

Use of the prone position in pregnant women with COVID-19 or other health conditions


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Objective: to analyze, in the scientific literature, the knowledge available on the use of the prone position in pregnant women diagnosed with COVID-19 or other health conditions. **Method:** an integrative literature review developed through the following guiding question: What is the scientific knowledge available on the use of the prone position in pregnant women with COVID-19 or other health conditions? The search for studies was carried out in eight databases. **Results:** using the prone position in pregnant women with Acute Respiratory Distress syndrome allowed for improvements in lung compliance and oxygenation. It also allowed reducing uterine compression on the maternal large vessels, and a reduction in blood pressure was observed in pregnant women with pre-eclampsia. The prone position was also safe in the surgical management of pregnant patients. In addition, the following conditions stood out as disadvantages related to the prone position in pregnant women: possibility of aortocaval compression, causing severe hypotension, and inability to easily monitor fetal status or to perform emergency Cesarean sections. **Conclusion:** the prone position was considered safe, reliable and comfortable for its use in the clinical management of pregnant women, where specific care measures must be taken to avoid compression of gravid abdomen, as well as fetal monitoring is important to detect placental circulation impairment.

Descriptors: Pregnant Women; Pregnancy; Coronavirus Infections; Adult Respiratory Distress Syndrome; Prone Position; Nursing.

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Introduction

SARS-CoV-2 had its first cases in Wuhan, China, where in late December 2019 a number of pneumonia cases caused by unknown etiologic agents were reported to the World Health Organization (WHO). In the following year, the problem became global, being declared as a pandemic in March 2020. COVID-19, a disease caused by SARS-CoV-2, can cause complications to the infected patient, such as Acute Respiratory Distress Syndrome (ARDS), sepsis, acute renal failure and cardiac dysfunction⁽¹⁾.

Since notification of the first COVID-19 cases in the American Continent, more than 60,000 confirmed cases of the disease were identified among pregnant women, including 458 maternal deaths according to the Pan American Health Organization (PAHO), with more than half occurring in Brazil and Mexico⁽²⁾. Until December 16th, 2020, the Brazilian Ministry of Health recorded 4,564 hospitalization cases due to ARDS and 233 deaths among pregnant women with confirmed COVID-19 cases in the country, indicating a mortality rate of 86.2 deaths/100,000 inhabitants in this population⁽³⁾.

The high morbidity and mortality rate due to COVID-19 among Brazilian pregnant women can be related both to pathophysiological conditions inherent to the process of pregnancy and illness caused by infection with SARS-CoV-2, and to the chronic problems faced by Brazilian obstetric care – such as low quality and difficulty accessing emergency and high-complexity care⁽⁴⁾. Thus, it is understood that the assistance provided to pregnant women affected by the disease requires special care measures, in an attempt to preserve the best obstetric practices and to achieve positive maternal and fetal outcomes⁽⁵⁾.

Initially, pregnant women did not constitute a risk group for COVID-19, but they were later included in this classification. While the number of infections by the new coronavirus in this group is not higher when compared to the general population, current studies have pointed out an increased need for hospitalization in Intensive Care Units (ICUs) and for invasive ventilation and extracorporeal membrane oxygenation support, as well as a higher risk for premature birth and maternal death in the group of pregnant women, when compared to the non-pregnant population⁽⁶⁻⁷⁾.

In this context, it is important to note that the physiological changes that occur during pregnancy make pregnant women more vulnerable to serious infections. Elevation of the diaphragm, coupled with increased oxygen consumption, causes a reduction in pulmonary functional capacity during pregnancy, which increases complications in ARDS cases. In addition, pregnant women with ARDS have increased risk for Cesarean sections, premature births,

decreased Apgar scores and low weight in their newborns. Even patients with COVID-19 who present mild symptoms have a high risk of developing ARDS and adverse pregnancy outcomes, with special attention to pregnant women with diabetes, cardiovascular diseases, obesity, pre-eclampsia or other complications/comorbidities^(4,8).

Improved respiratory patterns in patients with ARDS can be obtained with prone positioning, which increases ventilation homogeneity, since it decreases ventral alveolar distension and alveolar dorsal collapse to reduce the difference between the dorsal and ventral transpulmonary pressures, in addition to reducing compression of the lungs. The patient's prone positioning in the bed must be implemented as early as possible, preferably within the first 24 or 48 hours, given the ARDS condition⁽⁹⁾.

