolled into the study by census method.

All patients underwent preoperative physical examination and imaging. Abdominal and vaginal ultrasound was performed by an expert; the mass size was characterized based on the maximum diameter reported in the imaging studies. One venous blood sample was obtained from all patients and sent to the laboratory for measurement of tumor markers including lactate dehydrogenase (LDH), cancer antigen (CA)19 - 9, CA125, carcinoma embryonic antigen (CEA), Human epididymis protein 4 (HE4), inhibin, and beta-HCG were measured in all patients prior to surgery. Those patients who had ascites or metastasis, obesity, pregnancy, a previous history of abdominal surgery, and a probable malignancy without metastasis (mass features in imaging or elevated tumor markers) were not included into the study.

All the surgeries were performed by a single surgeon (B. Nouri), under general anesthesia, with a single surgical protocol. For this purpose, patients were laid in the dorsal lithotomy position and after induction of general anesthesia, a 10-mm trocar was inserted either directly or using an altered open technique at the umbilicus, subxiphoid, or palmar site, according to the tumor size. Other trocars were placed under direct visualization. First, the whole abdomen and pelvis were inspected. Subsequently, peritoneal fluid was sent for cytological assessment. Peritoneal washing was performed in case of no peritoneal fluid. The ovarian masses were removed with caution to remain intact and placed within endo-bag using a 15-cm opening diameter (Endo Catch II TM, Covidien Tyco, Norwalk, CT, USA). If we decided to initiate the drainage of very large masses, we performed cystectomy or oophorectomy with or without salpingectomy, decided based on the patients' age, medical history, and intraoperative findings. The cyst walls were punctured by either of the following methods. In the first method, we drained the cyst fluid using a 5-mm trocar with sleeve inserted into cyst wall dome in laparoscopic visualization; then, we removed the trocar and placed a suction-irrigation device into the cyst wall through the sleeve. In the second approach, the cyst wall was incised between two graspers and the mass was inserted with the suction-irrigation device. The mass was drained as much as possible and the puncture site was immediately closed by a grasper to avoid leakage. Homeostasis was achieved and the access site for specimen retrieval and the umbilical port site were closed in different anatomical layers.

The management plans were made based on the frozen section findings. Surgical staging was performed by laparoscopy and conversion to laparotomy was conducted only for cases with technical difficulties. Intraoperative and postoperative complications, conversion to laparotomy, type of procedure, operation time, and pathologic reports were documented. Operative time was recorded as the time from skin incision to skin closure. Blood loss was measured based on the fluid gathered in the suction bottle. Spillage was characterized as any deliberate or accidental mass wall rupture. If the tumor was drained intentionally into the endo-bag without a peritoneal spill, the tumor was not regarded as a ruptured tumor.

## Statistical analysis

Statistical analysis was performed using Excel program, 2007 version. The Kolmogorov-Smirnov test was used to examine normal distribution of the data. One-way analysis of variance (ANOVA) was applied to determine the differences among the groups; in case of significance, pairwise comparisons were performed using Tukey's test.

Fisher's exact test was applied to analyze ratio and chi-square test was used for categorical variables. P-values less than .05 were considered significant.

## Results

A total of 126 women completed the study. Patients' demographic characteristics are shown in Table 1. The mean age of the patients was  $30.21 \pm 11.64$  years; 80.2% had benign tumor type (N = 101), 7.1% borderline (N = 10), and 11.9% malignant/metastasis (N = 15). There was a significant difference among the three groups in terms of mean age and operation time; age and duration of surgery were higher in the malignant type compared to that of the benign type ( $P < .001$ ; Table 1). But, mean BMI, number of deliveries, bleeding volume, fluid volume drained from the mass were not different based on the tumor type ( $P > .05$ ; Table 1). Mean mass size was  $15.08 \pm 5.03$  in all participants without significant difference based on the tumor type ( $P = .624$ ; Table 1).

