Idiopathic granulomatous mastitis

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Abstract: Idiopathic granulomatous mastitis (IGM) is a rare, benign breast condition characterized by multiple draining sterile breast abscesses. This condition of unknown etiology commonly presents in young, parous women with a recent history of lactation and of Mediterranean or Hispanic descent. IGM commonly presents unilaterally with localization in the upper outer quadrant but can present in any quadrant or both breasts concurrently. This disease can mimic breast cancer on various imaging modalities causing concern as well as presenting with erythema, breast edema, breast pain, and sinus tract formation. IGM is diagnosed through the exclusion of all other common pathogens and diseases as well as distinct histological findings of non-caseating granulomas and multinucleated giant cells upon core needle biopsy. IGM is a self-limiting disease and can self-resolve on an average of 5 months, but treatment modalities are recommended to help manage the symptoms. Treatment methods range from observation, steroids, methotrexate, and surgical excision with relapse commonly occurring. Currently, no consensus within the literature exists on the best treatment strategy. Each treatment method has various advantages and disadvantages, therefore this review aims to provide focused, up-to-date guidance on IGM. This review specifically highlights each treatment method, showcases studies on different treatment modalities in a comprehensive table, and provides a precise algorithm for clinicians on the workup and treatment of IGM.

Keywords: Idiopathic granulomatous mastitis (IGM); treatment; corticosteroids; methotrexate; steroid injections

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Introduction

Idiopathic granulomatous mastitis (IGM) is a rare inflammatory breast condition first described in the literature in 1972 (1). Also referred to as idiopathic granulomatous lobular mastitis, it is a rare and chronic condition characterized by relapsing sterile, draining breast abscesses. IGM is challenging clinically, as it mimics the presentation of a bacterial abscess or breast cancer. Often, the diagnosis of IGM is given when all other differential diagnoses are excluded. IGM usually presents in premenopausal women who were recently pregnant or lactating (2-4). It can occur in any race but does have a higher incidence in Hispanics (3,5-7) and people of Mediterranean descent (8).

Despite being present in the literature for the last fifty years, many things are still unknown about this complex, inflammatory disease. First, the etiology remains unclear despite many research studies investigating this disease. Many hypotheses exist for the exact mechanism of action, but an amplified autoimmune response is considered one of the top theories (1,9). Second, the gold-standard treatment modality for this disease remains highly debated within the...
literature with no clear consensus on the recommended
treatment. The recommended treatments range from
observation, steroids, methotrexate, surgical excision, and
unique combinations of these treatment approaches (10).
In this review, we aim to provide a clear overview of IGM
as well as analyze the common treatment modalities
highlighted in the literature.

Methods
A PubMed search was used to identify all articles regarding
the diagnosis and treatment of IGM. A total of 616 articles
from the time frame of 1972 to June 2020 were identified
utilizing the search term of “granulomatous mastitis”. Each
article was analyzed for the main finding of the study as well as
the recurrence rate. Few articles were prospective randomized
trials and many were retrospective analyses or case studies
identifying the success of various treatment regimens. All
pertinent articles are included online: https://cdn.amegroups.
cn/static/public/ABS-2020-BBD-03-supplementary.xlsx.
Institutional review board approval was not obtained since
only published studies were analyzed for this review article.

A summarized version of the appendix is included in this
paper (Table 1) which highlights the type of study performed,
number of subjects included, which treatment modalities
were compared, recurrence rates as well as findings and
recommendations. Table 1 was created from the appendix by
first identifying the different treatment modalities and then
identifying how many published articles, in the conclusion
of the manuscript, supported that treatment modality.
Manuscripts supporting the various treatments were grouped
together. Treatment groups that contained less than ten
publications had every article included in the table. If a
treatment group had more than ten published studies, then the
articles were selectively chosen to be added to Table 1 if they (I)
had a sample size larger than 20 subjects and (II) contributed
to the field through multiple citations, robust data, supported
conclusions and low recurrence rates. With the presented
conflicting arguments of each treatment modality highlighted,
this review will give treatment guidelines for clinicians as well
as a simplified management algorithm.