Prone positioning, which consists in moving the patient from the supine position to lying face down, is a therapy used to increase survival probability in patients with COVID-19. The technique was first described as a treatment for Acute Respiratory Distress Syndrome (ARDS) in the scientific literature more than 40 years ago. The procedure was initially used as a last resource, when all other treatments have failed. However, recent findings suggest that the use of prone positioning must be included as part of the early treatment for severe ARDS⁽¹⁰⁾.

A number of studies show that the prone position, applied in an early and sustained way, can be a protective factor against mortality in patients with ARDS using invasive ventilation. However, its use in conscious patients does not yet present conclusive results, mainly in pregnant women⁽¹¹⁻¹²⁾.

Thus, given the scientific gaps, the question on the use of the prone position in pregnant women with COVID-19 or other health conditions emerged. A randomized clinical trial conducted in Australia evidenced an improvement in systolic blood pressure in pregnant women with pre-eclampsia after prone positioning⁽¹³⁾. Seven pregnant women in urolithiasis crises in the first gestational semester underwent Percutaneous Nephrolithotomy with use of prone positioning and achieved good outcomes without complications⁽¹⁴⁾. The analysis of 22 clinical cases in a narrative review found that the prone position was feasible to perform lumbar disc hernia surgery in pregnant women during the third gestational trimester⁽¹⁵⁾.

Therefore, this study is justified by the need to foster prone positioning in patients with COVID-19 or other health conditions, especially for pregnant women, who represent a population with significant hints about the risks and complications arising from SARS-CoV-2. Thus, this study aimed at analyzing, in the scientific literature, the knowledge available on the use of the prone position in pregnant women diagnosed with COVID-19 or other health conditions.

Method

Study design

An integrative literature review developed through the following stages: elaboration of the research question; definition of eligibility criteria for the studies; search for publications in the scientific literature; data collection from the publications; critical analysis of the selected studies; discussion of the results; and presentation of the integrative review⁽¹⁶⁾.

The study guiding question was prepared using the Context, Population, Interest (PICO) strategy⁽¹⁷⁾, where the following was considered: P (Population): Pregnant women; I (Interest): Prone position; Co (Context): Pregnancy. Thus, the following question was defined: What is the scientific knowledge available on the use of the prone position in pregnant women with COVID-19 or other health conditions?

It was decided to include the "COVID-19" term in the guiding question so as to confer more emphasis to the content of this manuscript, which may facilitate retrieval of publications during the search for articles on the theme. On the other hand, the "other health conditions" term refers to any clinical or trauma complication leading the pregnant women to need prone positioning, being possible to infer that, when defining the term Pregnant women in the PICO strategy, it is implied that any health condition experienced during the gestational period would be obtained in the search.

Period

Data collection was conducted from October to November 2020.

Selection criteria

Selection of the studies took place according to the recommendations of the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA)⁽¹⁸⁾, by means of the following inclusion criterion: publications that addressed the use of the prone position in pregnant women, published without time and language restrictions. Review studies, theses, dissertations, editorials, annals and duplicate studies were excluded.

Data collection

The following databases were used to search for publications: PubMed Central (PubMed/PMC), Scientific Electronic Library Online (SciELO), Scopus, *Literatura Latino-Americana e do Caribe em Ciências da Saúde* (LILACS), Web of Science, Cochrane, Cumulative Index of Nursing and Allied Health Literature (CINAHL) and Excerpta Medica dataBASE (EMBASE).

The search, screening, selection and analysis process of the studies was developed by two researchers independently and in a paired manner, in order to verify possible differences in the findings. It is worth noting that if there was disagreement between the two researchers in the selection of studies, a third reviewer analyzed the study and gave the final decision on its inclusion or not.

To obtain the greatest number of possible results in each database, descriptors and keywords from the Medical Subjects Heading (MeSH), Descriptors in Health Sciences (*Descritores em Ciências da Saúde*, DeCS), EMBASE Heading Subjects (EMTREE) and CINAHL® Headings were used, with which the search strategies described in Figure 1 were defined.

