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Puerperal mastitis in the past decade: results of a single institution analysis

J. Lukassek[1,3] · A. Ignatov[1] · J. Faerber[2] · S. D. Costa[1] · H. Eggemann[1]

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Abstract

Purpose Although puerperal mastitis is a common disease, published data are poor. Increasing rates of community-acquired MRSA (CA-MRSA) cases are reported in the USA. However, information about common pathogens and CA-MRSA in Germany is still insufficient. The aim of this study was to investigate the most common pathogens of puerperal mastitis in the last decade, its therapy, resistance rate and the effectiveness of the current treatment strategies.

Methods The pathogens, the respective antibiograms and the treatment strategies of patients treated for puerperal mastits at the University Clinic Magdeburg (Germany) between 2006 and 2016 were retrospectively reviewed. Statistical analysis was performed using SPSS Version 21.

Results In our series, 59 cases with puerperal mastitis were reviewed, 26 (44.1%) of these developed a breast abscess. In 37 of 59 (67.3%) cases the symptoms occurred in the first 8 weeks postpartum. The most common pathogens were *Staphylococcus aureus* (64.9%) and Coagulase-negative *Staphylococcus* (13.5%). Methicillin-resistant *Staphylococcus aureus* (MRSA) was found in one case. Of the 19 cases with *Staphylococcus aureus,* 17 were resistant to Penicillin. Conservative management was mainly performed with Flucloxacillin (60%), which was successful in most cases. Sixteen of 26 (61.5%) women with abscesses underwent ultrasound (US)-guided needle aspiration.

Conclusion In this cohort, MRSA was not a main pathogen responsible for breast abscesses. Conservative treatment strategies remained constant during the observed period and Flucloxacillin was the most frequent antibiotic used. The analysis of the courses of diseases leads to the conclusion that surgical incision is progressively replaced by US-guided needle aspiration.

Keywords Lactational breast abscess · MRSA · Puerperal mastitis · Ultrasound-guided needle aspiration

Introduction

Puerperal mastitis is an infection of breast tissue during lactation with an incidence of 10% [1], although some studies have revealed a higher incidence [2]. Less than 3% of patients with mastitis are developing a breast abscess [3, 4]. *Staphylococcus aureus* and coagulase-negative *Staphylococcus* are the most common pathogens and are observed in 78.7% of cases [5]. An infection with oxacillin-resistant *Staphylococcus aureus* manifests itself more dramatically and more often requires a surgical intervention like incision and drainage [5].

Predisposing factors for mastitis are cracked nipples, breastfeeding attachment issues and milk stasis [6]. Women with a history of puerperal mastitis are more likely to develop recurrent mastitis [7]. Interestingly, mastitis is also associated with urinary infections and fungal infections [7]. The most common symptoms of mastitis are local tenderness, erythema of the breast, fever, and flu-like symptoms [3]. Cullinane et al. [8], found that nasal colonization with *Staphylococcus aureus* of the mother does not correlate with the risk of developing puerperal mastitis, whereas the colonization of the nipple or breast milk is a risk factor of developing puerperal mastitis [6]. Since, there are only limited data available about the clinical management of puerperal mastitis, we aimed to gain an overview of the treatment strategies in our department over the last decade.

✉ J. Lukassek
Julia.lukassek@gmx.de

[1] Department of Obstetrics and Gynaecology, Otto-von-Guericke University, Magdeburg, Germany

[2] Department of Medical Microbiology and Hospital Hygiene, Otto-von-Guericke University, Magdeburg, Germany

[3] Gottfried-Kellerstrasse 24, 86720 Noerdlingen, Germany

In this context, we aimed to gain an overview of the management of puerperal mastitis in our institution over the last decade. The focus was to identify the main pathogens responsible for puerperal mastitis and their resistance to common antibiotics. Our goal was to determine, whether proven treatment strategies need to be adapted. With the increasing prevalence of MRSA induced puerperal mastitis in the United States, we investigated the role of MRSA pathogens in our cohort.