Review results
Diagnosis
Presentation
IGM presents clinically as a palpable breast lesion(s)
(Figure 1) that vary in size from 1–5 cm, with an array
of other symptoms such as tenderness, overlying skin
induration, erythema, sinus tract formation, or breast
edema which can clinically mimic a breast abscess or breast
cancer on various imaging modalities (1,3,30-32,54-56).
IGM commonly presents unilaterally (3) in the upper outer
quadrant of the breast (3,4,31), but can be found in any
quadrant as well as in both breasts concurrently (27). The
palpable, erythematous breast lesion(s) are sterile abscesses
often accompanied by the development of spontaneous
fistulae or sinus formation.

Inflammation of Cooper’s ligaments can occur, causing
nipple inversion or retraction (9). In 13% to 40% of
women, enlarged, palpable reactive lymph nodes are noted
on exam (3,4,56). Systemic symptoms, such as a fever, are
generally absent from the objective findings (8). An essential
component of this challenging disease is recognizing
the complex presentation to avoid unnecessary surgical
interventions and excessive antibiotics. Clinicians diagnose
IGM when all other differential diagnoses are excluded,
and specific pathologic findings on core needle biopsy are
present.

Imaging
In addition to the clinical symptoms mimicking other
diseases, the imaging can also present ambiguously.
Mammography findings can include an ill-defined density
with speculated margins along with associated overlying skin
thickening (Figure 2) (56,57). On ultrasound, IGM displays
abscess formation with tubular extensions or hypoechoic
mass (Figure 3A), with or without enlarged lymph nodes
(Figure 3B) with mild concentric cortical thickening
(3,56,57). Magnetic Resonance Imaging (MRI) shows IGM
as one or many masses with a ring or nodular enhancement
(Figure 4) (57). Since IGM is a chronic disease that needs
monitoring for a significant amount of time, MRI’s can help
evaluate the extent of the disease at presentation as well as
monitor progression following the reduction and resolution
of lesions with time (9).

Biopsies
IGM is confirmed with specific histopathological findings
obtained from a core needle biopsy of the abscess wall. The
hallmark pathological finding of IGM is the presence of
multinucleated giant cells, plasma cells, polymorphonuclear
leukocytes, lymphocytes, and occasionally sterile
microabscesses (Figure 5) (3,4,31,56,58). A core needle
biopsy is preferred over an excisional biopsy or fine-needle
### Table 1 Comprehensive summary of high-impact treatment publications

