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Catastrophic antiphospholipid syndrome (CAPS) is an uncommon and the most severe form of antiphospholipid syndrome (APS). A 33-week pregnant patient with Klippel-Trenaunay syndrome, past SARS-CoV-2 infection and type I fetal growth restriction with shortening of the fetal long bone was diagnosed in our center with a probable CAPS. Cesarean section was performed four days after the diagnosis due to the torpid evolution of the patient. Clinical improvement was noted a few days later and the mother and baby were discharged within a week. We review the current literature on CAPS during pregnancy and provide an updated view.
third, so a proper diagnosis and emergency treatment are essential [1,3,4].

Case report

A 20-year-old woman, gravida 1, arrived at 33 + 2 weeks gestation, complaining of pain in the fifth toe of her right foot and presented associated thrombocytopenia.

Her pregnancy had been controlled by our High Risk Obstetrics Unit for a known history of antiphospholipid syndrome with high titers of the three antiphospholipid antibodies and 4 episodes of deep venous thrombosis, as well as a rare congenital syndrome called Klippel-Trenaunay syndrome (KTS).

KTS is a complex congenital disorder historically defined as the triad of capillary malformation, venous malformation, and limb overgrowth, of unknown prevalence and incidence. In our patient this syndrome presented with agenesis of the infrarenal inferior vena cava, agenesis of the left iliac venous sector and lymphatic malformation in the lower limbs. Therefore, and due to her high thrombotic risk, she had been controlled and treated with warfarin until she got pregnant.

In the first trimester of her pregnancy she suffered from SARS-CoV-2 infection and was diagnosed with type I fetal growth restriction at 26 weeks of pregnancy, in association with shortening of the fetal long bones (normal amniocentesis and negative immune serology with Rubella, Varicella, CMV, Parvovirus and Toxoplasma). Due to a history of non-pregnancy related thrombosis, Hematology modified her previous treatment from warfarin to tinzaparin 10,000 IU and aspirin 150 mg from the beginning of pregnancy.

The examination revealed two very painful violaceous lesions on the 5th toe of the right foot as well as erythematous-violaceous plaques that disappeared on acupressure on the malar region, conserving the nasal dorsum.

Blood test showed low platelets (78,000/microliter) and increased inflammatory parameters (ESR and CRP). Her renal function was deteriorated (estimated glomerular filtration rate dropping from 95 to 78 mL/min) with a protein/creatinine ratio <0.3, elevated liver enzymes (ALT 45 U/L; AST 54 U/L; GGT 41 U/L) and an increased activated partial thromboplastin time (aPTT) ratio of 3.9 (possibly justified by the underlying antiphospholipid syndrome and the use of heparin).

On account of the symptoms of pain and erythema in the fifth toe (without involvement of other toes) and a foot X-Ray that ruled out osteomyelitis, broad-spectrum antibiotic treatment was instated.

A follow-up obstetric ultrasound was also performed, which revealed a breech presentation of a fetus with type I fetal growth restriction, a pathological mean uterine artery pulsatility index, and cerebro-placental index <5; Long bones were short for gestational age, with normal morphology of the fetus and nodular and dyshomogeneous placenta, probably related to placental infarcts.

Given the complexity of the case, the patient was reevaluated by the Rheumatology, Hematology, Internal Medicine and Gynecology services, and the suspicion of a possible ischemic origin of the foot lesions was established.

A diagnosis of probable CAPS was made on the basis of involvement of 3 or more organs (skin, kidney, liver), development of the symptoms in less than a week, and laboratory confirmation of elevated titers of antiphospholipid antibodies. Despite a lack of historical evidence, obstetric ultrasound was highly suspicious of placental infarctions.

The patient received treatment with methylprednisolone 500 mg IV/day for 3 days followed by prednisone 60 mg/day, enoxaparin 80 mg/24 h and plasmapheresis.

Previous fetal lung maturation, caesarean section was performed due to breech presentation and probable CAPS. A premature female was born at 33 + 4 weeks, weight 1560 gr. and Apgar score 8/10.