Table 1  
The demographic characteristics of the study participants categorized based on tumor type

Variable	Total (N = 126) Mean $\pm$ SD	Benign (N = 101) Mean $\pm$ SD	Borderline (N = 9) Mean $\pm$ SD	Malignant or metastasis (N = 15) Mean $\pm$ SD	P-value among the three groups*	P-value Benign-borderline <sup>†</sup>	P-value Benign-Malignant <sup>†</sup>	P-value Malignant-borderline <sup>†</sup>
Age (years)	30.21 $\pm$ 11.64	28.31 $\pm$ 10.27	33.56 $\pm$ 16.78	40.87 $\pm$ 11.76	< .001	.359	< .001	.260
BMI (kg/m <sup>2</sup> )	25.95 $\pm$ 6.12	26.03 $\pm$ 6.10	25.55 $\pm$ 5.15	26.20 $\pm$ 6.98	.968	.973	.994	.967
Parity (No.)	2.3 $\pm$ 1.2	.78 $\pm$ 1.11	.56 $\pm$ 1.13	1.13 $\pm$ 1.12	.414	.830	.946	.442
Mass size (cm)	15.29 $\pm$ 5.09	15.08 $\pm$ 5.03	16.33 $\pm$ 6.34	16.13 $\pm$ 5.08	.624	.763	.739	.995
Duration of surgery (min)	128.88 $\pm$ 63.37	116.92 $\pm$ 52.08	144.44 $\pm$ 92.88	184.67 $\pm$ 56.67	< .001	.340	< .001	.210
Bleeding volume (cc)	124.61 $\pm$ 287.32	105.02 $\pm$ 247.07	84.56 $\pm$ 68.38	275.53 $\pm$ 519.41	.092	.977	.082	.254
Fluid volume drained from the mass (cc)	1687.27 $\pm$ 928.37	1674.51 $\pm$ 948.86	2050.00 $\pm$ 353.55	1650.00 $\pm$ 1060.66	.858	.846	.999	.906
*results of test of ANOVA, <sup>†</sup> results of Tukey test; all tests were considered significant when < .05								

The first trocar was inserted in the umbilicus in 27.8% of patients (N = 35), upper umbilicus in 21.4% (N = 27), subxiphoid in 48% (N = 61), and palmar in 2.8% of patients (N = 3). Seventy-five patients (59.5%) were nulliparous, 17 women (13.5%) had one child, and 34 women (27%) had two or more children. The results of serum parameters are shown in Table 2.

Table 2  
The frequency of tumor markers in the study participants

Tumor marker	Number	Percentage
Normal	75	59.5
High CA125	26	20.6
High CA125 + High HE4	1	.8
High CA125 + High CA19-9	4	3.2
High HE4	13	10.3
High HE4 + High inhibin + High CA19-9	1	.8
High inhibin	2	1.6
High LDH	1	.8
High LDH + High CA19-9	1	.8
High CA19-9	1	.8
Positive BHCG	1	.8
Abbreviations: cancer antigen 19 – 9; CA19-9, cancer antigen 125; CA125, Human epididymis protein 4; HE4, lactate dehydrogenase; LDH, and beta-human chorionic gonadotropin (HCG)		

Twelve patients were menopause (9.5%) and there was a significant difference in the frequency of menopause among patients with different tumor types ( $P = .002$ ; Table 3). The type of surgery and frequency of intra-operative complications were also different among patients with different tumor types ( $P < .001$  and  $.003$ , respectively; Table 3), but the frequency of tumor type and side, site of the first trocar, history of abdominal surgery, and blood infusion were not different in patients with different tumor types ( $P > .05$ ; Table 3).

Table 3

The frequency of surgical and tumor characteristics in the study participants categorized based on tumor type

		Type of malignancy				p-value
		Total (N = 126)	Benign (N = 101)	Borderline (N = 9)	malignant/metastasis (N = 15)	
Tumor type	Cystic	72(57.1)	61(60.4)	4(44.4)	6(40.0)	.221
	Solid-cystic	52(41.3)	39(38.6)	5(55.6)	8(53.3)	
	Solid	3(2.4)	1(1.0)	0(0.0)	1(6.7)	
Tumor side	Unilateral	97(77.0)	78(82.1)	7(77.8)	11(78.6)	.258
	Bilateral	21(16.7)	17(17.9)	2(22.2)	2(14.3)	
Type of surgery	Cystectomy	76(63.2)	73(645.2)	2(22.2)	0(0.0)	< .001
	Cystectomy + staging	1(.8)	0(0.0)	0(0.0)	1(6.7)	
	Salpingo-oophorectomy	31(24.6)	25(23.8)	0(0.0)	6(33.4)	
	TLH + BSO + Omentectomy + Appendectomy	1(.8)	1(.8)	0(0.0)	0(0.0)	
	Ih + bilateral oophorectomy + staging	8(6.4)	0(0.0)	4(44.4)	4(26.7)	
	Bilateral oophorectomy + staging	5(4.0)	0(0.0)	2(22.2)	3(20.0)	
	TAH + BSO + cytoreductive surgery	1(.8)	0(0.0)	0(0.0)	1(.8)	
	Mass resection + adhesion release	5(4.0)	3(3.0)	0(0.0)	2(13.3)	
First trocar site	Umbilicus	35(27.8)	28(27.7)	1(11.1)	6(40.0)	.527
	Upper umbilicus	27(21.4)	19(18.8)	3(33.3)	5(33.3)	
	Sub xiphoid	60(48.0)	50(49.5)	5(55.6)	5(33.3)	
	Palmar	3(2.8)	2(2.0)	1(11.1)	0(0.0)	
Intra-operative complications	None	107(84.9)	90(89.1)	8(88.9)	8(53.3)	.816
	Accidental cyst rupture	6(4.8)	4(4.0)	0(0.0)	2(14.3)	
	Pelvic abscess	2(1.6)	0(0.0)	0(0.0)	2(14.3)	
	Intestinal perforation	1(.8)	0(0.0)	1(11.1)	0(0.0)	