Materials and methods

In our study, 59 cases with puerperal mastitis treated between January 2006 and December 2016 in the University Clinic Magdeburg, Germany were retrospectively reviewed. All patients were examined in the out-patients department. Those patients with an intravenous antibiotic treatment required a further hospital stay. Date of child birth, delivery report, breastfeeding characteristics, date of diagnosis, symptoms of mastitis, comorbidities and treatment modality were collected by reviewing clinical charts. Women with simple milk stasis were excluded. Breast swabs analyzed by the department of microbiology and antibiograms were additionally reviewed. The abscess size measured by ultrasound was recorded. Data were registered in a Microsoft Access databank.

Statistical analysis

Statistical calculations were performed using SPSS version 21.0 (SPSS, Chicago, IL, USA). The correlation of variables and the distribution of clinical, pathological and treatment characteristics were assessed using the Chi squared test. The statistical analyses were two-sided and p values of < 0.05 were considered statistically significant.

Results

Fifty-nine cases with puerperal mastitis were included in this study in the period of investigation. The mean age of the women was 30.5 years (range 20–40 years). Thirty-three cases (55.9%) experienced a simple puerperal mastitis, whereas 26 cases (44.1%) developed a breast abscess. The characteristics of the women are presented in Table 1. Most of the women ($n = 39$; 67.2%) were primiparous. Thirty-two women (57.1%) delivered spontaneously, 20 (35.8%) delivered via caesarean section and 4 (7.1%) with the aid of vacuum extraction. Over 90% started breastfeeding after delivery and continued breastfeeding at home. After developing symptoms of infection like mammillary redness, wounded nipples and malaise, 19 (59.4%) women stopped breastfeeding. Twelve (37.5%) women continued breastfeeding in the presence of symptoms. The most commonly suggested breastfeeding technique to treat the symptoms was pumping (79.2%). Of the 19 women who had stopped breastfeeding 8 women started to breastfeed again after consulting a physician. All patients experienced flu-like symptoms, and 22 women reported fever. All of the described symptoms are listed in Table 2.

Symptoms occurred in 67.3% in the first eight weeks postpartum (range 0–144 weeks postpartum). Eighty percent of women experienced puerperal mastitis in the first 12 weeks postpartum. Comorbidities such as smoking, diabetes, hypertension and pre-eclampsia were rarely reported.

Isolated pathogens and their antibiograms are shown in Table 3. In 37 cases breast swabs were taken and the specimens were analyzed. In 11 cases, more than one microorganism was detected. The main pathogen isolated in 64.9% of the cases was *Staphylococcus aureus*. *Staphylococcus aureus* was resistant to Penicillin in 17 of 19 (89%) cases and susceptible to Flucloxacillin in all cases. Coagulase-negative *Staphylococcus* was the responsible pathogen in 13.5% of cases. *Streptococcus viridans*, *Enterococcus faecalis*, MRSA, *Peptostreptococcus* and *Streptococcus agalactiae* were observed in 1 (2.7%) case each. In three cases no pathogen was detected (8.1%). Details about the frequency distribution of causative pathogens and the concomitant growth of second organisms are shown in Table 3.

Of the 33 patients with puerperal mastitis and 26 cases with breast abscess, 55 (93.2%) underwent conservative treatment including cooling, NSAR and an antibiotic treatment. Four (6.8%) cases had no antibiotic coverage. In two of those cases only an incision was performed, in the other two cases no further treatment details were documented. Furthermore, all patients with breast abscess underwent surgical treatment. Details about conservative treatment are presented in Table 4. Most women with (50%) and without (67.7%) an abscess received Flucloxacillin orally for 7 to 10 days (range 2–21 days). Thirty-eight of the 55 (69.1%) patients were successfully treated and did not need additional therapy. Seventeen of the 55 (30.9%) patients received further antibiotic treatment, described in Table 5.

Five women with simple puerperal mastitis required further treatment. Three patients received Flucloxacillin orally, intravenously or combined (first treatment contained Ampicillin, Amoxicillin or Cefotaxim), one patient received Ampicillin/Sulbactam orally and one patient received Amoxicillin/Clavulanate orally. After the second antibiotic therapy, all five women were cured.