On the first day postpartum, the patient presented high blood pressure levels that required oral treatment with calcium antagonists and labetalol, in addition to oliguria and elevated creatinine after surgical procedure. Clinical improvement was noted within a few days. Both the patient and newborn were discharged within a week and she is currently being treated with warfarin therapy.

The newborn presented moderate patent ductus arteriosus without hemodynamic impact. Amniotic fluid tests were negative for aneuploidies in 21, 18, 13 and sexual chromosomes. The pathological study of the placenta revealed several areas of necrosis and vascular congestion, all compatible with placental infarcts.

Literature review

Approximately 4–6% of CAPS occur during the third trimester of pregnancy or during puerperium, and half of the patients had a history of APS [10]. In addition, and according to Hoayek et al [3], CAPS in pregnancy or puerperium is associated with earlier age of onset and fewer previous clinical manifestations, compared to the general population with CAPS. Validated classification criteria for definitive CAPS were established in 2002 and are shown in Table 1. Given that CAPS only occurs in 1% of patients with APS, recommendations are based on case reports and expert opinions and there are no randomized clinical trials to guide the treatment of CAPS [1,9].

CAPS remains a diagnostic challenge as its broad range of clinical signs, symptoms, and laboratory findings, as seen in our case, often overlap with other obstetric complications.

Using the data recorded by Collict et al, Table 1 summarizes the clinical manifestations, treatment given and maternal and fetal outcomes of each CAPS case from 1994 until 2020, chronologically ordered (Table 2).

Discussion

Catastrophic antiphospholipid syndrome continues to be a diagnostic challenge due to its low prevalence and the non-specificity of its clinical and analytical presentation.

Maternal clinical manifestations can range from abdominal pain, general malaise, altered mental status, seizure, chest pain, hypertension, proteinuria, dyspnea, or pulmonary embolism among others. Fetal morbidities are directly associated with placental insufficiency leading to preterm birth, growth restriction or death [3,4]. Despite the criteria, CAPS symptoms and laboratory findings often overlap with other obstetric complications such as HELLP

| Table 1 | Validated classification criteria for definitive CAPS. |
| --- | --- |
| 1. Evidence of involvement of 3 or more organs. | |
| 2. Development of manifestations simultaneously or within less than a week. | |
| 3. Confirmation by histopathology of small vessel occlusion. | |
| 4. Laboratory confirmation of the presence of elevated titres of antiphospholipid antibodies (>12 weeks). | Probable CAPS if only three out of the four criteria above are met. |
Eighteen cases of CAPS in pregnancy.

