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Original Article

Predisposing Factors for Idiopathic Granulomatous Mastitis: A Large Prospective Multicentric Study

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Abstract

Background: Idiopathic granulomatous mastitis (IGM) is a chronic breast disease with unknown pathophysiological and clinical aspects. Therefore, we designed this multi-center prospective case-control study to explore and clarify the risk factors with an acceptable sample size.

Methods: From March 2021 to December 2023, five hundred-four women with a histologically proven IGM were entered into the IGM group and 504 women with healthy breasts were included in the control group across nine centers. Participants' information was obtained by trained staff. Multivariate binary logistic regression was used to estimate the odds ratio (OR) and 95% confidence intervals (CI) for the associations between variables and IGM.

Results: The mean age of all participants was 34.92 ± 7.12 yr. The previous history of diseases as a whole, was significantly higher in the IGM group (33.1%) compared with the control group (26.6%). Logistic regression showed that previous lactation (OR= 7.51, 95% CI= 2.37-23.77) and a positive history of diabetes (OR = 4.23, 95% CI= 1.32-13.51) had a positive association with IGM, while OCP use (OR = 0.70, 95% CI= 0.52-0.93) was associated with IGM reversely.

Conclusion: The history of breastfeeding and not its duration is associated with a 7-fold increase in the rate of IGM. Furthermore, previous history of diabetes is a risk factor, while OCP use is a protective factor against IGM. We are designing another study to further investigate the relationship between breastfeeding, milk stasis, and IGM, based on our findings.

Keywords: Case-control study; Granulomatous mastitis; Breastfeeding; Risk factor

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Introduction

Idiopathic granulomatous mastitis (IGM) is a rare benign disease of the breast that has been recognized since the 1970s (1), but its development pathways and the best treatment are still unknown. The present evidence shows a non-uniform global distribution of the disease. While scarcely seen in Western countries, it is reported most frequently in Asia. Turkey and Iran are countries that have reported the highest number of IGM cases, followed by China (2). The disease mostly consists of a chronic inflammation of the breast which presents clinically as mass-like indurations, accompanied by skin erythema or edema, breast enlargement, fistulae, abscesses, ulcers, and even breast deformity (3, 4). The clinical picture is sometimes very severe and causes tremendous morbidity; lack of data about the best treatment intensifies the problems (4).

As logical health guidance dictates, prevention of the disease should be the ultimate goal. However, the medical approach toward IGM is far from this target, because the causative and risk factors of IGM are not fully identified and confirmed. While numerous theories exist about the etiopathology of IGM, the most commonly considered factors include hormonal imbalances, immunological alterations, and the potential influence of microbial agents (5). However, heretofore, no study has proven an established causal relationship between these factors and IGM.

Patients' inherent characteristics that contribute to the risk of the disease have extensively been contemplated in most studies about IGM (6), but because of the low number of included patients, the retrospective nature of most studies, or the lack of a control group, the large information void about IGM risk factors has not yet been filled. Factors that have been mentioned so far are diverse but mostly consist of parity, breastfeeding, and the use of oral contraceptive pills (OCP) (6). However, strong arguments can be laid against these findings. First, since this disease is common in areas with a higher birth rate, the relationship between IGM and birth rate may be related to other reasons, including environmental or genetic aspects, and not specifically the number of live births. Second, the peak incidence of IGM is around 35 yr of age (6), and childbirth and lactation generally occur during or before this period. Thus, while the reason for this age-related prevalence might be the connection between IGM and reproductive features, it may also be caused by other age-related factors.

In the absence of longitudinal cohort studies, and the lack of comparison groups as well as low sample sizes in the existing studies (7-10), further investigations are needed in this field. Therefore, we designed this multicentric prospective case-control study to explore and clarify the risk factors of IGM, and overcome these limitations.

Materials and Methods

Study design

This case-control study was conducted in nine centers from Mar 2021 to Dec 2023. It has been approved by the Ethics Committee of Tehran University of Medical Sciences (IR.TUMS.IKHC.REC.1402.079). It was run according to the ethical principles of the Declaration of Helsinki. Informed consent was obtained from all participants.

