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Coronavirus Disease 2019 in Pregnancy: A Clinical Management Protocol and Considerations for Practice

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Abstract
The coronavirus disease 2019 (COVID-19) pandemic has represented a major impact to health systems and societies worldwide. The generation of knowledge about the disease has occurred almost as fast as its global expansion. The mother and fetus do not seem to be at particularly high risk. Nevertheless, obstetrics and maternal-fetal medicine practice have suffered profound changes to adapt to the pandemic. In addition, there are aspects specific to COVID-19 and gestation that should be known by specialists in order to correctly diagnose the disease, classify the severity, distinguish specific signs of COVID-19 from those of obstetric complications, and take the most appropriate management decisions. In this review we present in a highly concise manner an evidence-based protocol for the management of COVID-19 in pregnancy. We briefly contemplate all relevant aspects that we believe a specialist in obstetrics and maternal medicine should know, ranging from basic concepts about the disease and protection measures in the obstetric setting to more specific aspects related to maternal-fetal management and childbirth.

Introduction

In December 2019, a novel coronavirus (SARS-CoV-2) outbreak occurred in Wuhan (Hubei province, China). Since the first case of pneumonia was described, SARS-CoV-2 infection (coronavirus disease 2019 [COVID-19]) rapidly spread worldwide, being declared a pandemic infection on March 11 by the World Health Organization (WHO). Since then more than 2.8 million infections and 190,000 deaths (April 26) have been reported worldwide

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[1]. With 220,000 infections and more than 22,000 deaths, Spain is the third country in number of cases [1]. In this paper, we aimed to share our management protocol and address considerations for maternal-fetal medicine practice based on a qualitative review of existing data.

Disease Transmission

Available information [2] suggests that the infection was originally zoonotic. Still, the current transmission is person to person by respiratory droplets after contact with an infected person (<2 m) or direct contact with contaminated surfaces by infected secretions [3]. Transmission could also occur through infected faeces, but the propagation throughout this route is much less relevant [4]. The possibility of vertical transmission is highly unlikely and has not been demonstrated in the Chinese COVID-19 outbreak [5] or in previous epidemics by other similar coronaviruses (severe acute respiratory syndrome [SARS]-CoV and Middle East respiratory syndrome [MERS]-CoV) [6, 7]. Based on limited data, there is no evidence of the presence of the virus in genital fluids, urine, amniotic fluid, or breast milk [8]. The low maternal viremia found in this infection [9] also suggests a negligible placental seeding. However, most data on vertical transmission are based on women who had infection during the third trimester, and information regarding vertical transmission earlier in pregnancy is lacking.

Reported cases of newborn infection probably came from horizontal transmission. The usual incubation period is about 4–6 days, which can vary between 2 and 14 days [10]. The median duration of viral shedding is 20.0 days (being the 75th centile at 24 days) [11].

Disease Description

Most patients have mild symptoms, but approximately 20% develop severe disease. The most frequent symptoms include [12, 13]: fever (80–100%), cough (59–82%), myalgia/fatigue (44–70%), and shortness of breath (31–54%). Less frequent symptoms are expectoration (28–33%), headache (6–17%), and diarrhoea (2–10%). Presence of pneumonia with bilateral infiltrates or consolidation areas is a common finding in about 50% of symptomatic patients [12, 14]. It should be noted that reports on disease description are likely to be biased towards the most severe form of the spectrum (mostly in admitted patients). In fact, recent series on obstetric patients report lower rates of symptoms, with 23% of asymptomatic cases [5].

The main findings in laboratory tests during early stages of the disease include lymphopenia, transaminase elevation, proteinuria, as well as increased lactate dehydrogenase and C-reactive protein levels [11].

Complications include severe pneumonia, acute respiratory distress syndrome, cardiac abnormalities, respiratory tract superinfections, sepsis, and septic shock [11].