<table>
<thead>
<tr>
<th>Type of treatment</th>
<th>Authors</th>
<th>Journal</th>
<th>Year</th>
<th>Total number of subjects</th>
<th>Type of study</th>
<th>Recurrence rate (n, %)</th>
<th>Treatment modalities compared</th>
<th>Findings and recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgery</td>
<td>Pandey et al. (5)</td>
<td>The Breast</td>
<td>2014</td>
<td>49</td>
<td>Prospective case series</td>
<td>0 (0.0%)</td>
<td>Compared patients with IGM to observation, surgery, and steroid therapy</td>
<td>Recommended observational approach for painless cases; for painful cases, recommended against surgical treatment, favoring steroids</td>
</tr>
<tr>
<td></td>
<td>Ma et al. (11)</td>
<td>Breast Care</td>
<td>2020</td>
<td>970</td>
<td>Systemic review and meta-analysis</td>
<td>N/A</td>
<td>Reviewed 21 studies that compared surgical excision, steroids, abscess drainage, antibiotics, and observation</td>
<td>Concluded that observation for early IGM patients is beneficial</td>
</tr>
<tr>
<td></td>
<td>Bouton et al. (12)</td>
<td>The American J of Surg</td>
<td>2015</td>
<td>37</td>
<td>Retrospective chart review</td>
<td>3 (11.1%)</td>
<td>Compared antibiotic treatment, drainage, excision, and observation</td>
<td>Proposed that IGM is a self-limited condition which will resolve spontaneously without treatment</td>
</tr>
<tr>
<td></td>
<td>Mahlab-Guri et al. (13)</td>
<td>IMAJ</td>
<td>2015</td>
<td>17</td>
<td>Case series</td>
<td>1 (25.0%)</td>
<td>Compared oral steroids to oral steroids plus MTX and excision</td>
<td>The recommended treatment of choice is observation; corticosteroids recommended in severe cases</td>
</tr>
<tr>
<td></td>
<td>Hur et al. (14)</td>
<td>JKSS</td>
<td>2013</td>
<td>50</td>
<td>Retrospective chart review</td>
<td>1 (12.5%)</td>
<td>Five treatment groups: observation, antibiotics, steroid, drainage, and surgical excision</td>
<td>Concluded that observation is recommended when lesions were small and symptoms were mild</td>
</tr>
<tr>
<td></td>
<td>Davis et al. (15)</td>
<td>Surgery</td>
<td>2019</td>
<td>120</td>
<td>Retrospective chart review</td>
<td>19 (16.6%)</td>
<td>Analyzed observation only</td>
<td>Recommended observation; with resolution occurring at an average of 5 months</td>
</tr>
<tr>
<td>Oral steroids</td>
<td>Yabaroglu et al. (16)</td>
<td>The Breast</td>
<td>2015</td>
<td>77</td>
<td>Comparative study</td>
<td>0 (0.0%)</td>
<td>Compared steroids and surgical excision</td>
<td>Wide surgical excision was the preferred approach for treating patients with IGM because of the low recurrence rate</td>
</tr>
<tr>
<td></td>
<td>Alarayes et al. (17)</td>
<td>The Breast</td>
<td>2019</td>
<td>29</td>
<td>Retrospective chart review</td>
<td>0 (0.0%)</td>
<td>Surgical excision only</td>
<td>Surgical excision is recommended for IGM resolution; corticosteroids recommended in select patients</td>
</tr>
<tr>
<td></td>
<td>Korkut et al. (18)</td>
<td>Eurasian J Med</td>
<td>2015</td>
<td>73</td>
<td>Retrospective chart review</td>
<td>4 (11.1%)</td>
<td>Compared incision and drainage, surgical excision, and corticosteroids</td>
<td>Authors concluded that surgical excision is recommended for the treatment of IGM</td>
</tr>
<tr>
<td></td>
<td>Hur et al. (14)</td>
<td>JKSS</td>
<td>2013</td>
<td>50</td>
<td>Retrospective chart review</td>
<td>1 (8.3%)</td>
<td>Compared five treatment method groups: observation, antibiotics, steroid, drainage, and surgical excision</td>
<td>Concluded that surgery was best treatment modality when a lesion was determined to be mass forming or a localized abscess due to fast recovery and high success rate</td>
</tr>
<tr>
<td></td>
<td>Erozgen et al. (19)</td>
<td>Breast Cancer Res Treat</td>
<td>2010</td>
<td>25</td>
<td>Retrospective chart review</td>
<td>N/A</td>
<td>Compared oral steroids and surgical excision</td>
<td>Authors proposed that surgical treatment is the first line treatment due to corticosteroid therapy having extensive complications</td>
</tr>
<tr>
<td></td>
<td>Kok et al. (50)</td>
<td>Surgeon</td>
<td>2010</td>
<td>43</td>
<td>Retrospective cohort study</td>
<td>10 (25%)</td>
<td>Compared surgical excision and corticosteroids</td>
<td>Recommended treatment with complete surgical excision and drainage as first-line therapy</td>
</tr>
<tr>
<td></td>
<td>Yau et al. (21)</td>
<td>Ann Plast Surg</td>
<td>2010</td>
<td>31</td>
<td>Retrospective chart review</td>
<td>1 (3.2%)</td>
<td>Compared surgical excision and antibiotics</td>
<td>Concluded surgical intervention as an effective method for treating IGM</td>
</tr>
<tr>
<td></td>
<td>Deng et al. (22)</td>
<td>J of Clin Pathology</td>
<td>2017</td>
<td>65</td>
<td>Retrospective case report</td>
<td>12 (18.5%)</td>
<td>Oral corticosteroids only</td>
<td>Authors concluded that an effective treatment option is corticosteroids after removal of the lesion using the Mammotrace biopsy system</td>
</tr>
<tr>
<td></td>
<td>Cetin et al. (23)</td>
<td>World J Surg</td>
<td>2019</td>
<td>124</td>
<td>RCT</td>
<td>20.70%</td>
<td>Compared the different steroid administration modalities of topical, systemic, and topical plus systemic</td>
<td>Concluded that oral, systemic steroids are 80% effective for complete response with 20% recurrence rate</td>
</tr>
<tr>
<td></td>
<td>Mahmodova et al. (24)</td>
<td>Electronic Physician</td>
<td>2017</td>
<td>48</td>
<td>Retrospective cohort study</td>
<td>3 (6.25%)</td>
<td>Oral corticosteroids only</td>
<td>Authors concluded that steroid therapy is an effective treatment modality for IGM</td>
</tr>
<tr>
<td></td>
<td>Aghajanzadeh et al. (25)</td>
<td>The Breast</td>
<td>2015</td>
<td>206</td>
<td>Retrospective chart review</td>
<td>11 (5.5%)</td>
<td>Compared the treatments of surgical excision, oral steroids, steroids plus methotrexate, steroids plus bromocriptine, and surgery plus steroids plus antibiotics</td>
<td>Recommended oral corticosteroids as the first line of treatment</td>
</tr>
<tr>
<td></td>
<td>Pandey et al. (5)</td>
<td>The Breast</td>
<td>2014</td>
<td>49</td>
<td>Observational prospective cohort study</td>
<td>9 (20.5%)</td>
<td>Compared subjects with IGM to observation, surgery, and steroid therapy</td>
<td>Authors recommended steroid therapy as an effective non-surgical option</td>
</tr>
<tr>
<td></td>
<td>Montazar et al. (26)</td>
<td>Asian Pac J Cancer Prev</td>
<td>2020</td>
<td>30</td>
<td>RCT</td>
<td>N/A</td>
<td>Compared high and low dose corticosteroids</td>
<td>Concluded that high dose prednisolone is more beneficial than low dose prednisolone due to having a higher success rate with lower recurrence; could reduce the need for surgery</td>
</tr>
<tr>
<td></td>
<td>Mizraki et al. (27)</td>
<td>Surg Today</td>
<td>2015</td>
<td>49</td>
<td>Retrospective chart review</td>
<td>N/A</td>
<td>Compared oral corticosteroids, antibiotic therapy, and surgical excision</td>
<td>Authors concluded that systemic corticosteroids are an appropriate treatment option for IGM</td>
</tr>
<tr>
<td></td>
<td>Shin et al. (28)</td>
<td>BMC Women’s Health</td>
<td>2017</td>
<td>34</td>
<td>Retrospective chart review</td>
<td>5 (25.0%)</td>
<td>Compared wide excision, corticosteroids, and abscess drainage</td>
<td>Recommended first line treatment should be steroid therapy with or without abscess drainage</td>
</tr>
<tr>
<td></td>
<td>Wang et al. (29)</td>
<td>J of Invest Surg</td>
<td>2019</td>
<td>200</td>
<td>Retrospective chart review</td>
<td>8 (5.1%)</td>
<td>Compared steroid therapy alone to surgical excision after steroid therapy</td>
<td>Authors concluded that surgery after steroid therapy is a more satisfactory treatment for IGM than steroid therapy alone</td>
</tr>
<tr>
<td>Oral steroids + surgical management</td>
<td>Alikan et al. (30)</td>
<td>Breast Care</td>
<td>2014</td>
<td>74</td>
<td>Retrospective chart review</td>
<td>0 (0.0%)</td>
<td>Analyzed surgical excision with or without oral corticosteroids</td>
<td>Recommended systemic steroid therapy with surgical resection as first-line treatment</td>
</tr>
<tr>
<td></td>
<td>Oran et al. (31)</td>
<td>The Breast</td>
<td>2013</td>
<td>46</td>
<td>Retrospective chart review</td>
<td>0 (0.0%)</td>
<td>Compared surgical excision, steroid therapy, and steroid therapy plus surgical excision</td>
<td>Authors concluded that surgical excision plus steroid therapy is first line management for recurrence</td>
</tr>
</tbody>
</table>