| Author                  | Maternal age | Gestational age | CAPS features | Treatment | Maternal outcome | Fetal outcome |
|-------------------------|--------------|-----------------|---------------|-----------|------------------|---------------|
| Khizroeva et al         | n/a          | 28 weeks gestation | Multiorgan failure | Heparin, aspirin, glucocorticoids, IVIG, plasma exchange and dialysis | n/a | n/a |
| Hanouna et al (case 3)  | 26 years     | 25 weeks gestation | Cardiac, renal, hepatic, cutaneous, hemolytic anemia and thrombocytopenia | Heparin and glucocorticoids | n/a | Fetal death |
| Hanouna et al (case 6)  | 33 years     | 36 + 5 weeks gestation on the day of the delivery | Adrenal, cutaneous, hepatic, thrombocytopenia and hemolytic anemia | Heparin and glucocorticoids | Adrenal insufficiency | Healthy child |
| Hanouna et al (case 11) | 32 years     | 17 weeks gestation on the day of the delivery | Cutaneous, hepatic, renal, adrenal thrombocytopenia and gallbladder | Heparin, glucocorticoids, plasma exchange and dialysis | Renal insufficiency with proteinuria | Fetal death at 17 weeks |
| Hanouna et al (case 12) | 27 years     | 13 weeks gestation on the day of the delivery | Cardiac, cutaneous, hepatic, placenta and thrombocytopenia | Heparin, glucocorticoids and IVIG | n/a | Fetal death at 13 weeks |
| Hanouna et al (case 13) | 23 years     | 31 weeks gestation | Cardiac, renal, cutaneous, thrombocytopenia and hemolytic anemia | Heparin, aspirin, glucocorticoids and plasma exchange | Sudden death at 2.5 years | Child with developmental delay |
| Derks et al (case 1)    | 32 years     | n/a | Multiple infarcts in liver and placenta | Glucocorticoids | n/a | Fetal death |
| Derks et al (case 2)    | 27 years     | n/a | Thrombocytopenia, disturbances in hepatic function and epigastric pain | Glucocorticoids | n/a | Fetal death |
| Derks et al (case 3)    | 36 years     | n/a | Hepatic infarcts and petechiae | Glucocorticoids, IVIG and plasmapheresis | Recovery | Intrauterine death at 23 weeks |
| Marson et al            | 33 years     | 23 weeks gestation | HELLP, thrombocytopenia, anemia, acalculous cholecystitis and cutaneous. | Therapeutic plasma exchange | Recovery | Intrauterine death at 23 weeks |
| Bendon et al            | 22 years     | 30 weeks gestation | Placental infarctions, myocardium, renal, gastrointestinal and myometrium TMA HELLP, portal vein, inferior vena cava, mesenteric vein thrombosis | Anticoagulation | Death | Fetal death |
| Kitchens et al          | 38 years     | 38 weeks gestation | HELLP | Recovery | Miscarriage |
| Wislowska et al         | 26 years     | 25 weeks gestation | ARDs, encephalopathy, nephritis, skin ulcers | LMWH, glucocorticoids, cyclophosphamide Glucocorticoids, intravenous heparin, cyclophosphamide LMWH, fresh frozen plasma | Recovery | Death |
| Asherson et al          | 22 years     | 20 weeks gestation | HELLP, ARDS, cerebral infarcts | Glucocorticoids, intravenous heparin, cyclophosphamide | Recovery | Death |
| Koenig et al            | 19 years     | 17 weeks gestation | HELLP, hepatic infarctions, bone necrosis | Glucocorticoids, LMWH, fresh frozen plasma | Recovery | Death |
| Gomez-Puerta et al (case 1) | 29 years | 28 weeks gestation | HELLP, bone marrow hypoplasia, renal failure, DVT, respiratory failure, livedo reticularis | Glucocorticoids | Death | Prematurity |
| Elchalal et al          | 37 years     | 16 weeks gestation | Thrombocytopenia, bilateral pleural effusions | Glucocorticoids | Recovery | Fetal death |
| Collict M et al         | 31 years     | 28 + 5 weeks gestation | Severe PE, bilateral exudative retinal detachment, renal, acalculous cholecystitis, pulmonary and abdominal sepsis, liver, cardiac, placental infarction and multiorgan thrombosis (lung, brain, spleen) | Broad-spectrum antibiotics, glucocorticoids, LMWH, aspirin | Recovery | Healthy premature child |

ARDS, acute respiratory distress syndrome; CAPS, catastrophic antiphospholipid syndrome; DVT, deep venous thrombosis; HELLP, hemolysis, elevated liver enzymes, low platelet count; IVIG, intravenous immunoglobulin; LMWH, low molecular weight heparin; n/a, not available; PE, pulmonary embolism.

syndrome, thrombotic thrombocytopenic purpura (TTP), or acute fatty liver of pregnancy (AFLP), leading to a delayed diagnosis and treatment [6,7].

Given that CAPS is a thrombophilic disorder with characteristic extensive microvasculopathy, anticoagulant therapy is required. Pregnant patients with CAPS usually receive combined therapy with anticoagulants, corticosteroids, plasmapheresis or intra-venous immunoglobulins (triple therapy) [4,6,9].

Plasmapheresis may help to remove pathologic antibodies and other proinflammatory and prothrombotic mediators. The usual protocol is to remove 2–3 L of plasma daily for 3–5 days.