Database	Search strategy
SciELO, LILACS	("Pregnant Women" OR "Pregnant Woman" OR Pregnancy OR Gestation) AND ("Prone Position" OR "Prone Positions")
PubMed/PMC	("Pregnant Women" OR "Pregnant Woman" OR "Woman, Pregnant" OR "Women, Pregnant") AND ("Prone Position" OR "Position, Prone" OR "Positions, Prone" OR "Prone Positions" OR "Prone Positioning")
Scopus, Web of Science and Cochrane	("Pregnant Women" OR "Pregnant Woman" OR "Woman, Pregnant" OR "Women, Pregnant" OR Pregnancy OR Pregnancies OR Gestation) AND ("Prone Position" OR "Position, Prone" OR "Positions, Prone" OR "Prone Positions" OR "Prone Positioning")
CINAHL	("Expectant Mothers" OR "Pregnant Women" OR "Pregnant Woman" OR Pregnancy OR Gestation) AND ("Prone Position" OR "Prone Positions" OR "Prone Positioning")
EMBASE	("Pregnant Woman" OR "Pregnant Women" OR Pregnancy OR Gestation) AND ("Prone Position" OR "Prone Positioning")

Figure 1 - Search strategies and their respective databases. Sobral, CE, Brazil, 2020

It was decided not to use terms related to COVID-19 in order to enable retrieval of a greater number of possible results and due to the need to expand the possibility of

search for studies on the use of the prone position in women with other health problems. In addition to that, if the COVID-19 term was included in the search, it would

be necessary to also include terms related to other clinical conditions, such as metabolic and cardiovascular diseases that may come to occur during this period. It is also worth noting that the Gestation and Pregnancy terms were also selected in order to increase the search results, which would not be possible with the restriction for terms such as risk pregnancy or pregnancy with comorbidities, for example.

Data analysis

The studies found in the databases were exported to the *Mendeley* reference manager, whereby duplicate studies were excluded. Immediately after that, the titles and abstracts of the publications were read to select those that met the eligibility criteria, where the selected studies were read in full and those that did not answer the research question were excluded. Subsequently, the articles included in the final sample were fully analyzed through the use of a semi-structured instrument to obtain information considered relevant about the studies, such as: title; authors; year, language and country of publication; methodological aspects and main results evidenced, data that were grouped into descriptive charts.

In addition to that, the publications were classified into evidence levels according to the following convention: Level I - meta-analyses, controlled and randomized studies; Level II - experimental studies; Level III - quasi-experimental studies; Level IV - descriptive, non-experimental or qualitative studies; Level V - experience and case reports; and Level VI - experts' opinion and consensus⁽¹⁹⁾.

Ethical aspects

The ethical precepts set forth in Law No. 9,610/98 were followed, respecting the ideas, concepts and definitions of the authors of the studies selected for this review.

Results

A total of 1,291 publications were retrieved, of which 1,279 were excluded: 1,151 for not answering the guiding question and 128 for being duplicates. The final sample consisted of 11 studies. Figure 2 describes the process corresponding to the search and selection of studies.