Settings and Participants

The study population of the case group consisted of women attending the Breast Clinic or Surgery Clinic of participating centers, and that of the control group consisted of women accompanying patients of the above clinics, or women attending non-related clinics. Inclusion criteria for the case group were an age between 18 to 65 yr with a histologically-proven IGM; and for the control group, the same age range with no history of benign or malignant breast disease and no history of IGM in their first-degree relatives. Exclusion criteria for both groups were defined as a history of breast cancer, a pregnant or lactating status, and memory disorders. In addition, the presence

of extramammary presentations in favor of a systemic disease, fungal breast infection, and tuberculosis were considered for exclusion of the case group.

Variables, data sources, and measurements

Variables considered in this study include reproductive characteristics (age at menarche, history of infertility, age at first delivery, gravidity, parity, duration of breastfeeding, and OCP use), past medical history (history of diabetes, thyroid dysfunction, tuberculosis, sarcoidosis, or rheumatologic diseases), education level and employment status, which were recorded through interviews held with the patient, and anthropometric measures; all gathered by a trained staff. OCP consumption was defined as usage for more than 5 years. Duration of breastfeeding consisted of the sum of all periods of lactation of a woman, in months; this was calculated once by considering all the women, and once by excluding those who had not breastfed. In addition, breastfeeding was envisaged as a categorical variable classifying participants as those who had ever breastfed and those who had not. Parity also was defined as a continuous variable.

The level of education was categorized as less than 12 years and equal or higher than 12 years. Employment was subdivided into two general items consisting of housewife or employed including public, private, or self-employment; newly retired women were considered employed.

Study size

We estimated our sample size according to different studies and risk factors; we calculated that at least 450 participants would be required in each group to detect an odds ratio of 1.5, with a 20% proportion of control with risk factors, with a power of 80% and α= 0.05 by using the Epi info website (www.cdc.gov/epiinfo/).

Statistical analysis

We performed the statistical analysis using SPSS version 18 (SPSS, Inc., IL, USA). Comparisons of means between case and control were tested by the student t-test. Categorical variables differences were assessed using the Chi-square test or Fisher's exact-test, when appropriate. A two-sided p-value of less than 0.05 was considered statistically significant. Multivariate binary logistic regression was used to estimate the odds ratio (OR) and 95% confidence intervals (CI) for the associations between variables and IGM. Variables were selected a priori for inclusion in a multivariate model based on the association with IGM in univariate analysis (P <0.05).

Results

Participants, descriptive data and outcome data

Overall, 1008 women were recruited in the study, 504 in the IGM Group, and 504 in the control group. The mean age of all participants was 34.92 ± 7.12 yr. The mean body mass index (BMI) was 27.40 ± 4.85 kg/m^2. The demographic and reproductive features of participants are compared in Table 1.

In the IGM and control groups, 456 (93.6%) and 358 (71%) women were parous, respectively (P< 0.001). Also, 440 (93.2%) of IGM cases and 344 (68.3%) of controls had ever breastfed (P< 0.001). When considering the previous history of diseases as a whole, 167 (33.1%) of women in the IGM Group reported positive histories, while 134 (26.6%) of participants in the control group were recorded as such (P=0.02). Sub-analysis showed that the rate of diabetes was significantly difference between the two groups (Table 2).

Table 1: Characteristics of participants in the two study groups

Variable		IGM Group (n=504)	Control Group (n=504)	*P*-value
Age (yr)		35.03 ± 6.532	34.82± 7.645	0.65
Body mass index (kg/m²)		27.85± 4.54	27.0271± 5.06	0.01
Age at menarche (years)		13.20± 1.643	13.14± 1.659	0.59
Age at first delivery (years)		23.90± 4.910	23.55± 5.826	0.36
Gravidity (n)		2.3 ± 1.4	1.73± 1.528	<0.001
Parity (n)		1.9 ± 1.2	1.34± 1.156	<0.001
Duration of BF 1 (months)*		30.73± 27.484	23.70± 23.761	<0.001
Duration of BF 2 (months)*		32.41 ± 27.24	33.75± 21.55	0.45
Breastfeeding (n) Yes No		 440 (93.2%) 32 (6.8%)	 344 (68.3%) 160 (31.7%)	<0.001
History of infertility (n) Yes No		 32 (7.7%) 383 (92.3%)	 44 (8.8%) 458 (91.2%)	0.56
History of OCP use (n) Yes No		 170 (35.5%) 309 (64.5%)	 212 (42.1%) 292 (57.9%)	0.04
Education (n)				0.001
	<12 years	104 (23%)	91 (18.1%)	
	≥12 years	382 (77%)	413 (81.9%)	
Employment (n)	Housewife	359 (84.1%)	329 (65.4%)	0.05
	Employed	68 (15.9%)	174 (34.6)	
Past medical history (n)	Diabetes	17 (3.4%)	4 (1%)	0.02
	Hyperthyroidism	4 (0.8%)	6 (1.6%)	
	Hypothyroidism	62 (12.3%)	64 (12.7%)	
	Rheumatoid disease	6 (1.2%)	5 (1%)	
	Tuberculosis	2 (0.4%)	0 (0%)	
	Other	76 (15.1%)	55 (10.9%)	
	Nothing	337 (66.9%)	370 (73.4%)	

