Prevalence and clinical features of maternal sepsis in the Intensive Care Unit of a tertiary care center

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Abstract

***Introduction*: According to the World Health Organization (WHO), sepsis is currently the leading cause of mortality and critical illness worldwide, with a reported mortality rate of 28.6% among the population and, therefore, belongs to one of the leading causes of maternal death, with a percentage record of 11%.**

***Objective*: To determine the prevalence and clinical characteristics of maternal sepsis in the Intensive Care Unit (ICU) of a tertiary care center in Mexico from January 1, 2019 to February 28, 2022.**

***Materials and methods*: Retrospective, cross-sectional, descriptive study. All the records of patients admitted to the ICU of the Women's Hospital of Sinaloa during the aforementioned period were included, and those with a diagnosis of maternal sepsis were selected.**

***Results*: The prevalence of maternal sepsis was 11.2%. The predominant age was 25 to 32 years (34.37%). Sixteen primiparous (50%), 8 secondiparous (25%), 8 multiparous (25%); 15 in puerperium (46.8%), 12 pregnant (2 twins, 1 deceased) (37.5%), and 5 failed deliveries (15.6%). Infectious foci: kidney and urinary tract in 15 patients (42%), pelvis (uterus and adnexa) in 13 patients (36%), abdomen in 5 patients (14%), and lung in 3 cases (14%). Escherichia coli was the most frequent pathogen (n=5), followed by Klebsiella and Enterococcus (each 1 patient), respectively. Comorbidities: 5 with severe preeclampsia (15.6%), 1 gestational diabetes, 1 nephrotic syndrome (3.1%); 17 normal weight (53%), 12 overweight (38%), and 3 obese (9%). Mortality: 3 cases (9.3%).**

***Conclusions*: The prevalence of maternal sepsis was 11.2%. Characteristics: age between 25-32 years; primiparous women, puerperium, kidney/urinary tract as the most frequent source of infection, and Escherichia coli was the most common pathogen.**

Key words: Sepsis, maternal sepsis, mortality, intensive care.

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Introduction

The World Health Organization (WHO) redefines maternal sepsis as a life-threatening condition consisting of organ dysfunction resulting from infection during pregnancy, childbirth, postabortion, or postpartum. (1-3) Recent publications indicate that sepsis is now the leading cause of death and serious illness worldwide, with a reported mortality rate of 28.6% in the non-obstetric population and a reported maternal mortality rate of 12-28%. It has also been found that at least 2% of women with this diagnosis require admission to an intensive care unit (ICU). (4-6)

In relation to the data recorded in Latin American and Caribbean countries, maternal mortality due to sepsis is approximately 8.3%. (7) In our country,

it is one of the 10 leading causes of direct maternal death. (8) According to weekly records of immediate notification of maternal death by epidemiological services from week 1 to week 33 of the year 2022, between 2 and 3.8% of cases. (9)
Despite the progress made in the diagnosis and treatment of sepsis, and although it is not the leading cause of maternal mortality, it is considered one of the ten most important diagnoses as a cause of maternal death. Its incidence and impact have been increasing worldwide in recent years, and morbidity continues to be reported, with high hospitalization costs and prolonged hospital stays; it is believed to be growing at a rate of 9-10% annually, as reported in the literature. (2) And although the prevalence may seem low, the importance of the issue lies in the fact that it is a treatable and, therefore, combatable entity that has a rapid progression to deterioration and death. (10-12)
From the results obtained, we can compare them with those published in other parts of the world, for example, associated characteristics such as the gestational stage (pregnancy, abortion, or puerperium), the infectious focus and the most frequent pathogen, the associated comorbid diseases, and their mortality. Given this reality and its impact worldwide, it was decided to determine in this retrospective study the prevalence of maternal sepsis in the ICU of the Women's Hospital of Sinaloa, Mexico, during the period from January 1, 2019, to February 28, 2022.

Material and methods

All clinical records of patients admitted to the Intensive Care Unit of the Women's Hospital of Sinaloa were reviewed, and those with a diagnosis of sepsis were selected. If the inclusion criteria were met, the necessary information was obtained and recorded in an Excel™ database, consisting of age, weight, height, body mass index, gestational age, associated infectious foci, associated comorbidity, laboratory findings, and maternal death. Finally, with all the data obtained from the collection sheet, a summary was made to finally summarize the information in graphs and tables.

Inclusion criteria
Patients with a diagnosis of maternal sepsis who have undergone abortion, pregnancy, or puerperium.