\*results of chi square test, †results of Fisher's exact test; all tests were considered significant when < .05; all values are reported as number(percentage)

	Intestinal serous trauma	1(.8)	1(1.0)	0(0.0)	0(0.0)	
	Blood transfusion	5(4.0)	5(5.0)	0(0.0)	0(0.0)	
	Conversion to laparotomy	2(1.6)	0(0.0)	0(0.0)	2(14.2)	
	Rupture of bladder	1(.8)	1(1.0)	0(0.0)	0(0.0)	
	Umbilical infection	1(.8)	0(0.0)	0(0.0)	1(7.1)	
History of surgery	No	75(59.5)	63(62.4)	5(55.6)	7(50.0)	.687
	Yes	50(40.5)	38(37.6)	4(44.4)	7(50.0)	
Blood infusion	No	117(92.9)	96(95.0)	9(100.0)	11(78.6)	.109
	Yes	7(5.6)	5(5.0)	0(0.0)	2(14.3)	
Menopause	No	111(88.1)	93(94.9)	7(77.8)	10(66.7)	.002
	Yes	12(9.5)	5(5.1)	2(22.2)	5(33.3)	
*results of chi square test, †results of Fisher's exact test; all tests were considered significant when < .05; all values are reported as number(percentage)						

## Discussion

In this study, we reported the surgical outcome of 126 patients with adnexal tumors  $\geq 10$  cm (mean of  $15.08 \pm 5.03$  cm; maximum of 30 cm), among whom only one required conversion to open surgery. These results suggest the feasibility of laparoscopic management of adnexal masses  $\geq 10$  cm. In another study on 77 women with ovarian cysts  $\geq 10$  cm, conversion to open was required in four patients (12), which is higher than that of ours. This difference could be due to the difference in the experience of the laparoscopic surgeon and the difference in the rate of intra-operative complications between the studies. Among 19 patients, in the study by Vlahos et al. who had adnexal mass with a mean diameter of 8.3 cm, there were no cases of conversion to open (13). The difference between the results of this study and that of ours could be due to the small sample size of their study, but this study also confirms the results of the present study, considering the low risk of conversion to open surgery in large adnexal masses.

One of the important factors against the suggestion of laparoscopic surgery for large adnexal masses is the risk of rupture and its negative effect on patients' outcomes (7, 8). However, in our study, incidental rupture was only observed in 8 patients, two of whom were malignant. These results show that the laparoscopic method has an acceptable rate of cyst rupture. In another study by Shiota et al., comparison of 1483 cases of benign ovarian cysts according to the cyst size showed no difference in the incidence of cyst rupture among patients with cyst size  $< 5$  cm, 5-10cm, and  $> 10$  cm (14), which confirm the results of the present study. In another study by Detorakis et al., studying the surgical outcome of 102 women with adnexal cysts with mean size of 5.7 cm (2.3–10.5 cm) showed cyst rupture in 31.8% of the patients and 7.2% in masses  $> 8$  cm (15). These authors concluded that laparotomy is the preferred method for large adnexal masses, but generally speaking, iatrogenic or accidental rupture and spillage of the adnexal mass contents are considered an inevitable incidence during surgery and may occur both in laparoscopic and laparotomic approaches (4). Furthermore, the prognostic value of significant spillage in malignant cases is still controversial and some suggest that laparoscopic treatment of ovarian cancer does not have a higher risk of spillage (16). Therefore, we believe that the risk of rupture should not ban surgeons from the choice of laparoscopy, considering the other

advantages of this method. With the availability of frozen sections at many tertiary centers and adherence to proper surgical techniques, the chance of spreading malignancy has been reduced considerably.