Compared to men, women are less likely to die or to require hospital admission or intensive care [15]. In fact, women at reproductive age have a 60% lower likelihood of intensive care admission than their age-matched male counterparts [15]. Pregnant women do not appear to be more susceptible to infection or serious complications, but the existing data are still limited, and sizable series are scarce [16–18]. In fact, physiological changes in pregnancy – in the cardiovascular, respiratory, and coagulation systems – may confer an increased risk of morbidity. In any case, COVID-19 complications during pregnancy should be identified and treated early. Presence of comorbidities [19] (chronic hypertension, pregestational diabetes, cardiopulmonary diseases, chronic kidney disease stage III–IV, immunosuppression like in organ transplant recipients, HIV infection with <350 CD4+ cells, or prolonged corticosteroid therapy) may increase the risk of developing more severe clinical manifestations.

Fetal Complications

Periconceptional fever has been linked to neural tube defects, with epidemiological evidence that this risk is attenuated by folic acid supplementation [20]. Current data do not suggest an increased risk of miscarriage or early pregnancy loss in pregnancies with COVID-19 [5]. Likewise, previous results in pregnant women infected with SARS-CoV and MERS-CoV did not demonstrate a clear causal relationship with these complications [21]. In the absence of evidence of intrauterine transmission, it is highly unlikely that infection by COVID-19 may cause birth defects. Cases of preterm delivery have been described in women with COVID-19 [6], and this has also been observed in maternal SARS-CoV and MERS-CoV infections. Although in many cases prematurity can be induced to preserve maternal health, previous studies in pregnant women with other types of viral pneumonia have shown that there is an increased risk of preterm labour, fetal growth restriction, and loss of intrapartum fe-

tal well-being [22]. However, there is little evidence of these associations in COVID-19. The largest series on pregnant women [5] shows a risk for spontaneous preterm delivery of 6% and a risk for preterm rupture of membranes of 6%, which do not greatly differ from what is expected in the general population.

Initial Management

Pregnant women with suspected COVID-19 attended by any telehealth channel (phone, videoconferencing, …) can be safely monitored following specific checklists in which respiratory symptoms, co-morbidities, and obstetric symptoms will be assessed (online suppl. Annex 1; see www.karger.com/doi/10.1159/000508487 for all online suppl. material). In case of mild symptoms without co-morbidities, specific instructions (online suppl. Annex 2) should be given to the patient and telephone follow-up be scheduled in 24–48 h and 7 days to assess the clinical evolution. When diagnostic testing is performed in all symptomatic women, walk-in or drive-in facilities have been described as appropriate.

In health centres, suspected or confirmed patients (self-reported or identified by routine triage of symptoms [online suppl. Annex 3]) should be provided with a surgical mask and diverted to a specific isolated examination area (with no visitors). Accompanying visitors should also be provided with a surgical mask and instructed to wait at the waiting room in an isolated area or outside the hospital. Healthcare workers will assist the patient following the protection protocol established at each hospital.

Initial evaluation includes:

- To minimize exposure, the initial assessment may be performed by interphone from outside the examination box to confirm suspicion. As a general rule, we recommend minimizing the number of professionals involved in face-to-face visits.
- Medical history and physical examination including blood pressure, temperature, oxygen saturation (SO_2), and heart and respiratory rate.
- Fetal heart rate auscultation, cardiotocography (CTG), or fetal ultrasound should be used depending on gestational age and maternal symptoms to confirm fetal viability or well-being.
- If there is a clinical indication (respiratory rate >20 bpm, SO_2 <96%, presence of dyspnoea, or body temperature ≥38 °C):

– Chest X-ray: Measures of fetal protection (abdominal apron) are needed.

Table 1. Admission criteria for pregnant women with COVID-19

– Persistent fever >38°C despite using paracetamol
– Chest X-ray demonstrating pneumonia
– Pregnant women with other co-morbidities like chronic hypertension, obstructive pulmonary disease, pregestational diabetes, immunosuppression, organ transplant recipients, HIV infection with <350 CD4+ cells, or patients who receive corticosteroids equivalent to >20 mg of prednisone for >2 weeks, use of immunosuppressive drugs, neutropenia, etc.) must be carefully evaluated by an infectious disease specialist
– CURB severity scale with a total score >0 (each item gives a score of one point): C: Acute confusion U: Urea >19 mg/dL R: ≥30 bpm B: SBP ≤90 mm Hg or DBP ≤60 mm Hg
– Intensive care unit admission criteria (Table 2)

COVID-19, coronavirus disease 2019; DBP, diastolic blood pressure; SBP, systolic blood pressure.