Table 1 (continued)
<table>
<thead>
<tr>
<th>Type of treatment</th>
<th>Authors</th>
<th>Journal</th>
<th>Year</th>
<th>Total number of subjects</th>
<th>Type of study</th>
<th>Recurrence rate (n, %)</th>
<th>Treatment modalities compared</th>
<th>Findings and recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral steroids + methotrexate</td>
<td>Aghajanzadeh et al. (25)</td>
<td>The Breast</td>
<td>2015</td>
<td>206</td>
<td>Retrospective chart review</td>
<td>16 (28.6%)</td>
<td>Compared the treatments of surgical excision, oral steroids, steroids plus methotrexate, steroids plus bromocriptine, and surgery plus steroids and antibiotics</td>
<td>Concluded that the treatment of choice is corticosteroids and methotrexate, with or without surgery</td>
</tr>
<tr>
<td>Topical steroids</td>
<td>Tang et al. (39)</td>
<td>Journal of Surgical Research</td>
<td>2020</td>
<td>49</td>
<td>Retrospective cohort study</td>
<td>0 (0%)</td>
<td>Compared the treatment methods of observation, steroid injection, and surgical resection</td>
<td>Authors concluded that intralesional steroid injection is an effective treatment option</td>
</tr>
<tr>
<td>Steroid injections</td>
<td>Munot et al. (42)</td>
<td>European Journal of Surgical Oncology</td>
<td>2012</td>
<td>4</td>
<td>Case reports</td>
<td>0 (0%)</td>
<td>Compared steroid injections only</td>
<td>Injection of steroids for the treatment of IGM is an effective method with minimal complications</td>
</tr>
<tr>
<td>Methotrexate and other agents</td>
<td>Raj et al. (43)</td>
<td>Rheumatology</td>
<td>2004</td>
<td>3</td>
<td>Case reports</td>
<td>N/A</td>
<td>Compared the treatment modalities of methotrexate plus corticosteroids and methotrexate plus azathioprine</td>
<td>Recommended the use of methotrexate with azathioprine without long-term steroids use to avoid steroid side effects</td>
</tr>
</tbody>
</table>