Exclusion criteria
- Non-pregnant patients.
- Non-pregnant patients who were not in the postpartum period.
- Patients admitted to the ICU for reasons other than maternal sepsis.
- Patients with suspected maternal sepsis who did not have a defined source of infection and did not have biochemical changes.

Design
Retrospective, cross-sectional, and descriptive. No intervention design was required.

Study type
Descriptive observational study.

Universe
All records of patients admitted to the Intensive Care Unit of the Women's Hospital of Sinaloa from January 1, 2019, to February 28, 2022, were included.

Target population
Patients admitted to the ICU of the Women's Hospital of Sinaloa, Mexico, with a diagnosis of maternal sepsis.

Sampling method
Non-probability, consecutive.

Instruments or techniques
Data collection was performed in the digitized clinical records of the sigho system (management and operational operation system) of patients diagnosed with sepsis according to the registry within the ICU of the Women's Hospital of Sinaloa.
The author of the study was responsible for data collection.

Ethical issues
No risks have been taken into account and no fundamental principles have been violated in the conduct of this research since it has been carried out only by collecting information from existing records, as well as from medical records/electronic files, and the confidentiality of the information has been maintained. Thus, the researcher was the only one authorized to handle the data obtained exclusively for the purposes corresponding to the study.

Results

The number of admissions to the ICU by year was as follows: The year 2019 (January-December), a total of 60 patients, 12 with a diagnosis of maternal sepsis (20%), determining the month of January with the highest prevalence of diagnosis. During 2020 (January-December), there were 94 admissions, 10 with a diagnosis of maternal sepsis

(10.6%), in which the month of January and August presented the highest number of diagnostic cases. During 2021 (January-December), 107 admissions and 6 patients, respectively, with a percentage of 5.6%, with a predominance of diagnoses in the month of August. Finally, during 2022 (January-February), 24 admissions, 4 with a diagnosis of maternal sepsis (3 of them diagnosed in the month of February), equivalent to 16.6% (**Table 1**). The total of all years was 285 patients, 32 cases of maternal sepsis, so the prevalence rate of maternal sepsis in this study was 11.2%.

In terms of age, an average of 21 years was found, with a range between 13 and 37 years, with a predominance between the period of 25-32 years, equivalent to 34.37% of the total.

Obstetric characteristics: 16 (50%) primiparous patients, 8 (25%) secondiparous, and 8 (25%) multipregnant; 15 (46.8%) in the puerperium, 12 pregnant women (37.5%), 2 for a twin pregnancy and only 1 case of death and 5 with abortion (15.6%); 2 in the first trimester, 14 in the second trimester, and 16 in the third trimester.

The main hematologic alterations observed were hemoglobin level, which predominantly decreased in 81.2% of cases (26 patients), of which 5 corresponded to grade I anemia (16%), 17 to grade II anemia (53%), and 4 to grade III anemia (13%). There was 1 isolated case of above-normal values (3%) and 5 patients (16%) with no alterations. The distribution of the results by years showed a tendency to low values between 2019 and 2020, normalizing between 2020 and 2021, and decreasing again towards the year 2022. The hemoglobin-hematocrit ratio was 1:3. The leukocyte values ranged between 6.5-50.4x10^9/µl, with a mean of 20.5 and a mode of 21. While in the relationship of leukocyte values with age, the increase of figures predominates mainly between 15-19 years and maximum in the last case of life, patient with 37 years.

As for the main biochemical alterations: C-reactive protein with distribution by years with an upward trend of values between 2019 and 2021; overall with elevated figures in 29 patients (90.6%), the rest in normal ranges: 3 cases (9.3%).

The dispersion of procalcitonin (PCT)/leukocytosis values by year determined that the results of values were maintained between 2019 and 2020, with an increase of the curve towards 2021 and a decrease of the same for 2022; and in the overall results, an increase of procalcitonin levels predominated in 28 cases (87.5%). (**Table 2**)

Cases of acute kidney injury (AKI) were presented by creatinine values in 16 patients (50%), finding a relationship with a greater elevation of PCT figures and a greater number of cases of repercussions at the renal level (**Table 3**).

The main focus of infection was identified: kidney and urinary tract in 15 patients (42%), pelvis (uterus and adnexa) 13 (36%), abdomen (liver, gallbladder, appendix) 5 (14%), and lung in 3 cases (14%) (**Figure 1**).