Eleven women with breast abscesses required additional treatment. Most of the patients with breast abscesses received Clindamycin ($n = 5$) orally, intravenously or combined. Three patients received Ampicillin/Sulbactam intravenously ($n = 2$) or combined ($n = 1$). The other two

Table 1 Characteristics of patients

Characteristics	Number of cases	Mean value ± SD	Range
Age (years)		30.5 ± 5.42	20–43
Diagnosis (59 cases)			
Mastitis puerperal	33 (55.9%)		
Mastitis puerperal with abscess	26 (44.1%)		
Primiparae	39 (67.2%)		
Delivery method (56 cases)			
Vaginal	32 (57.1%)		
Caesarean section	20 (35.7%)		
Vacuum extraction	4 (7.1%)		
Breastfeeding after delivery	42 (91.3%)		
Breastfeeding with symptoms	12 (37.5%)		
Breastfeeding technique after developing symptoms (24 cases)			
Pumping	19 (79.2%)		
Directly	4 (16.7%)		
Combined	1 (4.2%)		
Post-delivery period			
0–8 weeks	37 (67.3%)		
0–16 weeks	44 (80.0%)		
Diabetes (55 cases)			
Yes	10 (18.2%)		
No	45 (81.8%)		
Pre-eclampsia (55 cases)			
Yes	2 (3.6%)		
No	53 (96.4%)		
Smoker (55 cases)			
Yes	4 (7.3%)		
No	51 (92.7%)		
Hypertension (55 cases)			
Yes	3 (5.5%)		
No	52 (94.5%)		
Surgical intervention (26 cases)			
US-guided aspiration	16 (61.5%)		
Incision	10 (38.5%)		

Table 2 Characteristic symptoms

Characteristic symptoms	Number
Milkstasis (58 cases)	
Yes	13 (22.4%)
No	45 (77.6%)
Flu-like symptoms (59 cases)	59 (100%)
Fever (39 cases)	
Yes	22 (56.4%)
No	17 (43.6%)
Mammillary characteristics (48 cases)	
Redness	41 (85.4%)
Wound	2 (4.2%)
Combined	2 (4.2%)
Unremarkable	3 (6.3%)

women received Flucloxacillin ($n = 1$) and Amoxicillin/Clavulanate ($n = 1$) orally. In four cases antibiotic third line therapy was required. Two of these women were further treated with Amoxicillin/Clavulanate and Ampicillin/Sulbactam for 7 days. Two women with breast abscesses received Clindamycin orally for 14–20 days and were cured afterwards.

Table 6 shows the outcome after first line conservative therapy in detail. In 15 of 17 (88.2%) cases with unsuccessful first line therapy, antibiotic treatment was performed orally. Patients received Flucloxacillin in 8 of 17 (47%) cases. Six patients who were initially treated with Flucloxacillin received Ampicillin/Sulbactam or Amoxicillin/Clavulanate. Three of 17 (17.6%) patients needed further treatment after receiving Ampicillin/Sulbactam; two (66.7%) received this treatment orally and one (33.3%) intravenously.

Table 3 Isolated pathogens and resistances

Number and type of bacteria (37 specimens)	Number (%)
Staphylococcus aureus	24 (64.9%)
Concomitant growth of a second organism: Staph. coagulase-neg. (4), Corynebacterium species (1)	
Penicillin susceptible	2/19
Penicillin resistant	17/19
Flucloxacillin susceptible	22/22
Flucloxacillin resistant	0/22
Clindamycin susceptible	15/18
Clindamycin resistant	3/18
Cefuroxim susceptible	15/15
Cefuroxim resistant	0/15
Ceftriaxon susceptible	17/17
Ceftriaxon resistant	0/17
Cefotaxim susceptible	15/15
Cefotaxim resistant	0/15
Staphylococcus coagulase neg.	5 (13.5%)
Concomitant growth of a second organism: *Streptococcus viridans* (1), *Enterococcus faecalis* (1)	
Streptococcus viridans	1 (2.7%)
Concomitant growth of Staph. coagulase-negative (1)	
Enterococcus faecialis	1 (2.7%)
Concomitant growth of *Lactococcus lactans* (1)	
Streptococcus agalactiae	1 (2.7%)
Concomitant growth of Staph. coagulase-neg. (1)	
MRSA	1 (2.7%)
Peptostreptococcus	1 (2.7%)
Concomitant growth of Staph. coagulase-neg. (1)	
None	3 (8.1%)