In cases of refractory CAPS, other immunosuppressive therapies should be considered. Given its relative safety, it is reasonable to consider hydroxychloroquine because of its numerous immunosuppressive properties. Rituximab has been reported to be useful in improving CAPS in 75%, as proposed by Silver [1]. Another monoclonal antibody, Eculizumab, represents a valid addition to the current treatment regimen. It can prevent the rapid deterioration of clinical conditions in CAPS during pregnancy, as Rovere-Querini et al and A. Gustavsen mentioned in both of their articles [9,11].

Among the studies that focus on new treatments, the one by Mineo C et al. shows that 1N11, a fully human antibody that disrupts aPL recognition of β2-GPI, may afford another opportunity to develop an anti-β2-GPI monoclonal antibody as a therapy [8].

Rapid deterioration can occur at any time in CAPS, leading to detrimental outcomes to both mother and fetus. A proper management is therefore crucial in these patients, as early diagnosis and
aggressive treatment remain key factors for a favorable mother and fetal outcome and survival.

Conclusions

Catastrophic antiphospholipid syndrome (CAPS) is a severe form of antiphospholipid syndrome (APS) rarely seen in pregnancy, making early recognition difficult.

The suspicion should be high in any pregnant woman who presents multi-organ thrombosis, thrombocytopenia as well as positive antiphospholipid antibodies.

Early intervention before microvascular thrombosis and organ failure should be a fundamental goal in pregnant patients. Therefore, a proper management is required with the triple therapy (anticoagulants, corticosteroids and fresh frozen plasma replacement therapy or intravenous immunoglobulins), if necessary combined with immunosuppressive therapies.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] Silver RM. MD. Catastrophic antiphospholipid syndrome and pregnancy. Semin Perinatol 2018;42:26–32.

[2] Khizroeva J, Bitsadze V, Makatsariya A. Catastrophic antiphospholipid syndrome and pregnancy. Clinical report. J Matern-Fetal Neonatal Med 2019;32(12):2091–4.

[3] Hoeyek JC, Moussa HN, Rehman HA, Nasab SH, Blackwell SC and Sibai BM. Catastrophic antiphospholipid syndrome in pregnancy, a diagnosis that should not be missed. J Matern Fetal Neonatal Med 2016; Early Online: 1–6.

[4] Makatsariya AD, Khizroeva J, Bitsadze VG. Catastrophic antiphospholipid syndrome (Ronald Asherson syndrome) and obstetric pathology. J Perinat Med 2018;46(4):387–400.

[5] Collict M, Sciberras Buhagiar W, Mercieca C, Thake J. Catastrophic antiphospholipid syndrome in pregnancy: a life-threatening condition. BMJ Case Reports 2019;12:e230863.

[6] Hakman E and Mikhael S. Clinical report of probable catastrophic antiphospholipid syndrome in pregnancy. Case Rep Obstetr Gynecol 2018, Article ID 4176456, 3 pages.

[7] Sadick V, Lane S, Fischer E, Seppelt I, Shetty A, McLean A. Post-partum catastrophic antiphospholipid syndrome presenting with shock and digital ischaemia – a diagnostic and management challenge. J Intensive Care Soc 2018;19(4):357–64.

[8] Mineo C, Lanier L, Jung E, Sengupta S, Ulrich V, Sacharidou A, et al. Identification of a monoclonal antibody that attenuates antiphospholipid syndrome-related pregnancy complications and thrombosis. PLoS ONE 2016;11(7):e0158757.

[9] Rovere-Querini P, Canti V, Erra R, Bianchi E, Slaviero G, D’Angelo A, et al. Eculizumab in a pregnant patient with laboratory onset of catastrophic antiphospholipid syndrome. Medicine (Baltimore) 2018;97(40):e12584.

[10] Girish B, Gairder S, Saha SC, Krishnappa D. Rare presentation of catastrophic antiphospholipid syndrome with myocarditis in post-partum period: case report and review of literature. J Obstetrics Gynecol India (January–February) 2018;68(1):70–2.

[11] Gustavsen A, Skattum L, Bergseth G, Lorentzen B, Flossand Y, Bosnes V, et al. Effect on mother and child of eculizumab given before caesarean section in a patient with severe antiphospholipid syndrome. Medicine 2017;96(11):e6338.