– Laboratory workup: blood count, kidney function including creatinine, urea, electrolyte panel (Na, K^+, Ca, Mg), liver profile, lactate dehydrogenase and C-reactive protein, and coagulation tests (prothrombin time and activated partial thromboplastin time).

Severity Classification and Admission Criteria in Pregnant Women with COVID-19

Patients can be classified according to the severity of the respiratory infection into mild/moderate or severe cases. Table 1 details the admission criteria used at our institution. The CURB (Confusion, Urea, Respiratory rate, Blood pressure) adapted severity scale can help us to assess the severity of the respiratory infection (Table 1) and the need for critical care could be assessed by standardized criteria (adapted from the American Thoracic Society and Infectious Diseases Society of America) (Table 2).

Mild Infection

Presence of local symptoms in the upper respiratory tract (cough, throat sore, rhinorrhoea, or anosmia) with or without non-specific symptoms such as fever or myalgia and a CURB score of 0.

Moderate Infection

Mild pneumonia, considered as pneumonia confirmed by chest X-ray, without presenting severity signs (basal

Table 2. Admission criteria to the intensive care unit

Major criteria
– Need for invasive mechanical ventilation
– Shock with the need for vasopressors
Minor criteria
– Respiratory rate ≥30 bpm
– PaO_2/FiO_2 ratio <250
– Multilobar infiltrates
– Confusion/disorientation
– Uraemia (blood urea nitrogen >20 mg/dL)
– Leukopenia: <4,000 cells/mm^3
– Thrombocytopenia: <100,000 platelets/mm^3
– Hypothermia/central temperature <36°C
– Hypotension in need of aggressive fluid resuscitation

Admission criteria: 1 major criterion or 3 minor criteria. FiO_2, fraction of inspired oxygen; PaO_2, partial pressure of oxygen.

SO_2 >90%, no need for vasopressors or ventilatory assistance, and CURB score ≤1). The patient should be admitted to an isolation ward (ideally in a negative pressure room) with vital signs monitoring and under the consultation of maternal-fetal, anaesthesiology, and infectious diseases specialists.

Severe Infection

Severe Pneumonia. When any of the following criteria are met: failure of ≥1 organ, basal SO_2 <90%, respiratory rate ≥30 bpm, or need for vasopressors.

Respiratory Distress. Suggestive clinical findings (dyspnoea, chest retraction, respiratory effort) or radiological evidence of bilateral infiltrates plus oxygenation deficit (SO_2/fraction of inspired oxygen [FiO_2] ratio ≤315 [if partial pressure of oxygen (PaO_2) is not available] or PaO_2/FiO_2 ratio ≤300). Mild: PaO_2/FiO_2 ratio 200–300; moderate: 100–200; severe: ≤100.

Sepsis. The Sepsis-Related Organ Failure Assessment (SOFA) scale can be used to evaluate sepsis severity (consider if score >2). Also quick SOFA with two of the three following criteria: Glasgow ≤13, systolic blood pressure ≤100 mm Hg, or respiratory rate ≥22 bpm.

Septic Shock. Arterial hypotension that persists after resuscitation volume and that requires vasopressors to maintain a mean arterial pressure ≥65 mm Hg and lactate ≥2 mmol/L (18 mg/dL) in the absence of hypovolemia.

Early identification of cases with severe manifestations allows timely treatment and referral to intermediate or intensive care. It is to note that COVID-19 patients may have a sudden clinical deterioration. The recognition of severity in the presence of pneumonia will be identified during the initial evaluation if there is suspicion of respiratory failure (basal SO_2 <90% breathing ambient air) or a respiratory rate ≥30 bpm.

