Rooming-in, Breastfeeding and Neonatal Follow-up of Infants Born to Mothers with COVID-19

Alojamento Conjunto, Amamentação e Seguimento Neonatal de Recém-Nascidos de Mãe com COVID-19

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ABSTRACT

Introduction: Due to growing evidence suggesting COVID-19 may have a benign course in the newborn, a number of guidelines supporting rooming-in and breastfeeding were developed. The main aim of the study was to assess the safety of this approach, through the risk of developing severe neonatal infection.

Material and Methods: Prospective observational study from April 2020 to February 2021 on the approach and neonatal follow-up of infants born to mothers with COVID-19 at the time of delivery in a hospital with advanced neonatal care, where rooming in and breastfeeding were promoted whenever possible. We collected data during hospital admission and over the phone during the neonatal period.

Results: We included 77 infants born to mothers with COVID-19 (3.8% of newborns born during the time of study), median gestational age 39 weeks + 5 days and median birth weight 3270 g; 9% were born premature (*versus* 12% born premature among newborns born during the time of study). Rooming-in took place in all of them although 4% were briefly admitted to the Neonatal Intensive Care Unit; 88% were discharged home up to day three, 97% were breastfed at the time of discharge and 90% were still breastfed by the end of the neonatal period. We completed neonatal follow-up of 63 newborns, eight of them developed COVID-associated symptoms, three with need of medical evaluation; 40% had no medical assessment after being discharged. Out of 77, 5% of infants were infected with SARS-CoV-2 (total of four, one mild, three asymptomatic), with no significant differences during hospital stay or follow-up.

Discussion: Neonatal infection was uncommon and mild, and there was no increase in prematurity. Rooming-in and breastfeeding were safe and should be promoted whenever clinically possible. Follow-up care after hospital discharge needs improvement.

Conclusion: Infants born to mothers with COVID-19 were safely roomed in with their mothers and exclusively breastfed.

Keywords: Breast Feeding; COVID-19; Infant, Newborn; Portugal; Rooming-in Care; SARS-CoV-2

RESUMO

Introdução: Dada a evidência crescente de maior benignidade da COVID-19 no recém-nascido, surgiram recomendações de promoção do alojamento conjunto e da amamentação. O principal objetivo do estudo foi avaliar a segurança dessa abordagem, através do risco de infeção neonatal grave.

Material e Métodos: Estudo observacional prospetivo de abril 2020 a fevereiro 2021 da abordagem hospitalar e seguimento após a alta dos recém-nascidos de mãe com COVID-19 num hospital com apoio perinatal diferenciado, onde foram advogados o alojamento conjunto e amamentação, sempre que possível. Recolhemos os dados no internamento e em seguimento telefónico durante o período neonatal.

Resultados: Incluímos 77 recém-nascidos de mãe com COVID-19 (3,8% do total de recém-nascidos), com medianas de idade gestacional 39 semanas e 5 dias e 2370 g de peso à nascença; destes, 9% nasceram pré-termos (*versus* 12% pré-termos no total de recém-nascidos). Todos estiveram em alojamento conjunto e 4% foram admitidos transitoriamente na Unidade de Cuidados Intensivos Neonatais; um total de 88% recém-nascidos tiveram alta até ao terceiro dia de vida, 97% tiveram alta sob aleitamento materno e 90% mantinham-no no fim do período neonatal. Dos 63 recém-nascidos com seguimento telefónico completo, oito tiveram sintomas compatíveis com COVID-19, três dos quais com observação médica. Em 40% dos casos não houve consulta médica de vigilância após a alta. Houve 5% recém-nascidos com COVID-19 (num total de quatro, registámos um quadro ligeiro e três assintomáticos), sem particularidades no internamento ou seguimento.

Discussão: A infeção neonatal foi incomum, não houve quadros graves nem maior incidência de prematuridade. O alojamento conjunto e a amamentação foram práticas seguras, devendo ser promovidas desde que clinicamente possível. Destacamos que a vigilância de saúde após a alta necessita de ser melhorada.

Conclusão: Os recém-nascidos de mãe com COVID-19 podem ser mantidos em alojamento conjunto e sob aleitamento materno exclusivo.