Table 4 Characteristics of conservative treatment

Conservative treatment characteristics	Mastitis	Breast abscess	Number in total (%)
First antibiotic application (55 cases)			
Oral	24 (77.4%)	17 (70.8%)	41 (74.5%)
Intravenous	3 (9.7%)	6 (25.0%)	7 (12.7%)
Oral + IV	4 (12.9%)	1 (4.2%)	7 (12.7%)
Total	31	24	
Antibiotics (55 cases)			
Flucloxacillin	21 (67.7%)	12 (50.0%)	33 (60.0%)
Amox/Clav	3 (9.7%)	4 (16.7%)	7 (12.7%)
Clindamycin	0	2 (8.3%)	2 (3.6%)
Ampicillin/Sulbactam	4 (12.9%)	4 (16.7%)	8 (14.5%)
Cefuroxim	1 (3.2%)	1 (4.2%)	2 (3.6%)
Other	2 (6.5%)	1 (4.2%)	3 (5.5%)
Total	31	24	
Duration (36 cases)			
2–6 days	2 (10.0%)	4 (25.0%)	6 (16.7%)
7–10 days	15 (75.0%)	9 (56.3%)	24 (66.6%)
>10 days	3 (15.0%)	3 (18.7%)	6 (16.7%)
Total	20	16	
Successfully treated (55 cases)			
Yes	25 (80.6%)	13 (54.2%)	38 (69.1%)
Partially	4 (12.9%)	6 (25.0%)	10 (18.2%)
No	2 (6.5%)	5 (20.8%)	7 (12.7%)
Total	31	24	

Therapy for patients with breast abscess included antibiotic coverage and surgical treatment. Antibiotic treatment details were mentioned before. All 26 patients with breast abscess underwent surgical therapy (Table 7). Common therapy was US-guided needle aspiration in 16 cases (61.5%), followed by incision in 10 cases (38.5%). In 10 cases, US-guided needle aspiration was repeated. In one case, surgical incision was required after US-guided needle aspiration, due to the large abscess size. A quantitative analysis of surgical treatment options was performed and showed a trend that US-guided needle aspiration was performed more often in the last 3 years of the investigated period and progressively replaced incision. Details are presented in Table 8 and 9.

Discussion

Puerperal mastitis is rarely treated in the in-patient health care system. Most patients are successfully treated at their gynecologist's office or less frequent in an out-patient department, which explains the lower incidence of women with puerperal mastitis in out-patient departments [9]. Since studies in the ambulant health care system are lacking, the epidemiologic data, the causative pathogens and the treatment strategies of puerperal mastitis remain incomplete.

Lee et al. could show, that *Staphylococcus aureus* and coagulase-negative *Staphylococcus* caused puerperal mastitis in 78.7% of cases. The pathogens have been found in milk cultures and abscesses [5]. Our results confirm these findings. We found that *Staphylococcus aureus* and coagulase-negative *Staphylococci* are the most common pathogens. Interestingly, they have also been found in milk cultures from healthy women [10]. Risk factors such as wounded nipples and breast engorgement play an important role in the development of puerperal mastitis. The pathogens detected which are part of the physiological skin flora, might be the result of the collection technique.

It is reported that puerperal mastitis occurs predominantly in the first 4 weeks postpartum [6]. In our series, the most cases (67.3%) occurred in the first 8 weeks postpartum. This is comparable to data from Amir et al., where 71% of puerperal mastitis occured in the first 8 weeks postpartum [2]. Another study has shown that puerperal mastitis occurs in

Table 5 Characteristics of further conservative treatment

Further conservative treatment	Mastitis	Breast abscess	Number (%)
Second antibiotic application (15 cases)			
Oral	3 (60.0%)	4 (40.0%)	7 (46.7%)
IV	1 (20.0%)	4 (40.0%)	5 (33.3%)
Oral + IV	1 (20.0%)	2 (20.0%)	3 (20.0%)
Total	5	10	15
Antibiotics (16 cases)			
Flucloxacillin	3 (60.0%)	1 (9.1%)	4 (25.0%)
Amox/Clav	1 (20.0%)	1 (9.1%)	2 (12.5%)
Clindamycin	0	5 (45.4%)	5 (31.3%)
Ampicillin/Sulbactam	1 (20.0%)	3 (27.3%)	4 (25.0%)
Other	0	1 (9.1%)	1 (6.3%)
Total	5	11	16
Duration (12 cases)			
2–6 days	0	3 (37.5%)	3 (25.0%)
7–10 days	4 (100%)	5 (62.5%)	9 (75.0%)
Total	4	8	12
Successfully treated (15 cases)			
Yes	4 (100%)	7 (63.6%)	11 (73.3%)
Partial	0	3 (27.3%)	3 (20.0%)
No	0	1 (9.1%)	1 (6.7%)
Total	4	11	15