Another important surgical complication is the bleeding volume during surgery and requirement of blood transfusion and the results showed that the mean bleeding volume of the studied patients was  $124.61 \pm 287.32$  cc and only five patients required blood transfusion. In another study by Demir et al, the results showed that 97.8% of women with adnexal masses of 8-13cm treated with laparoscopy had blood loss < 200 cc (9). These results confirm that of the present study on the low bleeding in laparoscopic treatment of large adnexal masses, considered one of the important advantages of laparoscopy vs. laparotomy (17, 18). The mean operation time was  $128.88 \pm 63.37$  minutes in our study. In the study by Vlahos et al on 53 women with adnexal masses of all sizes, undergoing laparoscopy, the mean operative time was 45 minutes (13), which is much less than that of the present study. In the study by Demir et al., 97.92% of surgeries lasted < 136 minutes (9), which is similar to the results of the present study. But they have only evaluated patients with benign type, while we included patients with any pathologic type. In the study by Machida et al. comparison of the median operation time was significantly higher in cases with adnexal masses > 10 cm vs. <5 cm (73 vs. 59 minutes) (11). These results suggest that large adnexal masses can prolong the surgical duration, which is justifiable by the technical difficulty of laparoscopy in large masses, considered one of the disadvantages of this approach for these cases. However, the results of our study showed that the risk of surgical complications are not much, when patients are selected after complete physical examination, precise imaging studies, and measurement of tumor markers. Furthermore, all surgeries were carried out by a single surgeon; in the meantime, a multidisciplinary team of experts consisting of pathologists, oncologists, colorectal surgeons, and urologists were involved and ready to be called on when necessary. As suggested, the risk of surgical complications is not predicted by the tumor size (11). Therefore, it does not seem logical to impose patients to the critical risk of invasive open surgeries, especially in cases with benign pathologies. The maximum tumor size for safe laparoscopic approach is yet to be determined, as 10 cm threshold seems questionable.

The incidence rate of incidental finding of ovarian cancer during laparoscopy has been reported to be between 0.65% and 0.9% of premenopausal women and 3% of postmenopausal women (19). In our study, there were 15 patients with malignancy or metastasis, five of whom (33.3%) were postmenopausal. Other studies have reported other incidence rates for malignant ovarian mass (4, 9, 12), which can vary based on the frequency of malignancy in the study place and based on the inclusion criteria of the study. The results showed that patients with malignancy or metastasis were significantly older and had a longer duration of surgery and intra-operative complications. These results are consistent with the results of the study by Gad et al, which reported higher rate of complications and longer operative time in patients with borderline/malignant adnexal mass, compared to benign group undergoing laparoscopic treatment (20). Furthermore, they reported higher rate of conversion to open, blood loss, and duration of hospital stay (20), which was not observed in our study. Other studies have also confirmed the superiority of laparoscopy vs. laparotomy for treatment of ovarian cancers (21, 22), as well as comparable accuracy of staging of laparoscopy vs. laparotomy and comparable survival rates (23, 24), while the results of the present study suggested higher complication rates in large tumors. Due to the small sample size of this subgroup in our study, further studies should be performed to investigate the applicability of laparoscopy in large adnexal malignant tumors.

Our study had some limitations. The first limitation was the cross sectional nature of this study, which limited suggestion of causal relationship between the study variables. Furthermore, we did not follow patients to study the long term results and did not evaluate the survival or recurrence rate in the studied population. The small sample of the study, especially in subgroups, was another limitation of the present study.

## Conclusion

Our study showed that the size of tumor alone might not be a limiting factor for using laparoscopic approach in treatment of adnexal masses, as it resulted in acceptable rates of intra-operative complications. These results suggest the safety and efficacy of laparoscopic approach for large adnexal masses, when performed by an expert laparoscopic surgeon on selected patients. As higher rates of surgical complications and longer operation time were only observed in patients with malignancy or metastasis, due to the small sample size of this subgroup in our study, more studies are required to investigate the feasibility and safety of laparoscopic treatment of this subgroup of large adnexal masses.