Table 1 (continued)
Reviewed 21 studies that compared surgical excision, steroids, abscess drainage, antibiotics, and observation. Authors concluded that surgery after steroid therapy is a more satisfactory treatment for IGM than steroid therapy alone. Recommended observation for early IGM patients. Recommended observation for early IGM patients.

- **Wang et al. (29)**: *J Amer Surg* 2019; 200 Retrospective chart review N/A Compared surgery after steroid therapy and steroid therapy alone

- **Ma et al. (11)**: *Breast Care* 2020; 970 Systemic review and meta-analysis N/A Reviewed 21 studies that compared surgical excision, steroids, abscess drainage, antibiotics, and observation

- **Steuer et al. (48)**: *JAMA Dermatol* 2020; 32 Case reports N/A Analyzed antibiotics and methotrexate

- **Cettin et al. (23)**: *World J Surg* 2019; 124 RCT N/A Compared different steroid administration modalities of topical, systemic, and topical plus systemic. Concluded that topical steroids are first line treatment due to the decreased side effects.

- **Atak et al. (52)**: *Breast Dis.* 2015; 40 Retrospective chart review N/A Authors compared the treatment methods of antibiotics and anti-inflammatory agents, steroids, abscess drainage, and surgical excision. Concluded that surgical excision is the best treatment modality for IGM.

- **Akcarn et al. (30)**: *Breast Care* 2014; 74 Retrospective chart review N/A Compared surgical excision with or without oral corticosteroids. Authors recommend systemic steroid therapy with surgical reaction as first-line treatment.

- **Oran et al. (31)**: *The Breast* 2013; 46 Retrospective chart review N/A Three different treatment modalities were examined: surgical excision, steroid therapy, and steroid therapy plus surgical excision. Authors concluded that surgical excision or steroid therapy is first line.

- **Hur et al. (14)**: *JKSS* 2013; 50 Retrospective chart review N/A Five treatment method groups: observation, antibiotics, steroid, drainage, and surgical excision. Concluded that surgery be best treatment modality when a lesion is determined to be mass forming or localized as an abscess due to fast recovery and high success rate.

- **Kayahan et al. (53)**: *Breast Care* 2012; 31 Retrospective cohort study N/A Analyzed the treatment methods of surgical excision. Abscess drainage, or steroid therapy. Authors concluded that excision was a superior treatment modality compared to steroid therapy by providing less complications and faster healing.