Table 6 Overview of received first line antibiotics and outcome

First application	Antibiotics	Successfully treated			Total cases
		Yes	Partially	No	
Oral	Flucloxacillin	16	3	5	24
	Amoxicillin/Clavulanate	4	2	1	7
	Clindamycin	2	0	0	2
	Ampicillin/Sulbactam	2	1	1	4
	Cefuroxim	1	1	0	2
	Other	1	1	0	2
	Total cases	26	8	7	41
IV	Flucloxacillin	4	0	0	4
	Ampicillin/Sulbactam	1	1	0	2
	Other	0	1	0	1
	Total cases	5	2	0	7
Oral and IV	Flucloxacillin	5	0	0	5
	Ampicillin/Sulbactam	2	0	0	2
	Total cases	7	0	0	7
Total	Flucloxacillin	25	3	5	33
	Amoxicillin	4	2	1	7
	Clindamycin	2	0	0	2
	Ampicillin/Sulbactam	5	2	1	8
	Cefuroxim	1	1	0	2
	Andere	1	2	0	3
	Total cases	37	11	7	55

Table 7 Surgical intervention

	Number (%)
First surgical treatment	
US-guided aspiration	16 (61.5%)
Incision	10 (38.5%)
Second surgical treatment	
US-guided aspiration	10 (90.9%)
Incision	1 (9.1%)
Third surgical treatment	
US-guided aspiration	5 (83.3%)
Other	1 (16.7%)

Table 8 Performed surgical treatment in each year

Year of surgical treatment	Number of incisions	Number of US-guided needle aspirations
2006	2	0
2007	2	0
2008	1	0
2009	1	0
2010	0	1
2011	0	2
2012	1	2
2013	3	1
2014	0	1
2015	0	4
2016	0	5

88% of cases during the first 12 weeks postpartum, thus supporting our findings [1].

Regarding the method of delivery it has been found that the rate of mastitis is higher in women who delivered spontaneously [3]. In our study, 57.1% of the women had a vaginal delivery similar to the aforementioned study [3]. Previously, it has been found that breast infection influences breastfeeding and daily activities [6]. Results about continuing and stopping breastfeeding are controversial [11], whereas no association has been observed between the duration of breastfeeding and the development of mastitis [2]. In our study, 59.4% of women with symptoms had stopped breastfeeding. A study by Lee et al. demonstrated a discontinuation of breastfeeding in 73.2% of cases after developing symptoms [5].

The main goal of treating mastitis is to empty the breast completely [1]. In our population, 79.2% of women used a pump for temporary support of milk production after the discontinuation of breastfeeding. Nevertheless 59.4% stopped breastfeeding initially after developing symptoms. Therefore further information about breastfeeding should be given in advance to avoid a discontinuation of breastfeeding and following complications.

Regarding the microorganisms found, methicillin-resistant *Staphylococcus aureus* was found in only one case and was associated with a development of breast abscess. Stafford et al. discovered that community-acquired *MRSA* (CA-MRSA) was primarily responsible for breast abscesses in 67% [3]. In contrast to Reddy et al. and Stafford et al., CA-MRSA was not a crucial causative organism for puerperal mastitis in our population [3, 12], Our results showed, that MRSA did not have the same significance as a pathogen for mastitis compared to data obtained by Stafford et al. Due to the limited number of cases and the retrospective nature of the study, we cannot draw general conclusions from these findings. Large studies about puerperal mastitis are missing in Germany. Therefore, further studies are warranted to investigate in detail the low incidence of MRSA-associated puerperal mastitis found in this study.