*In all women. ** In those who had breastfed. BF= Breastfeeding, OCP= Oral contraceptive pill. Values are expressed as mean ± standard deviation and number (percentage) for continuous and categorical variables, respectively. *P*-values refer to Student *t*-test, Fisher's exact-test, and Chi-square test, when appropriate.

Table 2: Comparison of past medical history between two groups

Disease	IGM (n=504)	Control (n=504)	*P*-value
Rheumatoid disease	6 (1.2)	5 (1)	0.76
Diabetes	17 (3.4)	5 (1)	0.01*
Hypothyroidism	62 (12.3)	64 (12.7)	0.84*
Hyperthyroidism	4 (0.8)	6 (1.2)	0.55*
Tuberculosis	2 (0.4)	0 (0)	0.50**

IGM= Idiopathic granolomatosis mastitis. Values are presented as number (percentage).
* Chi-square test. **Fisher's exact-test.

Logistic regression analysis showed (Table 3) that previous lactation 7.51 (2.37-23.77, *P*<0.001) and history of diabetes (OR= 4.23, 95% CI=1.32-13.51, *P*=0.02) were directly associated with IGM, while OCP use (OR= 0.70, 95% CI=0.52-0.93, *P*=0.01) had a reverse association.

Table 3: Analysis of risk and protective factors for IGM using multivariable logistic regression

Risk factors	Crude OR (95% CI)	*P*-value	Adjusted OR (95% CI)	*P*-value
BMI	1.04 (1.01-1.06)	0.01	1(0.98-1.04)	0.58
Parity	1.57 (1.39-1.77)	<0.001	0.78 (0.24-2.51)	0.67
Breastfeeding (Yes/No)	6.40 (4.27-9.59)	<0.001	7.51 (2.37-23.77)	0.001
History of OCP use (Yes/No)	0.76 (0.59-0.98)	0.04	0.70 (0.52-0.93)	0.01
Education (<12 / ≥12 years)	0.74 (0.54-1.01)	0.05	1.16 (0.81-1.66)	0.41
Diabetes (Yes/No)	4.36 (1.46-13.06)	0.008	4.23 (1.32-13.51)	0.02

IGM= Idiopathic granolomatosis mastitis; OR= Odds ratio; CI= Confidence Interval; OCP= Oral contraceptive pill

Discussion

In this study, we evaluated the variables commonly cited as risk factors of IGM by recording them prospectively in a considerable number of IGM patients and comparing them with a group of healthy women. Our findings prove that having previously breastfed, and not the length of lactation is an actual risk factor for IGM. Furthermore, a history of diabetes increases the risk of IGM, while OCP has a protective effect on IGM. Based on our results, parity and gravidity are not among IGM risk factors of IGM.

Despite the increasing number of publications focusing on IGM, evidence around all the basic and clinical aspects of the disease remains undisclosed; the risk factors are no exception, and the present literature lacks facts on this topic. While verifying women with IGM retrospectively to discover the clinical aspects, most studies have reported the rates of parity, breastfeeding, and OCP consumption. The figures are very diverse, and the sample size and setting of the studies differ greatly.