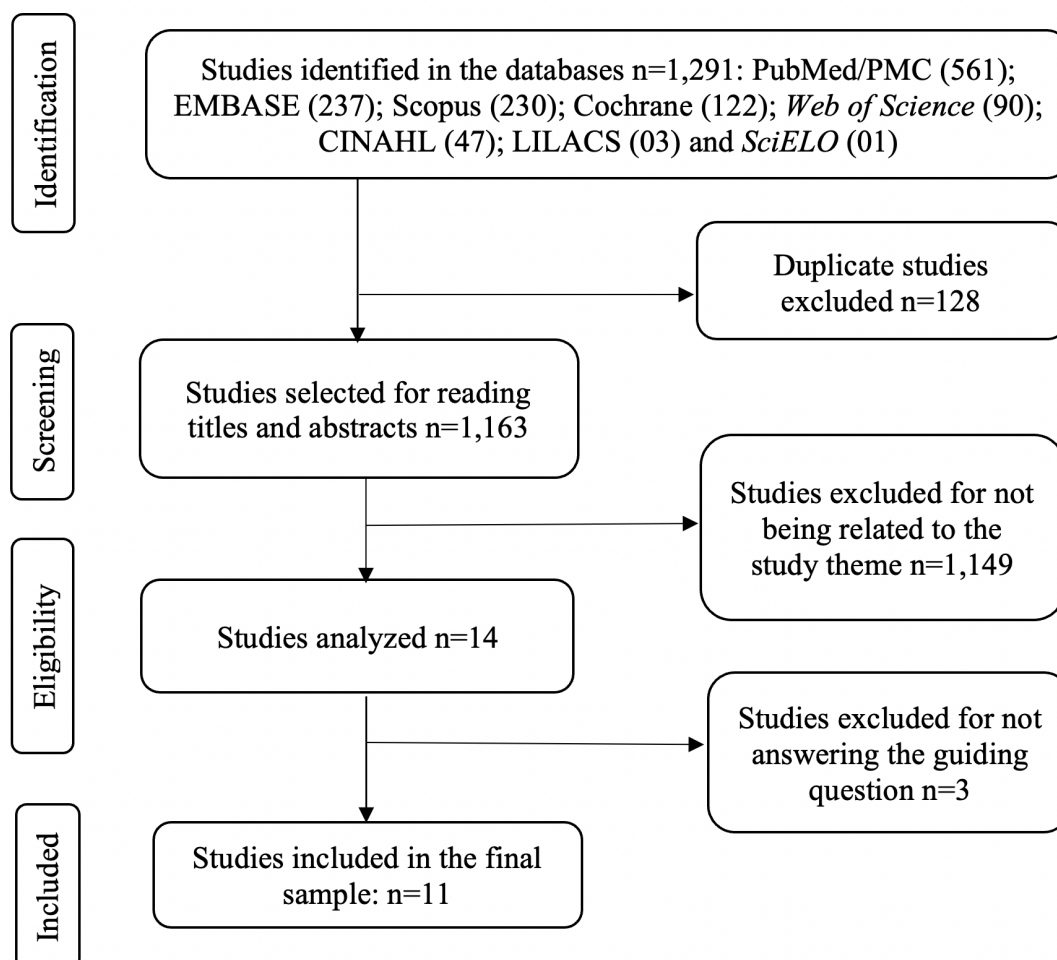


Figure 2 - Search flowchart according to the PRISMA⁽¹⁸⁾ recommendations

The publications were predominantly from 2020 (36.3%), followed by 2014 (18.1%) and 2018, 2017, 2015, 2009 and 1998, with one (9.0%) publication each. All the studies were published in English. Regarding the country of origin, the United States, Italy and Australia predominated with two (18.1%) publications each, while Brazil, Japan, India, the United Kingdom and Germany contributed one (9.0%) publication each.

Studies of the case-report type prevailed (54.5%), followed by experts' recommendations (18.1%). The cross-sectional study, randomized clinical trial and observational study types had one (9.1%) publication each. As for the level of evidence, Level V (n=6, 54.5%) was prevalent, followed by Level VI (n=2, 18.1%), Level IV (n=2, 18.1%) and Level II (n=1, 9.1%). Figure 3 shows the description of the studies.