- **Shaybani et al. (54)**: *The American College of Obstetricians and Gynecologists* 2015; 22 Prospective cohort study N/A Compared oral steroids to oral steroids plus methotrexate. Concluded the treatment of choice is corticosteroids and methotrexate, with or without surgery.

- **Pandey et al. (5)**: *The Breast* 2014; 49 Prospective case series N/A Compared the treatment modalities of observation, surgery, and steroid therapy. Concluded that the majority of women did not need surgical treatment; recommended observation for painless cases and steroid therapy as an effective nonsurgical option.

- **Karaniik et al. (33)**: *Breast Care (Basel)* 2014; 60 Prospective, non-randomized observational study N/A Analyzed low-dose oral corticosteroid therapy alone to low-dose corticosteroid therapy followed by surgery. Concluded that surgical excision after steroid therapy is more advantageous treatment option than steroid therapy alone.

- **Aghajanzadeh et al. (25)**: *The Breast* 2015; 206 Retrospective chart review N/A Compared the treatments of surgical excision, oral steroids, steroids plus methotrexate, steroids plus bromocriptine, and surgery plus steroids plus antibiotics. Authors recommended oral corticosteroids as the first line of treatment.

- **Tang et al. (39)**: *Journal of Surgical Research* 2020; 49 Retrospective cohort study N/A Compared the treatment modalities of observation, steroid injections, and surgical excision. Authors concluded that intralesional steroid injection is an effective treatment; surgical resection is not necessary for most patients.

- **Yabanoglu et al. (16)**: *The Breast* 2015; 77 Comparative study N/A Authors compared conservative management (steroids) vs. surgical excision. Found that wide surgical excision is the preferred approach for treating patients with IGM because of the low recurrence rate.

- **Shin et al. (28)**: *BMC Women’s Health* 2017; 34 Retrospective chart review N/A Compared the different treatment modalities of wide excision, steroids after incision and drainage, and antibiotic therapy. Steroid therapy with or without abscess drainage may be the first choice of treatment; recommended against wide excision.
aspiration (FNA) because it completely characterizes the lesion, is less disfiguring and rules out malignancy (31). If an abscess is present, drainage should occur by FNA and cultures should be obtained to rule out any infectious etiology such as aerobes, anaerobes, fungal infection (periodic acid-Schiff), as well as microorganisms such as Corynebacterium (Gram stain), or acid-fast bacilli (Zeihl-Neelsen) (3,59). Other plausible pathogens should be ruled out at this time including mycobacterial, parasitic, or mycotic origins (1,9,27). Tuberculosis mastitis should also be eliminated from the differential diagnosis through

Figure 1 Clinical presentation of IGM in two separate patients.

Figure 2 Mammography imaging demonstrates asymmetric densities mimicking breast carcinoma and enlarged lymph node.

Figure 3 Ultrasound images of IGM. (A) Ultrasound findings of breast parenchyma with ill-defined abscess cavities and (B) ultrasound findings of IGM showcase enlarged axillary lymph node with eccentric cortical thickening.
a purified protein derivative (PPD) serum test, skin test, or chest x-ray in addition to the tissue staining for the acid-fast bacilli. Autoimmune etiologies like sarcoidosis or foreign material should be excluded through blood work examining antinuclear antibody (ANA), rheumatoid factor, C-reactive protein, and alpha-I-antitrypsin (1,9,27).

**Etiology**

The etiology of IGM remains unclear, although a correlation is well documented with recently pregnant or lactating women (51). Many studies support the hypothesis of an autoimmune component (1,9). Other theories suggest an association of hormonal imbalance, oral contraceptives (31), smoking (60), corynebacterium (28), unknown microbiological agents (8), and α1-antitrypsin deficiency (8) whereas other studies have refuted these associations (8,30). It is speculated that the pathology is from local trauma or changes to the ductal epithelium allowing for luminal secretions to be present in the lobular connective tissue, therefore causing lymphocyte and macrophage migration, triggering a granulomatous response within the breast (9). Further research is needed to isolate the exact mechanism of IGM, which would allow for a more personalized treatment approach.