Recording of culture results and isolated pathogens: 25 patients (78%) had negative cultures, meanwhile, 21.8% of the total 32 cases were positive and included in the study. Of these, E. coli was identified as the pathogen in 5 cases (72%), Klebsiella and Enterococcus in 1 isolated case each (14%) (**Figure 2**).

Comorbidities: 5 cases had severe pre-eclampsia (15.6%), 1 gestational diabetes, and 1 nephrotic syndrome (3.1% each). The rest of the patients (25 patients [78.1%]) had no additional pathology. According to body mass index, 17 patients were normal weight (53%), 12 were overweight (38%), and 3 were obese (9%).

The associated mortality in the present study was 3 deaths in total in the period analyzed, of which 1 occurred during the year 2019 (equivalent to 8.3% of the diagnosed cases of maternal sepsis) and 2 in 2020 (twenty percent), with no record of death during the year 2021, nor in the period January-February 2022. This corresponded to 1.05% of all admissions registered in the intensive care unit (**Table 3**).

The most common hematologic and biochemical changes were anemia, polycythemia, leukocytosis, elevated acute phase reactants, mainly C-reactive protein, and elevated procalcitonin levels. Multiple organ dysfunction was also noted, with a more pronounced effect on the renal level, determining the infectious focus (kidney, lung, and pelvis).

In addition, the presence of associated comorbidities such as overweight/obesity, hypertensive pathology typical of pregnancy (severe pre-eclampsia), and nephrotic syndrome were identified in all three cases.

Discussion

Sepsis remains a major risk factor for maternal mortality worldwide, particularly among women of childbearing age. Factors such as parity, multiple pregnancies, or a history of at least one or more chronic infections predispose to some type of complication during pregnancy that could progress to sepsis and have a fatal outcome. (10)

Strategic approaches to reducing maternal mortality over the past 15 years have focused primarily on clinical interventions and strengthening health systems. (13) The challenge for modern obstetrics must be to find resources and ways to promote work in

health promotion and disease prevention since sepsis is considered a preventable cause of death, and this goes hand in hand with timely recognition.

The WHO has pointed out that preventive actions should be strengthened with health promotion in order to avoid morbidities during pregnancy, obstetric, and/or postpartum events since it is a public health problem. (14) Regarding statistical records in other parts of the world, it has been found that at least 2% of women diagnosed with maternal sepsis require admission to an intensive care unit. (6) However, in the hospital unit of this study, it was found that about 90% of the total cases registered with this diagnosis were treated in the intensive care unit. The relationship between admissions and the number of cases attended with a diagnosis of maternal sepsis by year/month between 2019 and 2022 showed that between 5.6-20% of the total number of admissions corresponded to the main subject of this research. Therefore, we could conclude that there was no exponential growth in our unit in terms of the number of cases seen for maternal sepsis. Similarly, there was no month in which ICU care predominated.

International studies in Pakistan, Suriname, and Zimbabwe on characteristics and mortality, in which the most common age of patients diagnosed with maternal sepsis has been determined, have shown that 71.7% were between 20 and 30 years of age. (15) In Latin America, studies published in countries such as Nicaragua and Colombia have shown that the average age of diagnosis was between 20 and 34 years. (16) In relation to the above, we can see that the cases presented in our unit ranged between 13 and 37 years of age, with a predominance between 25 and 32 years. A range in which 11 patients presented out of a total of 32 studied (34.37%) showed that there was a relationship between the reproductive age and the age published in the previous studies mentioned. It is worth mentioning that, although not the majority within the group considered adolescent (13-17 years), it was identified as the second place in diagnosis (n=8) as opposed to only 1 case identified in a patient older than 33 years: determining an average of 21. In this sense, it can be concluded that the younger the age, the higher the percentage of cases related to maternal sepsis.

Regarding the obstetric characteristics, according to parity, 50% of the cases (n=16) occurred in primiparous patients. In comparison with the studies carried out in our country, there was not a majority related to multiparity. (17) So, it cannot be determined as the main associated risk factor. Fifteen patients (46.8%) presented during the puerperium; therefore, it corresponded to what was reported in the literature, which recorded that in its majority, it was diagnosed after delivery in 72% of cases (study carried out at an international level in Pakistan). (18-22) There was a predominance related to the trimester of pregnancy: the majority of cases being in the 3rd trimester (n=16). (23) Likewise, multiple pregnancies were not considered in this research as a predominant risk factor since only 2 cases presented in multiple pregnancies (twin pregnancies).