Year/ Language/ Country	Objective	Methods
2020/ English/ Italy ⁽²⁰⁾	To report on the use of the prone position and convalescent plasma therapy in a pregnant woman with COVID-19.	A case report conducted with a pregnant woman aged 34 years old and at 27.4 gestational weeks admitted to the ICU*.
2020/ English/ United States ⁽²¹⁾	To synthesize the guidelines on the management of pregnant women infected by COVID-19.	Experts' recommendations.
2020/ English/ Australia ⁽²²⁾	To describe the recommendations of the Work Group for the care of pregnant and puerperal women with COVID-19.	Experts' recommendations.
2020/ English/ Italy ⁽²³⁾	To report the case of a pregnant woman in the third gestational trimester with ARDS [†] due to COVID-19.	A case report conducted with a 48-year-old pregnant woman with ARDS [†] due to COVID-19, admitted to the ICU*.
2018/ English/ Australia ⁽¹³⁾	To evaluate the feasibility and acceptability of the prone position in women in late pregnancy and to determine if blood pressure was initially reduced in the prone position in women with pre-eclampsia.	A prospective and observational study conducted with 50 healthy pregnant women and 15 women with pre-eclampsia, admitted to the obstetric center of a tertiary-level hospital. <i>BellyPillow</i> [®] was used, a pillow designed with a central orifice that supports the pregnant uterus.
2017/ English/ Brazil ⁽²⁴⁾	To analyze the influence of a lying position on an especially designed stretcher on the maternal-fetal hemodynamic parameters and pregnant women's comfort.	A randomized and controlled trial conducted in the Obstetrics Department of a hospital in São Paulo, with 33 pregnant women divided into 2 groups: Sequence one group of pregnant women (PGS1) [‡] and sequence two group of pregnant women (PGS2) [§] , where both used a special stretcher prototype in order to accommodate the pregnant women in different positions.
2015/ English/ United States ⁽²⁵⁾	To present the successful peri-operative management of a traumatized pregnant patient with multiple injuries.	Case report; 32-year-old woman at 17 gestational weeks, with trauma after a motor vehicle collision.
2014/ English/ United Kingdom ⁽²⁶⁾	To describe case management of an obese pregnant patient who was placed in the prone position for surgery.	Case report of a woman aged 24 years old at 15 gestational weeks, admitted to the neurosurgery tertiary-level unit.
2014/ English/ India ⁽²⁷⁾	To report a case of ventilation in the prone position in a pregnant woman with refractory ARDS [†] due to influenza A (H1N1).	A case report conducted with a pregnant woman aged 25 years old and at 31 gestational weeks, admitted to the ICU*.
2009/ English/ Germany ⁽²⁸⁾	To report the case of a pregnant woman with ARDS [†] secondary to blunt chest trauma suffered in a traffic accident.	A case report conducted with a pregnant woman aged 25 years old at 34 gestational weeks, admitted to the ICU*.
1998/ English/ Japan ⁽²⁹⁾	To clarify the effect of maternal prone position on fetal-placental flow.	A cross-sectional study conducted with 23 pregnant women. An adapted bed with a wide opening for the uterus was used, the women were admitted to the gynecology and obstetrics department of a hospital.

*ICU = Intensive Care Unit; [†]ARDS = Acute Respiratory Distress Syndrome; [‡]PGS1 = Sequence one group of pregnant women; [§]PGS2 = Sequence two group of pregnant women

Figure 3 - Description of the studies included in the review. Sobral, CE, Brazil, 2020

Figure 4 presents the main findings of the studies, with regard to the results and conclusions. Only two studies pointed the disadvantages related to using the prone position in pregnant women, in which they emphasized the possibility of aortocaval compression

causing severe hypotension⁽²⁰⁾; as well as the inability to easily monitor fetal status or to perform an emergency Cesarean section⁽²⁵⁾. No study reported the use of protocols or checklists for the procedure.