Palavras-chave: Alojamento Conjunto; Amamentação; COVID-19; Portugal; Recém-Nascido; SARS-CoV-2

INTRODUCTION

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection was reported by China to the World Health Organization on 31 December 2019[1] and was declared a pandemic on 11 March 2020.[2]

Coronavirus disease 2019 (COVID-19) is an acute respiratory infection of variable clinical severity, with two-thirds of the patients showing no symptoms[3] - among these, most (81%) patients present with mild illness and 5% with critical illness.[4] There is a lower incidence and less severity in the paediatric age group, including in the neonatal

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period.[5-8]

The disease is uncommon in newborn (NB) patients and mothers are the main focus of transmission.[9,10] Following the introduction of universal screening for SARS-CoV-2 in parturients during hospital admission, evidence suggests that up to 15% of pregnant mothers present with COVID-19 and up to 90% with no symptoms.[11] Their NBs may be at an increased risk of infection,[12] leading to a wide discussion on the approach to the mother-newborn dyad.[10,13]

Initially, the recommendations of the major Paediatric and Neonatology societies followed two different trends: (i) the Chinese trend, including recommendations for mother-child separation and exclusive formula feeding[14] and (ii) the trend of the Italian Society of Neonatology (SIN), including recommendations for rooming-in and breastfeeding with measures to prevent transmission.[15] The recommendations of the Portuguese Society of Neonatology (SPN)[16] followed the Italian trend, while the American Academy of Pediatrics (AAP)[10] and the Royal College of Paediatrics and Child Health (RCPCH)[17] recommended mother-child separation and avoidance of breastfeeding.

This study was mainly aimed at assessing the safety of rooming-in of infants born to mothers diagnosed with COVID-19 and the risk of severe neonatal infection. Secondary study endpoints included the characterisation of the population of infants born to mothers diagnosed with COVID-19 in terms of demography, epidemiology and perinatal variables such as prematurity, transmissibility and spectrum of SARS-CoV-2 neonatal infection, clinical progression, as well as primary care follow-up laid down in the *Programa Nacional de Saúde Infantil e Juvenil* (PNSIJ) (National Programme for Child and Youth Health).[18]

MATERIAL AND METHODS

This was a prospective observational study and was carried out between April 1, 2020 and February 7, 2021 at *Hospital Garcia de Orta*, a level-II hospital with differentiated perinatal support, where a specific COVID-19 contingency plan for the mother-newborn dyad is in force, which was adopted from April 2020 onwards, with ongoing data collection. This plan included (i) shared decision-making regarding rooming-in and breastfeeding, provided the clinical condition allows it; (ii) no visitors during hospitalisation; (iii) clarification of doubts and concerns; (iv) usual criteria and healthcare regarding the route of delivery, late cord clamping, skin-to-skin contact, administration of vitamin K and eye prophylaxis; (v) transmission and preventive measures at all times including mask use, hand hygiene, washing the mother's breast and abdomen, cradling the baby two metres from the mother's bed in the rooming house, (vi) use of personal protective equipment; (vii) SARS-CoV-2 screening; (viii) discharge under the usual clinical criteria and (ix) telephone follow-up once or twice a week during the first 28 days, in addition to face-to-face follow-up in primary care.

According to the plan, the perinatal care of infants born to mothers diagnosed with COVID-19 would be as similar as possible to that of those born to mothers without COVID-19, with rooming-in promotion (admission of mothers and NB to the same physical space, with the cot next to the mother's bed), keeping the same criteria for the decision regarding the route of delivery, admission to the Neonatal Intensive Care Unit (NICU) and discharge. The main differences were hospitalisation in an isolation ward, transmission prevention measures, SARS-CoV-2 screening of NB, metabolic screening before the day 3 (with a favourable opinion from *Instituto Nacional de Saúde Doutor Ricardo Jorge*) and universal neonatal hearing screening (UNHS) following hospital discharge.

All infants born to mothers presenting with COVID-19 who cumulatively met the following four criteria were included in the study:

1) Hospital or out-of-hospital birth attending postpartum care at the hospital;

2) Mothers presenting with active SARS-COV-2 infection, defined by SARS-CoV-2 detection by real time polymerase chain reaction (RT-PCR) testing using naso-oropharyngeal swabs at hospital admission or having been previously diagnosed without having completed a recovery protocol;

3) Presence of clinical conditions compliant with rooming-in, defined by neonate-mother clinical stability. For example, the presence of early respiratory distress syndrome (RDS), prematurity (less than 33 weeks) or persistent feeding difficulties — which would be criteria for admission to the NICU – would prevent rooming-in. Similarly, maternal conditions including severe pre-eclampsia or respiratory pathologies (COVID-19 or not) with the need for admission to the ICU would also prevent rooming-in.

4) Mothers who agreed to participate in the study.

Infants born to mothers who had tested positive for SARS-CoV-2 at hospital admission in whom no active infection was assumed or in case of revoked consent at any time during follow-up were excluded from the study.

Study data included (i) family epidemiological framework — contacts, diagnosis and clinical data of mothers and cohabitants; perinatal variables — type of delivery, gestational age, birth weight, need for resuscitation and NICU admission; inpatient clinical course — NB SARS-CoV-2 screening, decision, type and conditions of accommodation, NB feeding, length of stay and discharge criteria; and (ii) follow-up after hospital discharge — clinical course of the NB, mothers and cohabitants, epidemiological surveillance and mother and NB recovery protocol (whenever applicable), primary care follow-up and general NB care.