Four studies investigating the risk factors of IGM involved a control group. Considering reproductive factors, Al-Khaffaf et al. (11), who compared 18 cases of IGM with 100 healthy women and 133 women with periductal mastitis (PDM), found that parity rates were not different among the groups, and OCP use was significantly less common in IGM patients. Pak et al. (8) compared 30 IGM patients with 60 controls. Their results detected no significant difference between the cases and controls regarding OCP use, gravidity, parity, and duration of breastfeeding. Interestingly, as seen in our results, the rate of OCP use was much lower in their IGM patients than in the control group (35.5% vs. 42.1, *P*=0.04). Raam et al. (10) compared 30 IGM cases with controls and, in contrast to the present study, detected a significant difference regarding the duration of lactation; but no difference for parity and OCP consumption. Ramadan et al. (9) compared 40 IGM patients with 40 controls; they showed a significantly higher rate of breastfeeding and OCP use among the cases. All of these case-control studies, although underpowered and comprising a small number of IGM patients, excluded parity as a risk factor for IGM. While Ramadan et al. (9) detected a positive association for OCP, Pak et al. (8) and Al-Khaffaf et al. (11)

revealed some weak evidence for an indirect association of OCP with the disease; these findings are strongly confirmed in our study. The low pooled prevalence of OCP consumption among non-controlled studies (6) also pushes against a positive relationship between this factor and IGM. Eventually, the present study shows a definite reverse association between OCP and IGM with an OR of 0.70 in regression analysis (P=0.01). Although this finding alone would not prompt the administration of OCP as a preventive measure against IGM, it could encourage further studies for to evaluate the effectiveness of OCP on reducing the recurrence of IGM. Moreover, our present attitude of recommending against OCP consumption in IGM patients might be wrong.

Although gravidity and parity rates were statistically different between the IGM and control groups in this study (P<0.001), logistic regression analysis did not support their association with IGM. The difference detected in the t-test analysis is due to a confounder; which should be breastfeeding (as a categorical binary variable) according to the subsequent regression analysis.

The results regarding breastfeeding were inconsistent among the four studies. In the study of Al-Khaffaf et al. (11), breastfeeding was not compared among the three groups (IGM, PDM, and control). However, higher rates were reported by Ramadan et al in the IGM group (9), and Raam et al. (10) found that the duration of breastfeeding was longer in IGM patients, while, it did not stand out as an effective factor in Pak's study (8). The method for calculating breastfeeding time (including women without breastfeeding or not) is not described in these studies, but the shortcomings related to the sample size and study power probably account for the largely varying results. In our study, considering all women, IGM patients had breastfed for a significantly longer time; but the gap between the mean duration in the case and control groups was not large (30.7 months versus 23.7 months). The exclusion of women who had not breastfed almost closed the gap (32.4 vs. 33.8 months) and eliminated the statistical significance. This infers that the statistical significance was dependent on the positive or negative history of breastfeeding, and not on the duration. On the other hand, a positive background of breastfeeding was seen around 7.1 times more commonly in IGM patients than in healthy women (P=0.001). These findings clearly show that lactating for a longer time would not intensify the risk of IGM, but having experienced a lactation period is a key predisposing factor. This momentous finding supports the hypothesis that considers milk stagnation as the starting point of the etiopathogenesis of IGM; the subsequent extravasation of milk into the interstitial stroma induces an inflammatory reaction, leading to the activation of immunologic cascades that cause the clinical picture of IGM (3, 12). IGM occurs more frequently during the five years after breastfeeding (9-11, 13, 14), this finding and the hyperprolactinemia hypothesis (15, 16) are in line with the milk stasis explanation. Two existing facts about IGM oppose the milk stasis hypothesis. First, some IGM patients are nulligravid; second, IGM has been seen in men (13, 17, 18). However, studies including men with IGM have not investigated the history of galactosis, which would act like milk stasis. Moreover, some secretory material is regularly produced in the breast of women regardless of breastfeeding, and retainment of these secretions in the ducts can simulate milk stasis (12). All things considered, for now, we state that the history of breastfeeding is a predisposing factor for IGM; and the causal association needs to be further investigated by using other study designs. We have already launched a prospective multicenter study on this topic.

Other factors have also been connected to the risk of IGM. Smoking is one of the factors that has been cited frequently, but results are contradictory (19). We did not investigate this variable because smoking rates in females in Western countries are much higher than in areas where IGM is frequent, including our country (20); and this association is very improbable.