## Abbreviations

magnetic resonance imaging  
MRI  
lactate dehydrogenase  
LDH  
cancer antigen  
CA  
carcinoma embryonic antigen  
CEA  
Human epididymis protein 4  
HE4

## Declarations

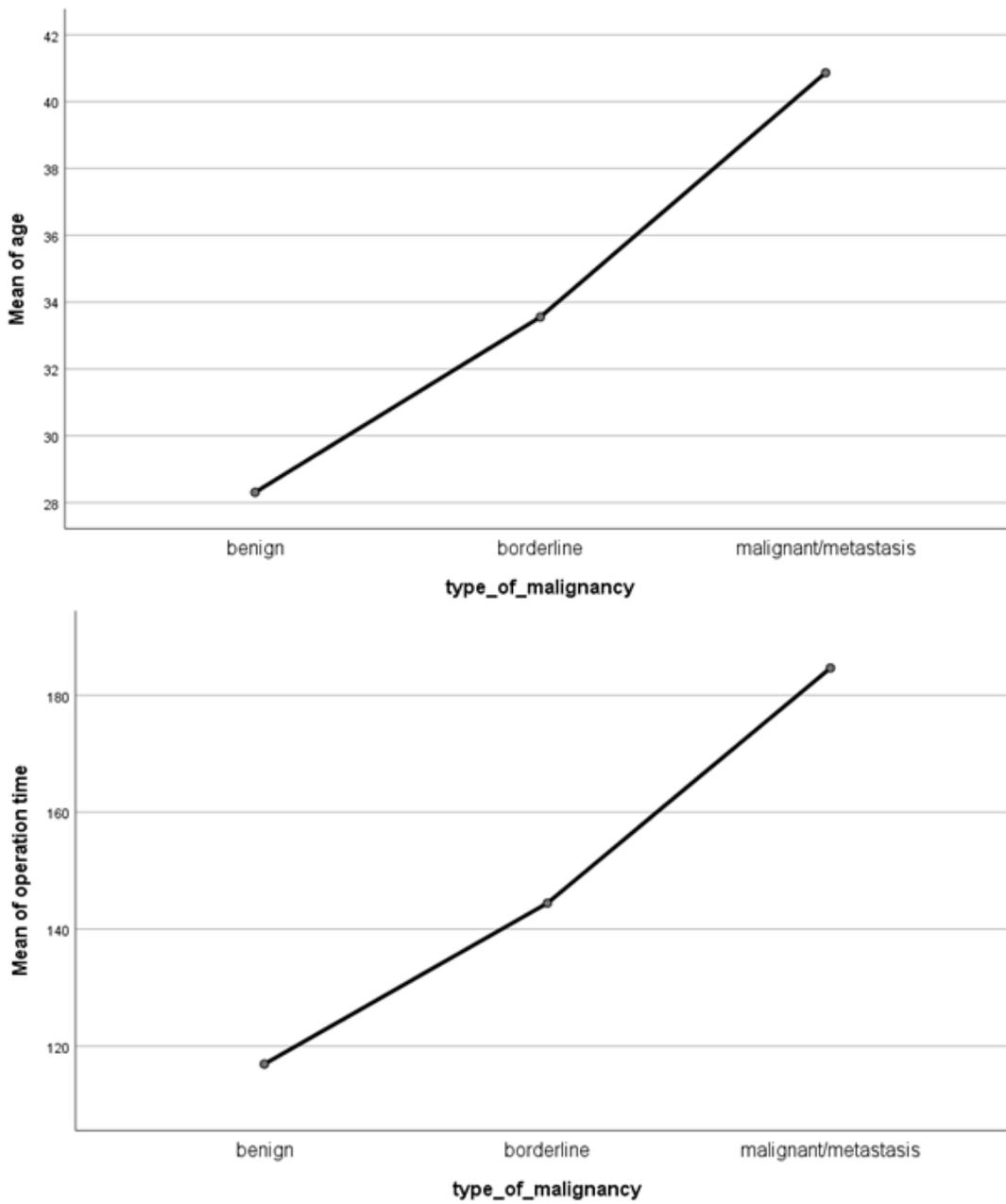
- **Ethics approval and consent to participate:** Written informed was obtained from the participants.
- **Consent for publication:** All participants gave consent for anonymous publication of their results.
- **Availability of data and materials:** Available upon request.
- **Competing interests:** The authors of the present study declare that they have no competing interests.
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# Figures



**Figure 1**

Comparison of mean age and duration of surgery in the patients with three tumor types