Clinical data of inpatient NB were based on clinical records and telephone follow-up during the neonatal period — obtained once or twice a week, with information regarding the clinical status of NB and cohabitants (including

mothers), general healthcare, breastfeeding, primary care follow-up and any parental concerns. Data were stored in Microsoft Excel® for further simple descriptive statistical analysis.

The study was approved by the Ethics Committee of *Hospital Garcia de Orta*.

Informed consent was obtained from all participants.

RESULTS

Results refer to the period 1 April to 31 December 2020.

1) Hospital approach

A total of 2,124 infants were born in the hospital to 2,074 mothers; 3.8% (78/2,074) of the mothers presented with SARS-CoV-2 infection at childbirth and 3.7% (78/2,124) of the infants were born to mothers diagnosed with COVID-19 — 77 were included in the study; one was excluded (without mother's consent) (Fig. 1).

a) Puerperae (Table 1)

Puerperae presenting with COVID-19 had a median age of 28 years (range 18-42); 83% (64/77) were diagnosed at admission and 17% (13/77) were previously diagnosed, with no recovery; twelve of these had presented with a symptomatic infection — hospital stay was required for one mother six weeks before delivery due to SARS-CoV-2

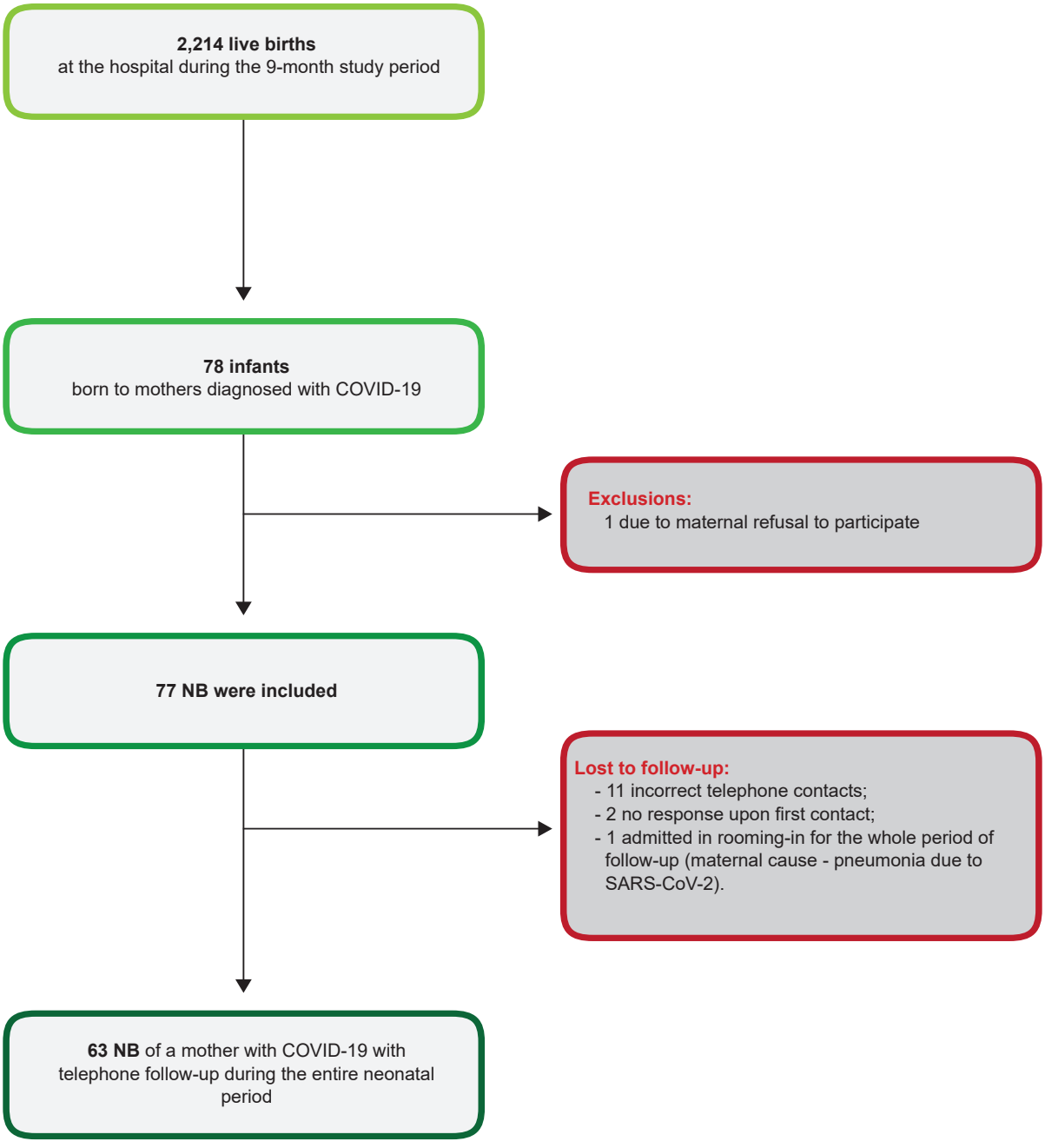

Figure 1 – Study eligibility criteria

Table 1 – Puerperae diagnosed with COVID-19 (n = 77)