Anemia was identified as the main hematological alteration associated with cases of maternal sepsis. So, there was a relationship with the bibliographic references that considered it as an associated factor. (17,24) Although no history of any study determines the relationship between leukocyte values and the age of the patients, we could conclude that the younger the age (15-19 years), the more cases of leukocytosis occurred.

Regarding biochemical aspects, there was evidence of elevated levels of C-reactive protein and procalcitonin in most patients diagnosed with maternal sepsis (90.6% and 87.5%, respectively), which has been documented in studies and literature. (6) Regarding the use of procalcitonin as a biomarker of acute kidney injury in patients with sepsis, there was a study conducted in Mexico (25) that found that in the spectrum of sepsis, a procalcitonin level ≥2.6 mg/dl on admission predicted acute kidney injury. In this study, we showed a similar relationship where we observed that the greater the increase in procalcitonin levels, the greater the number of cases of acute kidney injury. (26)

On the other hand, the documented studies indicated that the infectious focus was identified in only about 74% of the cases. (4) In contrast, in the present study, the infectious focus was identified in 100% of the cases, with a predominance of renal/urinary origin. So that in this aspect, there was a relationship with the literature described. Regarding culture results, 78% had negative cultures, which agreed with the literature, which explained that approximately 50% of patients with sepsis did not have positive cultures. (15) In terms of the etiologic agent, the most commonly identified germ in this study was Escherichia coli, which was similar to studies conducted in countries such as Ireland but not compared to those published in Japan, Australia, and the United Kingdom, where studies have considered Group A beta-hemolytic Streptococci (GAS) to be the most common pathogen in maternal sepsis. (27,28)

The conditions presented as comorbidity factors

were body mass index, associated hypertensive pathology, gestational diabetes, and nephrotic syndrome. In this regard, there are studies in our country that identify obesity and pre-eclampsia as some of the main associated and poor prognostic factors in cases of patients with maternal sepsis. (17) So, there is a relationship with what has been published previously.

As for mortality, in relation to the total number of admissions for maternal sepsis, it was estimated to be between 1.6-3.12%; and less than 2% (1.05) of the total. Only 3 deaths were recorded, so according to what has been published at the national level in official epidemiological reports and what was found in the medical unit where the present study was carried out, there was a lower percentage of deaths compared to national records. It is worth noting that in these deaths, the presence of comorbidities (obesity, pre-eclampsia, and nephrotic syndrome) and a history of abortion were identified, which was in line with published information. (29)

Therefore, if we analyze the results of this study, we can say that adequate sexual counseling, detection through basic prenatal tests such as a general urine test, the use of urine test strips, etc., can significantly help to reduce the number of cases, since, as mentioned above, sepsis is preventable. If we strengthen the prenatal education and counseling of pregnant women, emphasizing the recognition of the warning signs in pregnancy, as well as promoting adequate prenatal control and performing the relevant studies at each stage of pregnancy, it will be possible to diagnose and prevent most of the diseases related to the problem of maternal sepsis.

Conclusion

The prevalence rate of maternal sepsis in this study was 11.2%, with primiparas, puerperium, and renal/urinary tract as the infectious foci with the highest prevalence of cases and E. coli as the most common isolated pathogen. There was no upward trend in the number of cases of maternal sepsis treated in the ICU. Age less than 33 years, diagnosis during the puerperium, and a history of multiparity were some of the most common characteristics. In cases where maternal sepsis was diagnosed during pregnancy, most cases were documented during the third trimester. The urinary tract was the most common site of infection, followed by the pelvis/abdomen. The respiratory tract was the least common site. The vast majority of cases did not present positive cultures, and the recorded cases of mortality were characterized by having an added diagnosis of some comorbidity, where body mass index (overweight/obesity) was the most frequent.

Finally, it is important to point out the following aspects: Maternal sepsis is entirely preventable. If it were given the importance it deserves by implementing specific strategies for its timely detection from the first level of care, we believe that its prevalence could be significantly reduced. Therefore, we agree with the World Health Organization's statement that other pregnancy-related conditions, such as pre-eclampsia and obstetric hemorrhage, have received more attention.

Conflicts of interest

None of the authors have any proprietary interests or conflicts of interest related to this submission.