One of the issues that is being discussed about IGM is its relation with other diseases. The present study results showed that a previous history

of any disease increases the risk of IGM for about 37% (OR=1.37, data not shown in the table). A systematic search (6) retrieved 48 studies that mentioned the rates of some background diseases in IGM patients, but most of them evaluated a few disorders, with no control group. In that study, the authors report a high rate of hypothyroidism among their 123 patients and propose a probable association; and suggest that controlled studies should investigate this subject further. The present study does not show a significant difference between IGM patients and controls (12.3% vs 12.7%, *P*=0.84) regarding the frequency of hypothyroidism. Overall, these findings probably have no noteworthy implication, except that the underlying diseases might induce a milieu that accentuates reactions to any causative factor and increase the risk of IGM. However, diabetes was directly related with IGM in the present study (OR=4.23). The meta-analysis of Alipour et al (6) also revealed a positive association (*P*=0.01) between IGM and diabetes in the 6 studies that had considered this topic. This finding should be investigated in studies that evaluate the laboratory evidence of diabetes in the two groups.

In the present study, we found low levels of education in IGM patients with borderline significance (*P*=0.05) in crude analysis. Two studies (21, 22) compared educational levels in IGM patients with control groups, the first showed a significant tendency toward lower levels of education in IGM patients, but the second did not show any statistical difference between the two groups. Uncontrolled studies (23-30) reported a preponderance of low levels of education, though this social variable should be balanced against the rates in that society to show their implication. The association was not analyzed in those studies, but the trends imply a probable indirect association. Our finding is slightly in favor of this issue, so studies focusing on the relation between IGM and education level could be very awarding, as education and knowledge are modifiable factors.

There are three main theories about IGM pathophysiology; hormonal, microbial, and immune-related factors. For the latter, auto-immunity is strongly considered, and one of its postulated triggers is the damage of the mammary duct's epithelium secondary to the penetration of milk into the interstitial tissue of the breast. So far, the present study provides the strongest evidence for the association of breastfeeding per se with IGM. In the mentioned theory, the reason of the milk extravasation is unanswered. We postulate that the microbial factor is also involved in this process, and we think that this might be related to events that occur during lactation; incidents like milk stasis, infection, transmission of an organism by the newborn, or similar conditions. We are investigating the question in our next study.

The best advantages of our study were the case-control design and large sample size. Our study had some limitations. We did not include ethnicity and socioeconomic factors other than education and employment in our variables. Moreover, hyperprolactinemia, a condition mentioned in some studies as the basis of IGM, was not considered among the variables because we did not conduct laboratory tests in the control group.

Conclusion

The history of breastfeeding, not its duration, as well as a history of diabetes, are risk factors for IGM, while OCP use is a protective factor. We propose conducting further studies to explore the relationship between breastfeeding, milk stasis, and related local factors in connection with IGM. In addition, given our borderline results regarding educational level, we recommend investigating the link between education level and IGM to gain a better understanding of this modifying factor.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of Interest

The authors have no conflicts of interest to declare.

References

1. Kessler E, Wolloch Y (1972). Granulomatous mastitis: a lesion clinically simulating carcinoma. *Am J Clin Pathol*, 58(6):642-646.
2. Metanat S, Jobaneh YS, Noori M, et al (2022). Global distribution of idiopathic granulomatous mastitis: a scoping review: IGM global distribution. *Arch Breast Cancer*, 9(3-SI):261-271.
3. Omranipour R, Mohammadi SF, Samimi P (2013). Idiopathic granulomatous lobular mastitis-report of 43 cases from iran; introducing a preliminary clinical practice guideline. *Breast Care (Basel)*, 8(6):439-443.
4. Kaviani A, Vasigh M, Omranipour R et al (2019). Idiopathic granulomatous mastitis: Looking for the most effective therapy with the least side effects according to the severity of the disease in 374 patients in Iran. *Breast J*, 25(4):672-677.
5. Yin Y, Liu X, Meng Q, et al (2022). Idiopathic granulomatous mastitis: etiology, clinical manifestation, diagnosis and treatment. *J Invest Surg*, 35(3):709-720.
6. Alipour S, Tabatabaeian M, Nafissi N, et al (2023). Idiopathic Granulomatous Mastitis and History of Hypothyroidism: Intervening Data of a Prospective Multicenter Trial and Meta-Analysis of the Existing Literature: IGM and Hypothyroidism. *Arch Breast Cancer*, 10(1):38-47.
7. Capiro N, Naik P, Lo A, et al (2023). Demographic and socioeconomic risk factors for granulomatous mastitis in the United States: a case-control study. *J Breast Imaging*, 5(2):174-179.
8. Pak H, Maghsoudi LH, Soltanian A, et al (2021). Evaluation of clinical manifestation and risk factors of idiopathic granulomatous mastitis. *Int J Surg Open*, 35:100380.
9. Ramadan R, Koryem IM, Fayed H (2022). Idiopathic granulomatous mastitis: Risk factors and management. *Breast Dis*, 41(1):413-420.
10. Raam M. Etiological evaluation of idiopathic granulomatous mastitis by a prospective case control study [Doctoral dissertation]. Christian Medical College, Vellore; 2018.
11. Al-Khaffaf B, Knox F, Bundred NJ (2008). Idiopathic granulomatous mastitis: a 25-year experience. *J Am Coll Surg*, 206(2):269-273.
12. Pereira FA, Mudgil AV, Macias ES, et al (2012). Idiopathic granulomatous lobular mastitis. *Int J Dermatol*, 51(2):142-151.
13. Barreto DS, Sedgwick EL, Nagi CS, et al (2018). Granulomatous mastitis: etiology, imaging, pathology, treatment, and clinical findings. *Breast Cancer Res Treat*, 171:527-534.
14. Boufettal H, Essodegui F, Noun M, et al (2012). Idiopathic granulomatous mastitis: a report of twenty cases. *Diagn Interv Imaging*, 93(7-8):586-596.
15. Li J, McGregor HP (2017). Idiopathic granulomatous mastitis associated with hyperprolactinemia: a nonoperative approach. *Breast J*, 23(6):742-744.
16. Nikolaev A, Blake CN, Carlson DL (2016). Association between hyperprolactinemia and granulomatous mastitis. *Breast J*, 22(2):224-231.
17. Prasad S, Jaiprakash P, Dave A, et al (2017). Idiopathic granulomatous mastitis: an institutional experience. *Turk J Surg*, 33(2):100-103.
18. Moris D, Damaskos C, Davakis S, et al (2017). Is idiopathic granulomatous mastitis a surgical