Age		**years**
Median		28
Minimum		18
Maximum		42
Diagnosis	**n**	**%**
Previous	64	83%
At admission	13	17%
	77	100%
Symptoms	**n**	**%**
No symptoms	58	75%
Mild-moderate	16	21%
Severe	3	4%
	77	100%

Table 2 – Infants born to mothers diagnosed with COVID-19: delivery and immediate post-natal period (n = 77)

Gender	**n**	**%**
Female	40	52%
Delivery type	**n**	**%**
Eutocic	42	55%
Forceps	4	5%
Vacuum-assisted	5	6%
C-section	26	34%
	77	100%
Gestational age		**weeks + days**
Median (range)		39 + 5 (33 + 4 – 41 + 2)
	n	**%**
Preterm, < 37w	7	9%
Full-term, [37 – 42w[	70	91%
Post-term, ≥ 42w	0	0%
	77	100%
Birth weight		**g**
Median (range)		3270 (2030 – 4150)
	n	**%**
AGA	70	91%
SGA	5	6%
LGA	2	3%

pneumonia.

Only 10% of the puerperae (8/77) presented with (mild) symptoms at childbirth and the remaining presented with no symptoms, while prolonged hospital stay was required for 3% (2/77) due to SARS-CoV-2 pneumonia.

b) Delivery and immediate postnatal period (Table 2)

From a total of 77 NB, 52% (40/77) were female and 55% (42/77) were born by eutocic delivery; as regards dystocic deliveries (35), 74% (26/35) regarded C-sections: due to non-reassuring foetal status (35%, 9/26), failure to progress in labour (23%, 6/26), maternal history of C-section (27%, 7/26), maternal pathology (12%, 3/26) and foetopelvic disproportion (4%, 1/26).

Gestational age ranged from 33 weeks and four days to 41 weeks and two days, (median of 39 weeks and five days). There were 9% (7/77) preterm infants among infants born to mothers with COVID-19 and 12% (246/2,046) among those born to mothers without COVID-19.

Birthweight ranged from 2,030 g to 4,150 g (median of 3,270 g), with most NBs being appropriate for gestational age [AGA (91%, 70/77)]; 6% (5/77) small for gestational age (SGA) and 3% (2/77) large for gestational age (LGA) were identified.

Neonatal resuscitation manoeuvres were required for 5% (4/77) of the cases, only one from which had an Apgar score of less than 7 at the fifth minute; three had a rapid recovery and were admitted to rooming-in. The other NB also recovered quickly, but was admitted to the NICU during the obstetric stabilisation of the mother and was then admitted to rooming-in until discharge. No preterm NB required neonatal resuscitation.

All NB were clinically able for rooming-in during at least part of their stay in the hospital. The need for a transitory admission to the NICU was found in 4% (3/77): two directly from the delivery room (one due to early RDS and one due to the mother's condition) and one admitted due to respiratory and feeding difficulties at day 10 (still in hospital at the time, due to social reasons). The latter was diagnosed with a congenital heart disease associated to paroxysmal supraventricular tachycardia and congestive heart failure; SARS-CoV-2 tests were negative. The NB admitted with early RDS was a preterm infant, improved within the first 24 hours and was transferred to rooming-in until discharge on day 3; SARS-CoV-2 tests were negative. None of the remaining preterm infants was admitted to the NICU.

c) Rooming-in, feeding and perinatal care (Table 3)

By decision shared between the mothers and the medical team, 100% (77/77) of the mother/newborn dyads were admitted to rooming-in, in isolation with prevention measures. The three NB admitted to the NICU were the only ones who did not stay with their mothers during the whole hospital stay.

From the 77 NB, 52% (40/77) were exclusively breastfed, 3% (2/77) were exclusively formula fed (one due to mother's choice, one due to mother presenting with human immunodeficiency virus infection) and the remaining 45% (35/77) were discharged with mixed feeding. Two NB (one preterm and one SGA infant) presented with hypoglycaemic episodes.

All infants were given the first dose of hepatitis B vaccine at admission, while 94% (72/77) were screened for metabolic diseases and 5% (4/77) were screened for universal neonatal hearing loss.