Table 1. ICU admissions and number of cases with the diagnosis of maternal sepsis

	2019			2020			2021			2022		
	ICU admissions	n	%	ICU admissions	n	%	ICU admissions	n	%	ICU admissions	n	%
January	15	6	40	9	2	22.2	8	0	0	12	1	8.
February	9	3	33.3	10	1	10	6	1	16.6	12	3	25
March	6	1	16.6	3	1	33.3	3	0	0	N/A	N/A	N/A
April	12	0	0	7	0	0	12	0	0	N/A	N/A	N/A
May	6	1	16.6	8	1	12.5	6	0	0	N/A	N/A	N/A
June	0	0	0	9	1	11.1	11	0	0	N/A	N/A	N/A
July	0	0	0	8	1	12.5	4	0	0	N/A	N/A	N/A
August	0	0	0	6	2	33.3	10	2	20	N/A	N/A	N/A
September	0	0	0	4	0	0	16	1	6.25	N/A	N/A	N/A
October	2	0	0	8	1	12.5	8	1	12.5	N/A	N/A	N/A
November	2	0	0	9	0	0	13	0	0	N/A	N/A	N/A
December	8	1	12.5	13	0	0	10	1	10	N/A	N/A	N/A
Total	60	12	20	94	10	10.6	107	6	5.6	24	4	16.6

Legend: ICU=intersive care unit; n= number of patients with a maternal sepsis diagnosis; N/A=not available.

Table 2. The relationship between PCT values and AKI

PCT	n	Number of cases with AKI	%
0.05-<0.5	4	1	25
0.5-<2	9	4	44.40
2-<10	6	2	33.33
≥10	13	9	69.20
Total	32	16	50.00

Legend: PCT=procalcitonin; AKI=acute kidney injury.

Table 3. Maternal sepsis mortality in ICU

Period	ICU admissions (n)	Patients with maternal sepsis diagnosis (n)	Death cases (n)	Relationship between ICU admissions cases and death (%)
2019	60	12	1	1.6%
2020	94	10	2	3.12%
2021	107	6	0	-
January 1-February 28, 2022	24	4	0	-
Total	285	32	3	1.05%

Legend: ICU=intesive care unit.

Figure 1. Source of infection

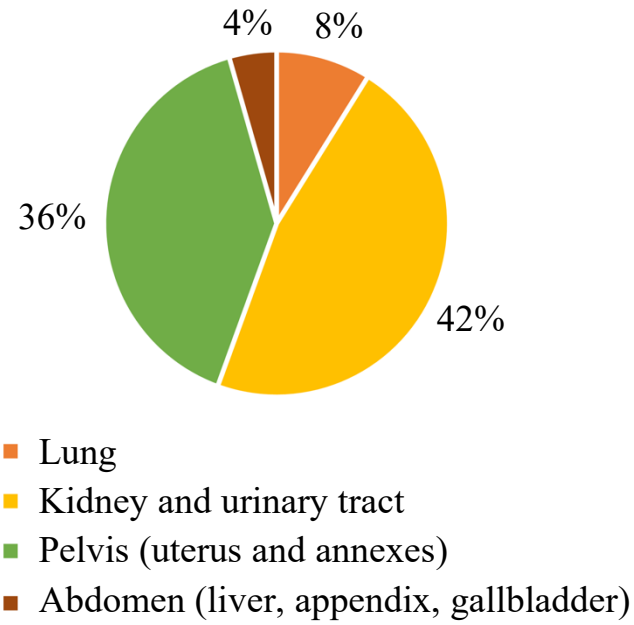
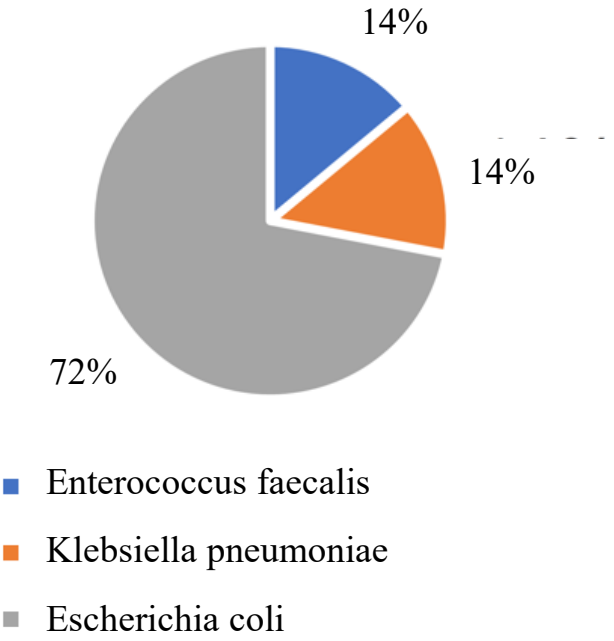


Figure 2. Organisms isolated in cultures



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