Additional Investigation of COVID-19 Cases That Require Hospital Admission

- Respiratory samples: If not previously performed, a swab of the upper respiratory tract (nasopharyngeal) for PCR testing (COVID-19, seasonal influenza, and syncytial respiratory virus) should be performed. In cases of highly suggestive COVID-19 infection with a previous negative PCR, retesting of a lower respiratory tract sample (sputum) is recommended.
- Chest imaging: If it has not been previously performed. Chest tomography can be informative and is not contraindicated in selected cases. In some settings, lung ultrasound is an acceptable imaging technique alternative to X-ray.
- Basal electrocardiogram (repeat after 48 h if medications that may have an effect on the QT interval are administered, such as hydroxychloroquine sulphate, azithromycin, or lopinavir/ritonavir).
- Blood sample COVID-19 profile: for haematology, biochemistry, coagulation, and severity markers (ferritin, troponin-I, D-dimer [increased 2–3 times at third trimester]; procalcitonin [if bacterial superinfection is suspected]). In some settings, HIV, HBV serologies, and QuantiFERON test (for tuberculosis) may be indicated because some COVID-19 treatments can influence these infections.

Clinical Management of Pregnant Women

Figure 1 summarizes the management of COVID-19 during pregnancy.

Mild Infection at Home Isolation

- Hydration.
- Temperature control (twice a day and opportunistically if new-onset symptoms occur, such as sweating, shivering, or headache), and if needed paracetamol up to 500–1,000 g/6–8 h (up to a maximum of 4 g/day).
- Although available, use of home pulse oximetry by smartphone or smartwatch apps is not recommended as there is concern regarding reliability [23].

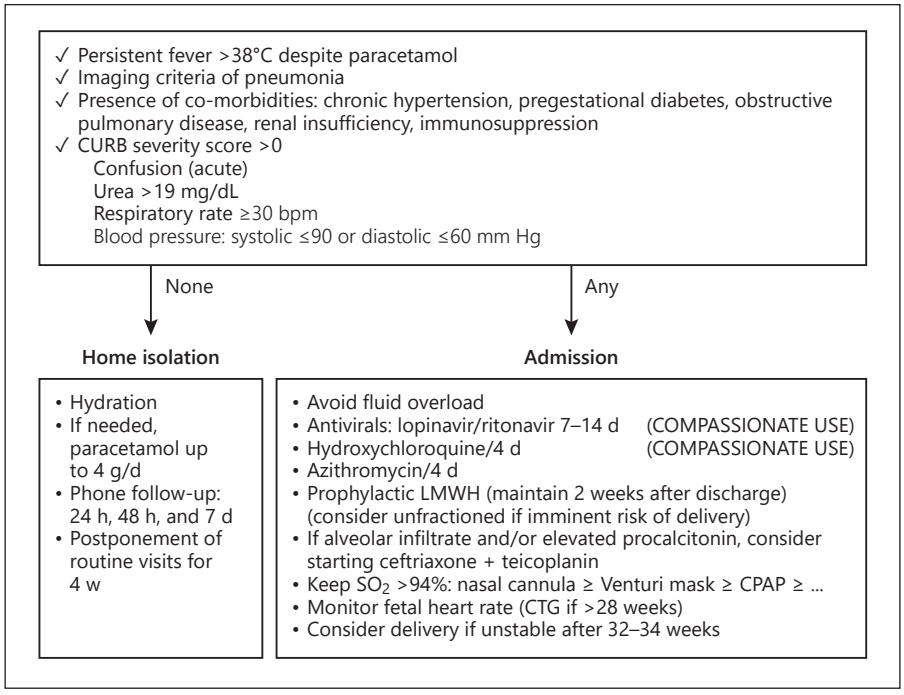

Fig. 1. Summarized management of COVID-19 during pregnancy. COVID-19, coronavirus disease 2019; CPAP, continuous positive airway pressure; CTG, cardiotocography; LMWH, low-molecular-weight heparin; SO_2, oxygen saturation.