A median length of stay of two days has been found (range 1-36) and 88% (68/77) were discharged on day 3. Eight NB/mothers stayed in hospital beyond day 3 due to maternal or social causes (including two mothers admitted with COVID-19 pneumonia) and one NB due to congenital heart disease (this was the only NB who was not discharged with the mother and who was transferred to another hospital).

d) SARS-CoV-2 screening (Table 3)

SARS-CoV-2 detection by real time polymerase chain reaction (RT-PCR) testing using naso-oropharyngeal swabs was obtained from 97% (75/77) of NB [double testing was obtained at 24 and 48 hours from 81% (61/75)], in compliance with standard 026/2020[26] of the Directorate General of Health (DGS), introduced at 19 May 2020, in transition from a single swab at 24 hours to double testing performed in most NB - the second swab was obtained following a first negative test and was not required in case of a positive test. In four cases, corresponding to 5% of the infants born to mothers diagnosed with COVID-19, positive SARS-CoV-2 tests were obtained: two within the first 24 hours and two that were initially negative and subsequently positive at 48 hours.

In this subgroup of four NB with positive SARS-CoV-2 testing, all were SGA at birth, one pre-term (36 weeks and six days) and the remaining three full term. None required neonatal resuscitation or admission to the NICU. They were admitted to rooming-in with their mothers during the whole hospital stay (median of two days) and were discharged exclusively breastfed (50%, 2/4) or with mixed (50%, 2/4) feeding. None of the SARS-CoV-2 positive NB developed symptomatic infection during hospitalisation, while one mother presented with mild symptoms and all the remaining had no symptoms.

2) Follow-up during the neonatal period (Table 4)

A complete telephone follow-up for at least the first 28 days of life has been obtained from 82% (63/77) of the infants born to mothers diagnosed with COVID-19 in 2020. In cases where no primary care follow-up had occurred at day 28, telephone follow-up was extended beyond that time, in order to keep the family support, which was own major objective. A complete follow-up was not possible [(18% of the cases (14/77)] due to no telephone contact (11/14), no response after the first contact (2/14) and maternal hospitalization for SARS-CoV-2 pneumonia throughout the neonatal period (1/14) (Fig.1). A telephone follow-up was obtained with the hospital where both the newborn infant diagnosed with congenital heart disease and mother were transferred to. None of the NB with no telephone follow-up were admitted to the paediatric emergency department at the hospital during the neonatal period.

a) Family epidemiological data

Single-parent families were identified in three cases. A screening of SARS-COV2 infection in cohabitants was not obtained from most of the remaining family nuclei (58%, 43/74), while one or more cohabitants in 42% of the households that were screened (13/31) were diagnosed with

Table 3 – Infants born to mothers diagnosed with COVID-19: rooming-in (n = 77)

Length of stay		**days**
Median (range)		2 (1 - 36)
	n	**%**
≤ 3 days	68	88%
Rooming-in	**n**	**%**
	77	100%
Admission to the NICU	**n**	**%**
	3	4%
Feeding	**n**	**%**
Exclusive breastfeeding	40	52%
Mixed	35	45%
Exclusive formula feeding	2	3%
General perinatal healthcare	**n**	**%**
Anti-VHB vaccine	77	100%
Metabolic screening	72	94%
UNHS	4	5%
SARS-CoV-2 screening in NB	**n**	**%**
≥ 1	75	97%
> 1	61	79%
Positive	4	5%

Table 4 – Infants born to mothers diagnosed with COVID-19: telephone follow-up up to day 28 (n = 77)

Lost to follow-up	**n**	**%**
Incorrect contact	11	14%
No response	2	3%
Length of stay ≥ 28 days	1	1%
	14	18%
Complete follow-up (n = 63)	**n**	**%**
Primary care attendance ≤ 14 days	11	17%
Primary care attendance ≤ 28 days	36	57%
Weight assessment	53	84%
Adequate weight gain	48	76%
Feeding at day 28		
Exclusive breastfeeding	35	56%
Mixed	22	35%
Exclusive formula feeding	6	10%
Symptoms related to COVID-19	**8**	**13%**
Nasal obstruction	6	10%
Perceived respiratory distress	2	3%
Reason for medical assessment	3	5%

COVID-19 and in 23% (3/13) at least one cohabitant was a child.