Regarding conservative therapy, Flucloxacillin was prescribed in 60% of the cases as first line therapy. Most of the women (74.5%) received oral treatment. Discussing the number of failed antibiotic treatments, it can be seen that in 15 of 17 failed cases, antibiotics were taken orally. In 8 of the 17 failed cases, patients received Flucloxacillin. The oral bioavailability of Flucloxacillin ranges from 50 to 79% and could explain the failure of treatment in 8 cases after first line therapy with oral Flucloxacillin. The oral bioavailability of Ampicillin/Sulbactam is 60%, of Amoxicillin is 72–94% and of Clavulanate is 60% [13]. The recommendations regarding the treatment of puerperal mastitis are quite different, and reflect the low number of studies and their limited participants. German evidence-based guidelines recommend first and second generation oral cephalosporins as the first line conservative therapy of puerperal mastitis, as well as β-lactamase Penicillins [14]. Due to the lack of studies with high levels of evidence, retrospective analysis similar to our study with high external validity should be used for the further optimization of treatment protocols. Furthermore, the oral availability of antibiotics should be respected. Altogether, these strategies should improve the treatment outcome and reduce the rate of treatment failure.

Another point of observation was the treatment of breast abscesses. In breast abscess therapy, the combination of needle aspiration and oral antibiotic coverage proved to be effective and evolves to be the gold standard of abscess treatment [5, 15, 16]. US-guided treatment was performed successfully in most of the reviewed cases. These findings support the generally observed tendency of abscess incision and drainage to be replaced by the less invasive and easy to perform US-guided aspiration technique [17, 18]. Moreover US-guided aspiration is highly successful and can be performed in the ambulant setting as a less invasive procedure without the need for general anaesthesia [19]. US-guided

Table 9 Measured abscess size befor and after the intervention

Abscess size (mm)	Second abszess size (mm)	Abscess size after intervention (mm)	Abscess size after further intervention (mm)
27× 26	40×40		
50			
19×10			
14×13× 9			
13× 8.66			
50× 50			
60×20	70×30		
58×29.2			
13×10× 11			
43×40× 25			
29.7×19.5			
40			
23.9×18.1× 28.5			
35×25× 30		18×25	
25×40× 25			
6.95×15.1× 0.69		8.99×9.78	
45.9		20.9×25.8	
51.4		52	14.2×34.3
24.3×8.14× 4.35		14	16.5×16.9
38.9×23.5× 18.7			
60× 50			
41×30× 24			

needle aspiration and drainage are associated with a reduced risk of fistula formation in both puerperal and non-puerperal abscesses [20]. In addition, the US-guided technique of the aspiration of breast abscesses is less expensive than surgery [21]. Our study confirmed that US-guided needle aspiration should be the treatment of choice for puerperal abscesses.

The limitations of the study included: (a) its retrospective character; (b) incompleteness of some cases; (c) the small number of patients; (d) missing data regarding further conservative treatment options. Nevertheless, the strengths of the study are: (a) its high external validity (e.g. unselected cohort, representative of the population-based incidence of puerperal mastitis); (b) all patients are similarly treated; and (c) the completed follow-up in all cases.

In conclusion, the main pathogens causing puerperal mastitis are similar to those reported in other studies. Interestingly the pathogens causing breast abscesses differ from findings in the literature. Our results show that breast infections with MRSA are very rare. This leads to the conclusion that MRSA infections had an inferior importance for patients with puerperal mastitis in a university clinic. Our study demonstrated that the conservative treatment of puerperal mastitis remained constant, whereas a tendency towards US-guided aspiration of breast abscesses can be observed. The effectiveness of the well-established conservative therapy is well supported by our findings. Concerning the cessation of breastfeeding, further information about the necessity of emptying the affected breast should be given to the patients in advance, to avoid complications.

Author contribution J. Lukassek: data collection, statistical analysis, manuscript writing. A.Ignatov: data management, manuscript writing and editing.J. Faerber: data management, manuscript editing.S.D. Costa: manuscript editing. H. Eggemann: protocol development, data management, manuscript writing and editing.

Compliance with ethical standards

Conflict of interest We declare that we have no conflict of interest.

Ethical approval Due to the retrospective design of the study ethical approval is not applicable.

Informed consent Due to the retrospective design of the study an informed consent is not applicable.

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