**Treatment**

Currently, no standardized treatment for IGM exists. Treatments are decided through analyzing each patient’s presentation, the severity of the symptoms, the size of the lesions, the overall health of the patient as well as the surgeon’s preferred treatment method. Many treatment algorithms are present throughout the literature, but none have been widely accepted (3,4,27,31,54,55,61). Although a benign disease, effective treatment is necessary to manage the symptoms and prevent the recurrence of the disease. Recurrence and relapse rates for IGM have varied from 20–50% (3,57,62) causing stress for the patient and the treating physician. Importantly and reassuringly, IGM is a self-limiting disease resolving within 2 to 24 months of onset, regardless of the treatment modality used (4,57). A variety of treatment methods have been utilized to relieve the patient’s chief complaints such as observation, various forms of steroids, immune modulators and surgical excision. This review will outline each treatment method and give an algorithm up-to-date with the current research. An extensive literature review of IGM treatment modalities is presented (Table 1).

**Antibiotics and pain management**

Since IGM is a disease of exclusion, it is essential upon presentation to rule out any infectious agents while beginning a workup, as bacterial abscesses are more common. Therefore, a bacterial etiology must be before diagnosing IGM. All abscesses should be aspirated or drained followed by broad-spectrum antibiotics during the period of diagnostic evaluation. Acceptable antibiotics include sulfamethoxazole and trimethoprim, amoxicillin/clavulanate (4), doxycycline (48) as well as metronidazole.

For symptomatic pain relief, nonsteroidal anti-inflammatory drugs (NSAIDs) such as ibuprofen (Advil) and celecoxib (Celebrex) are the drugs of choice to help with the inflammatory pain that corresponds to the IGM masses (3). Opiates are rarely required for this level of pain.
management (3).

Observation
IGM is known to be self-limiting; therefore a more conservative treatment method used is observation of the abscesses with regular clinic examinations (14). Many patients present with an array of symptoms and abscess sizes, but if the symptoms are mild to painless along with small lesions, observation may be the first line of treatment, as it will self-resolve (5,11-13,15). Patients need to be reassured that IGM does resolve, but the time to resolution can average 5 months (15). Once the diagnosis of IGM is confirmed, and infections etiology including Corynebacterium is ruled out, patients do not necessarily need to maintain on long-term antibiotics. However, physicians also need to follow patients during observation to ensure no signs of other opportunistic bacterial infection occur due to the open skin areas.

Surgical treatment
Surgical treatment methods vary from abscess drainage, wide surgical excision, and mastectomy. Although the literature has demonstrated that wide surgical excision has been successful (4,14,16,17,20,30,31,53,63), recurrence rates range from 0% to 50% (16,30,64). When completing a wide excision, the goal is a complete removal of the questionable area including fistula tract, affected skin, with a lesion free margin ranging from 5 to 10 mm (3,30).

Much debate still exists about the benefits of surgical excision. Since newer treatment methods have evolved within the last ten years, the utilization of surgical intervention as a first-line therapy has reduced (5,13,28,29). If the patient has a single small lesion, surgical excision could be considered but high recurrence rates are likely. Additionally, there are side effects to surgical excision such as poor cosmetic results, extensive scarring, as well as delays in both wound healing and fistula formation (28,32,33). Although mastectomy in severe cases has been described, so has recurrence after mastectomy, so this approach is not optimal.

Steroids
The utilization of steroids for IGM was first published in 1980 (65) and remains today the first-line treatment. Steroids are administered in three different ways: oral, topical, or injections.

Oral steroids are still commonly used and have documented success rates up to 80% (22), but still have the chance for relapse. The prescribed range for IGM is 10–60 mg/day of prednisone or 30–60 mg/day of prednisolone (27) with a gradual taper over the following weeks to months (30). Additional treatment options include 16 mg prednisolone twice a day for two weeks (36) or 1 mg/kg of prednisolone for three weeks (3). Unfortunately, the high rates of IGM resolution with use of oral steroids come at a price: systemic side effects. The side effects range from glucose intolerance and insomnia to cushingoid features. In addition, patients can potentially relapse when discontinuing treatment a few months later (3), however an extra course of steroids can be prescribed when that occurs.