- During influenza season, if no confirmation of COVID-19 infection and no exclusion of influenza: oseltamivir 75 mg every 12 h for 5 days.
- Home isolation with measures of droplet and contact isolation (online suppl. Annex 2).
- Give clear indications on reasons for emergency consultation (among others, respiratory distress, fever resistant to antipyretics).
- Prolonged bed rest should be discouraged given the risk of thrombosis associated both with pregnancy and COVID-19 infection.
- Schedule a telehealth visit in 24–48 h to assess the clinical evolution and plan further follow-up according to clinical evolution.
- Routine pregnancy visits, tests, and screening ultrasounds will be postponed until the end of the isolation period (4 weeks after the appearance of symptoms) or following negative PCR test after 2 weeks from the presence of symptoms, depending on public health authority's strategy. Follow-up of ambulatory cases with any maternal or fetal risk that need in-person evaluation (such as fetal growth restriction) will require individualized consideration by maternal-fetal specialists.

Moderate and Severe Cases

Hospital admission under vital signs monitoring (blood pressure, heart rate, respiratory rate, SO_2) in a high-dependency isolated unit. Treatment at our institution includes oxygen support to keep an SO_2 >94%, progressively including a nasal cannula or Venturi mask (up to 40% FiO_2) followed by continuous positive airway pressure masks. Progressive therapies should be applied in coordination with anaesthesiology/internal medicine specialist. Further support would need intensive care unit monitoring.

There is no evidence from well-designed trials about the effectiveness of any pharmacological treatment for COVID-19 infection. This may rapidly change because there were more than 100 ongoing registered trials by April 2, 2020. Therefore, current recommendations are mainly based on in vitro studies or studies performed in other coronavirus infections [24].

Pharmacological treatment:

- Lopinavir/ritonavir (100 mg/25 mg) 2 tablets every 12 h (7–14 days depending on the clinical evolution).
- Hydroxychloroquine sulphate 400 mg every 12 h the first day followed by 200 mg every 12 h for the following 4 days.
- Azithromycin 500 mg (first day) followed by 250 mg every 24 h to complete 4 days, orally or intravenously.

These treatments are not contraindicated during pregnancy, but require informed consent for compassionate use.

- In case of alveolar infiltrate and/or elevated procalcitonin (suspected bacterial superinfection), consider starting ceftriaxone 1–2 g every 24 h intravenously + teicoplanin 400 mg every 12 h for 3 doses followed by 400 mg every 24 h.
- Treatment with prophylactic low-molecular-weight heparin is indicated during hospitalization and 2 weeks thereafter (independent of D-dimer levels).

Other therapies are being investigated in critically patients, such as methylprednisolone (with proven benefits in the management of acute respiratory distress syndrome), tocilizumab (an anti-inflammatory monoclonal antibody with IL-6-inhibitory effect), or remdesivir (an RNA polymerase inhibitor with in vitro activity against SARS-CoV-2). Still, there are safety concerns regarding their use during pregnancy.

Fetal well-being should be assessed (by CTG) on a regular basis depending on gestational age and maternal situation.

Patients with COVID-19 with an Indication of Hospitalization due to Obstetric Conditions

- Droplet and contact isolation measures, preferably in a negative pressure room.
- Obstetric procedures should not be undertaken until healthcare personnel are under appropriate personal protective equipment.
- An urgent obstetric procedure should not be delayed to confirm diagnosis.
- The obstetric therapeutic procedures (threatened preterm labour, preeclampsia, …) will be the usual ones, but in a much-rationalized way for both maternal and fetal control, keeping in mind that medical/nursing care will only be carried out with the minimum essential personnel.
- Minimize the number of accompanying visitors, always asymptomatic and under proper isolation measures (droplets and contact).
- Current evidence suggests that in the context of a COVID-19 infection, administration of corticosteroids for fetal lung maturation does not produce maternal harmful effects, even though there is controversy over whether the use of corticosteroids could alter the clearance of the virus.
- Indication for delivery: in clinically stable pregnant women with confirmed or suspected COVID-19 infection, there is no indication to induce labour or perform a caesarean section. Preferably, it should occur when the microbiological test (PCR) has become negative.
- In case of required labour induction for obstetric indications, priority will be given to methods which minimize examination and/or transfers of the patient (such as extended-release prostaglandins, subjected to appropriate fetal monitoring protocols).
- COVID-19-symptomatic pregnant women may present severe preeclampsia/HELLP-like syndrome signs. If those signs are observed, the differential diagnosis with COVID-19 should be considered. The use of angiogenic factors (sFlt-1/PlGF ratio) to rule out preeclampsia has been shown to help establish differential diagnosis with true preeclampsia [25].