During follow-up, 97% (61/63) of the mothers had recovered, 43% (26/61) with no further testing; five mothers remained or developed mild symptoms after discharge, while the remainder remained with no symptoms.

b) Clinical progression

During follow-up, 13% (8/63) of the NB presented with symptoms associated with COVID-19: nasal obstruction (six patients) and difficulty breathing (two patients, as mother's perception). The frequency of telephone monitoring for parental support was adjusted in 5 out of 6 patients presenting with nasal obstruction, while the remaining patient was examined at the emergency department and was discharged clinically recovered, as well as one of the patients with a suspected difficulty breathing; the remaining newborn was examined during a home visit and showed a normal physical examination. These were not retested for SARS-CoV-2, which could have been positive, given the coexistence of symptoms and epidemiological context.

c) General healthcare

A complete follow-up was obtained from 63 NB and 52% (33/63) of these were breastfed at discharge and 56% (35/63) remained exclusively breastfed at day 28 - the remaining seven out of 40 NB who were exclusively breastfed at discharge, were included on those who were lost to follow-up; 35% (22/63) were on mixed feeding at day 28 and 10% (6/63) on formula feeding. Eight NB out of the 52% (33/63) who were exclusively breastfed at discharge were switched to mixed feeding, while ten out of the 44% (28/63) who were on mixed feeding at discharge were switched to exclusive breastfeeding. Weight development was assessed in 84% (53/63) of the NB and was considered suboptimal in 9% (5/53).

A metabolic screening was completed by the five NB who had not been submitted previously up to day 6, during a home visit or primary care nursing examination.

A UNHS was completed by the 73 NB who had not been submitted to an inpatient screening, at the ENT department, up to day 60 (one patient was screened at five months, as confirmed by the clinical records).

The main parental concerns were related to colic (5), jaundice (4) and breastfeeding/weight development (3). Parents informally declared their satisfaction with the telephone follow-up procedure.

d) Medical examination

Considering those NB with complete telephone follow-up, 57% (36/63) attended primary care within the neonatal period and 17% (11/63) within the first two weeks of life. Two NB were examined at home by the hospital telephone follow-up team within the first week, due to a medical decision in the absence of primary care response: in one case due to an unconfirmed suspected respiratory distress and for the management of a NB diagnosed with COVID-19. One of these NB was referred to primary care at day 14. A patient was admitted and remained at another hospital during the remaining neonatal period for clinical stabilisation in the paediatric cardiology department. The remaining 40% (25/63) of NB were not examined upon discharge.

Table 5 – NB diagnosed with COVID-19 (n = 4)

Length of stay		**days**
Median (range)		2 (2 - 3)
	n	**%**
Term	3	75%
AGA	4	100%
Neonatal resuscitation	0	0%
Admission to the NICU	0	0%
Diagnosis of COVID-19		
< 24h	2	50%
24 - 48h	2	50%
SINAVE notification	3	75%
Symptoms related to COVID-19	1	25%
Recovery	4	100%
With testing	1	25%
Primary care attendance ≤ 14 days	1	25%
Primary care attendance ≤ 28 days	3	75%
Medical examination ≤ 28 days	4	100%
Weight assessment	4	100%
Adequate weight gain	4	100%
Feeding at discharge		
Exclusive breastfeeding	2	50%
Mixed	2	50%
Exclusive formula feeding	0	0%
Feeding at day 28		
Exclusive breastfeeding	3	75%
Mixed	0	0%
Exclusive formula feeding	1	25%

e) NB diagnosed with COVID-19 (Table 5)

Three out of four NB diagnosed with COVID-19 were notified to the SINAVE database for epidemiological monitoring. None of the NB were followed through Trace-COVID and recovered during the neonatal period, according to the follow-up team (a confirmatory testing of recovery was obtained in one of the four cases).

One of these four patients presented with mild nasal obstruction on day 21 and recovered well. The other patients remained with no symptoms.

One of the two patients who were on mixed feeding at discharge was switched to exclusive breastfeeding and one to formula feeding due to the presence of hypogalactia according to maternal perception. Those who were exclusively

breastfed at discharge remained with this type of feeding. Both had an appropriate weight evolution.

The four NB diagnosed with COVID-19 were examined within the neonatal period: three attended primary care (one within the second week of life) and one had been examined during a home visit within the first week of life.

DISCUSSION

1) Difficulties and limitations of the study

A logistic reorganisation was required for the implementation of the Contingency Plan making a rooming-in option possible, with demanding links between departments, infection transmission prevention and control measures aimed at healthcare professionals without compromising the humanisation of healthcare. Despite the effort, the reduction in the mother's contact time with the professionals may have reduced the support in areas such as breastfeeding, contributing to the fact that 45% were on mixed feeding at discharge, higher than what was described in the 2013 report of the Breastfeeding Observatory (*Observatório do Aleitamento Materno*)[20], at the *Hospitais Amigos dos Bebés em Portugal* [20], considering that 79% of NBs were exclusively breastfed at discharge and only 19% were on mixed feeding.

The failure in the follow-up upon hospital discharge may have been due to the limitations imposed by isolation or the general disruption in healthcare activity, even though the absence of a control group of infants born to mothers with no COVID-19 has limited any conclusions in this regard.