Clinicians prescribe topical steroids as a popular alternative to oral steroids due to having less systemic side effects. Case reports all show positive results and endorse the usage of topical steroids (23,36-38). The pharmacological agent of choice is prednisolone ointment (0.125%) twice a day for 1–3 months (23,36). The recurrence rates for topical steroid use range from 10–18% (23,36-38). In a study published by Cetin et al., the steroid administration routes of topical, systemic, and topical plus systemic steroids were examined and topical steroids had the best results with the lowest recurrence rate of 14.7% (23).

Steroid injections directly into the IGM lesions are the newest advancements in the treatment of IGM and given the reported effectiveness and decreased recurrence rates (39-42), should be considered as the first-line therapy for any newly presenting IGM patient. Steroid injections are based on the well-established techniques for treating arthritic diseases. Steroid injections for IGM were first described in 2012 with a small sample size, but a very low recurrence rate (42). Many newer studies have reported no recurrences with steroid injections along with a faster resolution time compared to other treatment modalities (39-42). The prescribed dose is Kenalog-40 (triamcinolone 40 mg/mL) ranging in volume from 2–4 mL (80–160 mg) mixed with lidocaine as a local anesthetic (39). The injection into the IGM lesion(s) is completed under ultrasound guidance and repeated every 1–2 weeks until resolution. A potential complication of this treatment modality is skin atrophy (39), but otherwise it holds a great deal of promise as a minimally invasive first-line treatment approach.

Immune modulators
Methotrexate (MTX), an immunosuppressive agent, has also been successful in the treatment of IGM. This method is an alternate therapeutic option for any patient who is unresponsive to steroid therapy (3,49). MTX can be given
with other treatment modalities such as steroids (25), but a recent study has shown promising effects of this treatment modality on its own demonstrating that by 15 months of treatment, 94% of patients had disease improvement along with 75% achieving remission (50). The pharmacological dosing for MTX is 10–15 mg/week and increasing to 20–25 mg/week given either orally or subcutaneously based on clinical response (50). Reported adverse effects range from elevated liver enzymes and hair loss to more mild symptoms such as nausea, decreased appetite, and mild headaches (41,50).

In the situation where the IGM lesions are not responding (or progressing) and MTX is being considered, consultation to rheumatology and infectious disease is recommended.

**Studies comparing different treatment modalities**

A comprehensive search was conducted over all the published literature for IGM examining the many detailed treatment studies. A comprehensive table (Table 1) is provided of the most significant treatment studies along with all comparative studies to date (full review: https://cdn.amegroups.cn/static/public/ABS-2020-BBD-03-supplementary.xlsx). Based on review of these comparisons,
a flow sheet reviewing work-up and management options has been compiled as a reference (Figure 6).

**Discussion**

Many significant advancements in the treatment modalities for IGM have occurred within the last ten years. Still, randomized controlled trials are needed to determine which treatment modality is superior. Promising studies exist for each treatment modality, but an accurate conclusion about the best treatment modality cannot be drawn without a randomized control trial. As highlighted in the spreadsheet of treatment studies (Table 1), the recurrence rates for steroid injections into the abscess cavity are remarkably low in the published literature. Due to these low rates, steroid injections hold great promise and; therefore, we recommend it as the preferred treatment modality due to the high success, minimal systemic side effects and low recurrence rates.

Our comprehensive treatment algorithm (Figure 6) serves to provide a road map for any clinician to diagnose and treat IGM successfully. A thorough workup is critical to exclude all other differential diagnoses to detect IGM accurately. From our literature review, a comprehensive treatment plan is presented to help guide any clinician who encounters IGM in their clinic. Patients presenting with a mass suspicious for IGM should have diagnostic imaging. If an abscess is present, aspiration should be performed, sent for cultures and prophylactic antibiotics initiated. If the abscess cultures are sterile or there is a mass on imaging, a core biopsy should be performed to obtain a tissue diagnosis to confirm IGM. Based on the literature review, the authors recommend observation as the first line treatment with attention to symptom management. This includes non-steroidal anti-inflammatory medication for the pain and topical steroids to the affected area. If the symptoms worsen, use of injectable steroids into the abscess cavity can facilitate resolution of the breast abscesses. If no improvement or a large area of the breast is involved, oral steroids can be utilized. In refractory cases, methotrexate can be used. Surgical excision should be used sparingly, with mastectomy as a very last resort.

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