Delivery Care and Other Obstetric Procedures

In pregnant women with COVID-19 infection without severity criteria with spontaneous-onset delivery or with an indication of induction due to obstetric indications, the mode of delivery will depend on obstetric conditions and fetal status. In case of severe maternal disease, read below.

Testing is critical for risk mitigation. Policies for PCR testing on admission largely depend on disease prevalence, test availability, and laboratory response time. Priority testing of symptomatic cases and elective surgeries seems a reasonable first-step strategy.

Labour should be attended in a dedicated delivery room, preferably with negative pressure. Ideally, this delivery room should be convertible to allow a caesarean section, thus avoiding unnecessary transfers. The patient should use a surgical mask throughout labour. Read the Personal Protective Equipment for Obstetric Procedures section for instructions on protection for healthcare professionals.

Fetal Procedures

- Although the risk of spontaneous vertical transmission is low [26], it seems prudent to avoid transplacental access during invasive procedures. A balance between the fetal benefit of evidence-based therapies against the potential risks for the fetus, mother, and healthcare providers should be made on an individual basis.

Vaginal Delivery

- Continuous CTG monitoring is advised due to possible increased risk of fetal distress, as reported in some early reports [6]. Although there is no evidence on the presence of SARS-CoV-2 in vaginal secretions [26], it

seems reasonable to avoid fetal scalp pH testing or internal fetal heart rate monitoring. If fetal well-being loss is suspected, immediate delivery of pregnancy by the most appropriate mode of delivery according to obstetric conditions will be decided.
- Monitor temperature, respiratory rate, and SO_2 hourly.
- Under normal labor progression, vaginal examinations should be minimized (i.e., every 2–4 h). Ideally, a minimal number of professionals should be involved in labour management to minimize the risk of professional exposure.
- Neuraxial analgesia is not contraindicated, and by providing good analgesia, it may reduce cardiopulmonary stress from pain and anxiety. Preferably, it should be administered early to minimize the risk of requiring general anaesthesia for an emergency caesarean section, as airway manipulation, intubation, and extubation are high-risk procedures for professional infection. Some societies recommend against the use of nitrous oxide because of the risk of aerosol generation [27].
- Consider shortening the second stage of labour (forceps or vacuum) according to obstetric criteria as active pushing while wearing a surgical mask may be difficult for the woman [28].
- Unless indicated for suspected fetal or neonatal distress, routine umbilical cord gas analysis is avoidable.
- Allowing people support on labour and delivery is a controversial issue, mainly because in most of the situations, they are close contacts. In any case, the support person should be screened for symptoms (online suppl. Annex 3) before admission to the delivery room, wearing appropriate protective equipment (at least a surgical mask) and keeping droplet and contact isolation measures.
- Any generated material during labour should be treated as contaminated. This includes biological samples (such as the placenta) and other potential fomites such as neonatal finger- or footprints or CTG strips. As a general rule, their reduction is desirable. During the COVID-19 pandemic, the placenta should not be handed over to the patient.
- Newborn care should be carried out in the same operating/labour room unless resuscitation measures are required that can not be provided in-room.
- Although evidence of mother-to-child transmission is lacking, early cord clamping may be discussed with the patient and recommended to minimize the risk of transmission after 34 weeks of gestational age. Before 34 weeks, a risk-benefit decision should be made regarding delayed clamping.
- The patient could informedly decide skin-to-skin contact with the newborn [29]. This can only be offered if a good mother-child placement can be ensured, and in asymptomatic newborns >34 weeks, ensuring precautions for respiratory droplets with the use of a mask as well as hand and skin hygiene.