Generalisability of the study's results was limited by the small group of patients and also by the loss of almost one fifth of the population to the telephone follow-up.

2) Hospital approach

The patient approach was based on the recommendations of the SIN and SPN.[15,16] Even though well-founded, the selected strategy was innovative, as organisations including AAP, RCPCH and DGS were recommending approaches in line with Chinese guidelines at the beginning of the pandemic.[10,14,17,19]

Nationwide,[21] NB were admitted separated from their mothers in 61% of neonatology departments/clinics during April and May and 70% with breastfeeding avoidance, while a negative SARS-CoV-2 screening of the caregiver was required by 43% to allow for hospital discharge and also the mother's recovery was required in 24%, leading to prolonged hospitalisations, mother-child separation and avoidance of breastfeeding.[22-24] The option for mother-child separation and avoidance of breastfeeding was early questioned as transmission prevention was not ensured (particularly upon discharge), the benefits of a skin-to-skin contact for NB were compromised, in addition to affecting the success of breastfeeding that could compromise the mother's emotional stability, promoting a greater hospital logistic effort, which might not be affordable within the most demanding times of the pandemic.[25]

Since the beginning of the pandemic, rooming-in was promoted by our department, which has been confirmed as a safe option by this study; other clinics have moved towards this strategy;[10,17,26] a 100% mothers' adherence to rooming-in has been found and 97% to breastfeeding. Decisions on delivery, NICU admission and hospital discharge were based on the usual clinical criteria. All newborns were considered and approached as suspected cases of COVID-19, but with perinatal care as close as possible to the usual approach.

Overall, in line with an Italian study,[13] these results supported the predominance of benefits over risks regarding rooming-in of infants born to mothers diagnosed with COVID-19. Despite a lower incidence of COVID-19 in parturient women than what has been described in the study published in the New England Journal of Medicine[11] (3.8% *vs.* 15%), a similar rate of asymptomatic infections was found (90% *vs.* 88%). In contrast to other reviews in which up to 13% pregnant women had presented with severe disease,[27] there was no critical maternal diseases in our study and only one pregnant mother and two puerperal women had presented with severe disease (SARS-CoV-2 pneumonia requiring hospitalisation). According to The British Medical Journal review on COVID-19 in pregnancy,[27] 25% of infants born to mothers diagnosed with COVID-19 were admitted to the NICU, in contrast to what was found in this study (4%). It is worth mentioning that the reasons for admission are not explicit in the review and mother-child separation option may explain a higher rate of NICU admission without implying the presence of clinical admission criteria.

The rate of need for neonatal resuscitation was lower than described in previous studies (5% *vs.* 13%),[12] in line with what was found regarding prematurity — 9% *vs.* 23% - 45%[12,28,29]; on the other hand, the rate of prematurity in infants born to mothers diagnosed with COVID-19 was not higher to what has been found in the general population within the same period (9% *vs.* 12%). There were no deaths in the study population; worldwide, although rare cases of mortality in NB diagnosed with COVID-19 have been described, no causality has been confirmed.[13,29]

3) Follow-up in the neonatal period

Telephone follow-up enabled the remote assessment of NBs, as well as the compliance with neonatal screening and with the PNSIJ, the identification of NBs with criteria for an emergency assessment, the presence of symptoms or parental concerns, while — in the absence of any alarm signs — assisting parents with management at home. It also enabled a supportive contact with the family at a time of greater vulnerability and with a lower access to primary care.

The estimated follow-up has been compromised as 40%

of NBs did not attend a medical examination within the neonatal period. Less than one in every five NB was examined within the first two weeks of life, as recommended by the PNSIJ. The link between the hospital team and primary care in order to ensure an adequate assessment was not always optimal. The surveillance of healthy NBs is the responsibility of primary care and under these circumstances it was compromised. The reasons for this situation at the level of each hospital and each group of healthcare centres are certainly available. It is worth mentioning that child health consultations within the two first years of life are considered as a crucial assistance activity and should therefore be prioritised when restructuring the activity of each healthcare centre. As regards the assessment of NB in isolation, in units with no logistic conditions to do so, this should be completed during home-visits with the coordination of staffing resources and equipment; the definition of the resource limitations underlying this failure in follow-up could be established in cooperation, considering the sharing of resources (human and/or material) as an option.

Rooming-in allowed for a high rate of exclusive breastfeeding or mixed feeding (97%), in contrast to what could be expected with mother-child separation. It is worth mentioning that the rate of infants exclusively breastfed was slightly higher at the end of the neonatal period than at discharge (56 vs. 52%), due to the effort made by some mothers in switching from mixed to exclusive breastfeeding. Breastfeeding may have a protective effect, with a contribution to the absence of symptomatic neonatal infection in our group of patients, in whom a high rate of breastfeeding has been found.