Id*	Main results	Conclusions
20	The patient underwent a total of four pronation cycles, lasting 12 hours each, using supports and pads below the shoulders and hips, to prevent aortocaval compression. There was a gradual improvement in oxygenation.	Joint team decisions referring to the use of the prone position exerted a positive influence on the results achieved by the patient.
23	Associated with invasive mechanical ventilation, the pronation maneuver lasted 16 hours and, although only performed once, it provided hypoxia relief, preventing harms to the mother and fetus and avoiding urgent Cesarean section and premature labor.	Ventilation in the prone position can be considered to improve breathing and gas exchange in women with severe ARDS [†] , enabling to avoid prolonged maternal hypoxia. In the pregnant women, the diaphragm is moved caudally, reducing compression on the back of the lung and lung parenchyma flow, as well as the vessels are less compressed by the uterus if the abdomen is left without pressure on it.
13	There was a reduction in diastolic blood pressure in the prone position, both in the healthy pregnant women ($p^2=0.064$) and in those with pre-eclampsia ($p^2=0.019$); there was also increased maternal heart rate in the prone position when compared to the left lateral position, with statistical significance. In the pregnant women with pre-eclampsia, there was decreased respiratory rate in the prone position, not clinically significant, and reduced systolic blood pressure in the prone position in relation to the left lateral position ($p^2=0.019$). There was no difference in fetal respiratory rate, oxygen saturation, heart rate or comfort scores in the prone position when compared to the left lateral position.	The prone position is feasible, safe and acceptable in women in late pregnancy and can reduce systolic blood pressure in women with pre-eclampsia without immediate adverse effects. There can be a specific benefit in decompressing the lower vena cava in patients with placental insufficiency and, therefore, a benefit of this position for these women.
24	There were no differences between the positions in relation to maternal heart rate, diastolic blood pressure, oxygen saturation and fetal heart rate. There were significant reductions in respiratory rate and systolic blood pressure in the prone position, when compared to the left lateral position. There was increased oxygen saturation in the prone position when compared to Fowler's position and to the supine position in both sequences. All fetuses in this study maintained baseline fetal HR [§] with normal parameters in all the positions adopted by the pregnant women on the prototype stretcher.	The prone position on the stretcher prototype was considered safe and comfortable. It can be advantageous to improve oxygen saturation and reduce systolic blood pressure and respiratory rate, and can also be used by pregnant women during examinations, anesthesia or physiotherapeutic procedures.
25	The patient, under mechanical ventilation and anesthesia, was carefully placed in the prone position on a Jackson open table with care in order to avoid any pressure on the abdomen and verification and padding of all the other pressure points.	The surgery was successful due to the complete systematic evaluation of individual issues and priority stratification in the treatment.
26	The patient underwent the surgery in the prone position, presenting cardiovascular stability throughout the procedure. The effect of the prone position on uterine blood flow was not determined.	The prone position can be considered safe in performing the surgery.
27	Under mechanical ventilation and in the prone position, the patient had a drastic improvement in oxygenation after 8 hours, with improved oxygen pressure/fraction of inspired oxygen ratio; hemodynamics remained stable in the prone position, and there was improvement in lung compliance.	The prone position can only be considered in severe oxygenation impairment cases, as it also affects the fetus. Maternal prone position can provide complete relief from uterine compression of the large vessels.
28	Placing the patient in the prone position for eight hours, as well as rollers in the chest and pelvis to minimize abdominal compression, markedly improved gas exchange, allowing extubation on the fourth day after the accident.	The prone position proved to be safe and effective for managing hypoxia in ARDS [†] . Placental blood flow can be better preserved than with other therapeutic options for improved oxygenation.
29	Umbilical systolic/diastolic blood pressure ratio was significantly reduced in the prone position when compared with the supine position ($p^2<0.01$).	Maternal prone position can provide complete relief of uterine compression of the large maternal vessels, being more significant than in the lateral position.

*Id = Identification of the reference; †ARDS = Acute Respiratory Distress Syndrome; *p = Significance value; §HR = Heart Rate

Figure 4 - Description the main findings of the studies. Sobral, CE, Brazil, 2020

By analyzing the studies, it was possible to list the recommendations for using the prone position in pregnant

women, both in the COVID-19 cases and for other health conditions, as described in Figure 5.

Id*	Recommendations
20, 26	- Multidisciplinary management of pregnant women is necessary to ensure better maternal and fetal care, especially in the COVID-19 cases.
22, 27	- Define and use an adequate protocol before applying the prone position with appropriate use of PPE [†] to ensure the safety of patients and professionals, especially in the COVID-19 context.
21, 22	- The prone position must be implemented with hip and chest supports, in order to reduce abdominal compression. In the absence of specialized equipment, support in pronation can be accomplished with pillows and blankets.
22	- For pregnant and puerperal women with COVID-19 and respiratory symptoms, who are undergoing any form of supplemental oxygen therapy and who have not yet been intubated, the prone position must be considered. - For women with COVID-19 and hypoxemia under mechanical ventilation, consider the prone position for more than 12 hours a day.
23, 28	- Perform fetal monitoring before and after, or concomitantly to positioning. Regular assessment of fetal well-being and maternal monitoring become necessary.
26	- In surgical cases, fetal ultrasound must be performed before any intervention, and fetal heart monitoring during the surgery must be considered. - In surgical management, it is recommended that the left lateral position is preferred in pregnant women at the end of the second trimester and in the third trimester. - Fetal heart rate changes can warn the anesthesiologist, as soon as possible, regarding aortocaval compression and cardiovascular failure due to deficient positioning of the pregnant woman.

*Id = Identification of the reference; †PPE = Personal Protection Equipment

Figure 5 - Recommendations for the use of the prone position in pregnant women. Sobral, CE, Brazil, 2020

Discussion

This review enabled us to identify that most of the studies were published in 2020, which is justified due to the emerging need for production of knowledge on therapeutic methods for the treatment of patients who develop ARDS resulting from COVID-19, especially in cases of pregnant women. In this context, the prone position has shown to be safe, reliable and comfortable both for the clinical management of this vulnerable group, which presents severe ARDS cases related or not to the new coronavirus, and for surgeries.