Caesarean Delivery
- Caesarean section should follow usual obstetric indications. The potential risk of vertical transmission is not an indication for caesarean section.
- Maternal indication: in women with respiratory compromise, labour may stress the pulmonary situation, and maternal hypoxia also has fetal risks. Under this rationale, a caesarean section could be considered after 32–34 weeks in women with severe illness, when the risks of prematurity could be assumed. Before 32 weeks, multidisciplinary team decisions should be made, balancing maternal and neonatal risks, especially in intubated patients or those with need for maternal prone position due to acute respiratory distress syndrome [30]. Continuing maternal support with fetal monitoring in women that remain stable may be an option for severe preterm cases.

Neonatal Issues

Neonates from COVID-19-positive women should be tested, isolated, and cared following droplet and contact preventive measures [31]. The WHO recommends for mothers with COVID-19 infection to be able to room in with their babies [29]. The mother should wear a surgical mask and practice hand hygiene when in close contact with her infant, particularly when feeding. Alternatively, if another healthy adult is in the room, they can care for the newborn. Asymptomatic newborns could be discharged after delivery and cared by an asymptomatic family member with the adequate isolation measures. If they are symptomatic or have other hospitalization criteria (prematurity, etc.), they will be admitted to an isolated area defined in the neonatal care unit.

Postpartum Care

- Immediate postpartum and postanaesthetic recovery after caesarean section will be performed in the same isolation conditions and, ideally, in the same delivery/labour room. Preferably, surveillance will be under-

taken by the same nursing, anaesthesiology, and obstetric personnel until transfer to the hospitalization room.
- Paracetamol is the analgesic of choice due to some reports of rapid disease progression in young adults under non-steroidal anti-inflammatory drugs (ibuprofen) [32].
- Postpartum prophylactic low-molecular-weight heparin (if maternal weight <80 kg: enoxaparin 40 mg every 24 h or equivalent; if maternal weight >80 kg: 60 mg every 24 h) is indicated during hospitalization and 6 weeks thereafter, due to the association of COVID-19 infection with deep venous thrombosis and pulmonary thromboembolism in patients with severe COVID-19 [33]. In women with infection more than 4 weeks before delivery, thromboprophylaxis should follow the standard criteria.
- Postpartum discharge indications are the same as those of any person infected by COVID-19, considering that they can transmit the infection up to 14 days after clinical features resolve (or 4 weeks after the beginning of symptoms or after the PCR test is negative).

Breastfeeding

There is no evidence of the presence of SARS-CoV-2 in maternal milk from infected women [8], although only 6 patients were tested in this series. Breast milk is a passive source of antibodies and other protective factors. According to the current evidence, most international scientific organizations [29, 34] allow breastfeeding if maternal and neonatal conditions are favourable, always under contact and droplet precautions (use of a surgical mask, correct hand hygiene before and after contact, cleaning breast skin and surfaces that could be in contact).

Milk extraction could be another alternative under strict hygiene measures, using an individual milk extractor. This device should be cleaned after each use with adequate disinfectants. Breast milk should be administered to the newborn by a healthy family member (not considered contact) or healthcare personnel.

The final decision on the type and mode of lactation must be agreed between the patient and the neonatologists based on current scientific knowledge as well as and maternal and neonatal health status. If artificial feeding is decided, milk production can be maintained through extraction and discard until the mother tests negative for the infection.

There is no indication to stop breastfeeding in the case of a postpartum woman with COVID-19 infection and established lactation, but contact and droplet precautions should be recommended (use of a surgical mask, strict hand and breast hygiene measures).