4) NB diagnosed with COVID-19

A 5% mother-to-child transmission rate during the first 48 hours of life has been found, in line with other studies (1 to 5%).[10,13,21,29] A similar transmission rate (4.7%) has been found nationwide in April and May, even though mother-child separation has been found in 61% of the cases.[21] Globally, a contradictory evidence has been found: according to a systematic review published in Nature Communications, the risk of mother-to-child transmission was increased in rooming-in,[12] while mother-to-child transmission is similar when infants separated from their mothers at birth were compared to infants admitted in rooming-in, according to the AAP.[10]

The hypothesis of vertical transmission (described in up to 30% of cases)[12] through placental study or newborn serology was not analysed in our study.

In our study, there was only one patient (25%) presenting with symptoms and there were no cases of severe neonatal infection or NICU admission, in contrast to some published data,[9,12,27] in which up to 55% of NB diagnosed with COVID-19 had presented with symptoms, about 25% were admitted to the NICU and up to 16% presented with severe disease.

Although rooming-in may increase the risk of COVID-19 after 72 hours, the risk of severe disease does not seem to have increased[12]; in fact, there was no severe disease in this small group of four NB diagnosed with COVID-19. Considering that around 90% of the patients were discharged by the end of day 3, any confirmation of an increased risk beyond 72 hours would require an extension of the hospital stay or an outpatient testing.

5) Open issues

With increasing evidence that neonatal SARS-CoV-2 infection is mostly benign, the need for screening of asymptomatic infants born to mothers diagnosed with COVID-19 has been questioned by some organisations[17] given the scarce practical impact of this testing.

Despite questionable, the systematic SARS-CoV-2 screening in these circumstances has built the scientific evidence on maternal transmission and neonatal infection. Therefore, considering that potential medium/long-term effects of neonatal infection are still unknown, the current approach is still appropriate.

If testing of asymptomatic NB is to be maintained, the best method and the appropriate timing for it must be selected according to the purpose for which it is intended. SARS-CoV-2 RT-PCR is the most reliable method for screening and diagnosis, with higher sensitivity between day 3-5[17,26]; SARS-CoV-2 antigen testing, less sensitive than RT-PCR, is justified for diagnostic confirmation in symptomatic cases or for rapid evaluation (e.g., within the preoperative period); placental pathology and newborn serology are indicated in vertical transmission investigation.

Regarding the follow-up upon hospital discharge, surveillance has yet to be defined in a more appropriate clinical and epidemiological way.

As regards the epidemiological surveillance, there was no point in notifying the SINAVE or in obtaining SARS-CoV-2 screenings in NB due to the absence of a recovery protocol aimed at NB diagnosed with COVID-19, as these would not lead to any public health follow-up.

The follow-up of these NB is crucial for clinical surveillance, in order to comply with the PNSIJ. The measures that were considered may keep the responsibility of primary care, as is the case for the general population or they may increase the responsibility of the hospital team up to recovery. A joint strategy may also be planned, including 'home monitoring ensured by primary care, with the support of the neonatology team', as described in the DGS' Guideline Standard.[26]

CONCLUSION

COVID-19 in paediatric age and particularly in the neonatal period has a low incidence and mostly presents as an asymptomatic infection or mild disease.Early

mother-to-child transmission is uncommon (around 5%).

From the initial results of this study, limited by the size of the sample (77 mother/newborn dyads) and by the those lost to follow-up, it is worth mentioning the low rate of mother-to-child transmission in rooming-in taking measures to prevent transmission, the absence of severe neonatal disease, the incidence of prematurity when compared to the general population and the safety of rooming-in and breastfeeding. The approach adopted in our group of patients allowed keeping the benefits of rooming-in and breastfeeding with no increase in symptomatic neonatal infection.

The need for testing of asymptomatic NB is questionable, mainly due to the lack of any practical implication. The optimal method and timing for NB testing are still undetermined.

In view of the gaps in clinical and epidemiological surveillance, further measures are required to improve the links with primary care and public health.

AUTHORS' CONTRIBUTION

IB: Study design, data collection, storage and analysis, revision and discussion of results.

RS: Data collection, storage and analysis, revision and discussion of results.

BS: Design and coordination of the study, data collection, data storage and analysis, revision and discussion of results.

JF: Design, review and discussion of results.

SM: Study design and data collection.

AC: Study design and coordination, data collection, review and discussion of results.

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HUMAN AND ANIMAL PROTECTION

The authors declare that this project complied with the regulations that were established by the Ethics and Clinical Research Committee, according to the 2013 update of the Helsinki Declaration of the World Medical Association.

DATA CONFIDENTIALITY

The authors declare that they have followed the protocols of their work centre on the publication of patient data.

CONFLICTS OF INTEREST

The authors declare that there were no conflicts of interest in writing this manuscript.

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