disease? The jury is still out. *Ann Transl Med*, 5(15):309.
19. Altintoprak F, Kivilcim T, Ozkan OV (2014). Aetiology of idiopathic granulomatous mastitis. *World J Clin Cases*, 2(12):852-858.
20. Jafari A, Rajabi A, Gholian-Aval M, et al (2021). National, regional, and global prevalence of cigarette smoking among women/females in the general population: a systematic review and meta-analysis. *Environ Health Prev Med*, 26(1):5.
21. Goldman M, Selke HM, Pardo I, et al (2009). Idiopathic granulomatous mastitis in hispanic women-Indiana, 2006-2008. *MMWR Morb Mortal Wkly Rep*, 58(47):1317-1321.
22. Ong SS, Xu J, Sim CK, et al (2023). Profiling Microbial Communities in Idiopathic Granulomatous Mastitis. *Int J Mol Sci*, 24(2):1042.
23. Uysal E, Soran A, Sezgin E (2018), Granulomatous Mastitis Study Group. Factors related to recurrence of idiopathic granulomatous mastitis: what do we learn from a multicentre study? *ANZ J Surg*, 88(6):635-639.
24. Koksal H (2021). What are the new findings with regard to the mysterious disease idiopathic granulomatous mastitis? *Surg Today*, 51:1158-1168.
25. Alikhassi A, Azizi F, Ensani F (2020). Imaging features of granulomatous mastitis in 36 patients with new sonographic signs. *J Ultrasound*, 23:61-68.
26. Yücesoy C, Aydın ZB, Fidan N, et al (2021). Radiologic Features of Idiopathic Granulomatous Mastitis and Emphasis on Analysis of Socioeconomic Status: Over 5 Years of Experience. *Indian J Surg*, 84(Suppl 3):779-785.
27. Davis J, Cocco D, Matz S, et al (2019). Re-evaluating if observation continues to be the best management of idiopathic granulomatous mastitis. *Surgery*, 166(6):1176-1180.
28. Basim P, Argun D, Argun F (2022). Risk factors for idiopathic granulomatous mastitis recurrence after patient-tailored treatment: Do we need an escalating treatment algorithm? *Breast Care (Basel)*, 17(2):172-179.
29. Bademler S, Ucuncu MZ (2018). Our Therapeutic Approach to Idiopathic Granulomatous Mastitis. *Anatol Clin J Med Sci*, 23(2):88-92.
30. Patmano M, Akcan A, Oz AB, et al (2019). Comparison of surgery and surgery plus corticosteroid therapy in idiopathic granulomatous mastitis, prospective randomized study. *Ann Med Res*, 26(12):2984-2989.