Follow-Up of Pregnant Women after COVID-19 Resolution

After hospital discharge of pregnant women with COVID-19 infection, telehealth follow-up is recommended to ensure maternal well-being. Due to the limited evidence on the effects of COVID-19 infection during pregnancy, ani n-person follow-up appointment will be scheduled after the end of the infective period (at least 4 weeks after the onset of symptoms or after a negative test). Assessment of pregnancy risks, fetal growth, and well-being will be recommended throughout pregnancy. Due to concerns on fetal growth, serial ultrasounds in the third trimester (28, 32, and 37 weeks) may be indicated. If follow-up assessment is required within the contagiousness period, it will be carried out with the necessary protection measures.

Personal Protective Equipment for Obstetric Procedures

We adhere to the WHO recommendations on the rational use of personal protective equipment for COVID-19 [35]. In the absence of aerosol-generating procedures, the recommended protective equipment includes a surgical mask, a long-sleeved disposable gown, nitrile or latex gloves, and eye protection (full-face visor or protective glasses). For procedures with the potential to generate aerosols, the protective equipment is extended to disposable latex or nitrile double gloving (one external and one internal), a water-proof disposable apron, and protective goggles. In addition, the recommendations for this situation also include a respirator with a minimum filtering efficiency of 95% of particles <0.3 μm. According to the National Institute for Occupational Safety and Health this requirement corresponds to a category N95 respirator. According to the European classification, this requirement falls between the FFP2 and FFP3 categories.

However, there is controversy on whether the second stage of labour and delivery or caesarean sections are aerosol-generating events. In the absence of clear evidence, we recommend, subject to availability, a N95 or

FFP2/FFP3 respirator for vaginal examinations and other pelvic procedures (such as amniotomy or bladder catheterization) as well as for attending the second stage of labour or a caesarean section. In other situations or actions that do not require direct or prolonged contact with the patient, such as changes in dosage of oxytocin or monitoring vital signs, surgical masks/FFP2 respirators would meet the standards for personal protection. It should be noted that respirators with a valve do not confer protection against exhaled air. Thus, in case of a surgical procedure requiring asepsis (such as a caesarean section), respirators without a valve or wearing a surgical mask on top of a valved respirator would be required.

Summary

- COVID-19 transmission is person to person by respiratory droplets after contact with an infected person (<2 m) or direct contact with contaminated surfaces by infected secretions.
- Most patients have mild symptoms (flu-like), but approximately 20% develop severe disease (severe pneumonia, acute respiratory distress).
- Pregnant women do not appear to be more susceptible to infection or to serious complications compared to non-pregnant women, but the existing data are still limited, and sizable series are scarce. Presence of co-morbidities may increase the risk of presenting with more severe clinical manifestations.
- Current data do not suggest an increased risk of miscarriage or early pregnancy loss in pregnant women with COVID-19. At third trimester, cases of preterm delivery and fetal distress have been described in women with COVID-19 infection, although the evidence is still too weak to establish an association. A significant number of preterm deliveries are due to maternal indication.
- Women with mild symptoms without co-morbidities could be safely isolated at home and followed up by telehealth means.
- Early identification of cases with serious manifestations allows timely treatment, oxygen support, and referral to the intermediate or intensive care. It should be noted that COVID-19 patients may have sudden clinical deterioration.
- In pregnant women with COVID-19 infection without severity criteria with spontaneous-onset delivery or with an indication of induction due to obstetric conditions, the mode of delivery should be based on obstetric conditions and fetal status. Caesarean section should follow usual obstetric indications.
- COVID-19 is highly contagious, and this must be taken into consideration when planning intrapartum care. Rational use of personal protective equipment is key in preventing infection in attending professionals.
- Neonates from COVID-19-positive women should be tested, isolated, and cared for following droplet and contact preventive measures. Rooming-in and breastfeeding are acceptable under appropriate preventive measures.

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Statement of Ethics

Ethics approval was not required as no research individuals were involved in this study.

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Author Contributions

M. López, A. Gonce, E. Meler, S. Hernández, A. Plaza, R.J. Martinez-Portilla, F. García, M. Palacio, and F. Figueras contributed to the writing of the original draft. All members of the COVID Collaborative Group gave their assessment in their specific fields to the original draft content. All authors contributed actively in the revision and edition of the manuscript.

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