The studies conducted in Australia and Brazil showed no significant changes in pregnant women in the prone position, referring to the diastolic blood pressure, respiratory rate, oxygen saturation and fetal heart rate parameters; in addition, a study reported increased maternal heart rate with statistical significance, although the etiology of this finding is not known for certain⁽¹³⁻²⁴⁾. However, it is emphasized that, when applied correctly, the prone position will not result in adverse effects on the patient's hemodynamics, but may induce improvements in the hemodynamic parameters due to its positive effects on the cardiac and pulmonary systems, which makes it fundamental to preserve venous return when this technique is employed⁽³⁰⁾.

From this perspective, diverse evidence indicated that the prone position provided various beneficial effects when applied with different durations, both in conventional beds as in specially designed equipment, such as the *BellyPillow*[®], findings that signal this therapeutic method

as a potential care strategy for pregnant women at different gestational weeks^(17-19,25,27).

In relation to the benefits in the respiratory and ventilation pattern when the prone position is applied during different periods of time, a number of studies emphasized the improvement of lung compliance with a progressive increase in oxygenation and oxygen saturation, decreased hypoxia, improved relative partial pressure of oxygen (PO_2)/fraction of inspired oxygen (FiO_2), improved gas exchange and flow displacement of the diaphragm, which enables a reduction in lung compression^(20-23,27-28). Therefore, this care tool can be an alternative in the treatment of the severe cases of pregnant women with COVID-19.

In this sense, for the management of pregnant women with COVID-19 who require supplemental oxygen support, it is recommended that the prone position be applied for more than 12 hours a day. In these cases, multidisciplinary management becomes necessary to ensure that effective teamwork is performed for the safe application of the prone position with the fewest possible adverse events, as well as it is necessary to continuously evaluate the clinical parameters through blood gas analysis⁽²⁰⁾.

A descriptive study conducted by researchers from Houston, Texas, reported the development of a guideline and algorithm which included indications, contraindications, and step-by-step instructions for pronation of awake and intubated pregnant patients. The authors mentioned that admission of these clients with a severe respiratory condition requires multidisciplinary

planning in order to prevent complications associated with the use of the pronation technique⁽³¹⁾. Thus, prone positioning may present positive results, as long as it is carried out by a trained team, by means of validated and adapted protocols to the structural and technological reality of the health institutions.

Furthermore, it was shown that the prone position in pregnant women can provide relief from uterine compression of the large maternal vessels, with preservation of placental blood flow, when compared to other positions. Such fact makes its application feasible, since it also does not compromise blood supply to the fetus, as there is no abdomen compression^(27,29).

In this sense, the occurrence of aortocaval compression stood out as a disadvantage of implementing the prone position. Thus, special care must be taken to avoid compression of the uterus over the maternal vessels, since this can cause a significant reduction in maternal cardiac output and systemic blood pressure, which, can consequently trigger severe hypotension, impaired uterine blood flow, and fetal distress^(20,26).

A reduction was observed in systolic blood pressure without immediate adverse effects on the pregnant women with pre-eclampsia, in which there may be a benefit resulting from decompression of the lower vena cava in patients with placental insufficiency⁽¹³⁾. Such findings can justify the implementation of the prone position as a complementary therapeutic tool in order to reduce blood pressure in pregnant women with pre-eclampsia, although more studies are needed to assess the best duration of this positioning and its short- and long-term effects on this group.

A number of studies carried out in the United States and in the United Kingdom also reported successful surgical management of pregnant patients in the prone position, in which, in one of the cases, there was maternal hemodynamic stability throughout the procedure⁽²⁶⁾. Fetal cardiac parameters and uterine flow during the surgery were not evaluated; however, maternal stability throughout the procedure can suggest safety both for the pregnant woman and for the fetus. However, it is recommended that, although the prone position facilitates access to the surgical incision site, the lateral position can be considered to avoid uterine compression and possible complications for the fetus⁽²⁵⁻²⁶⁾.

It was also identified that, during the first and early second trimesters, the prone position for performing neurosurgery is safe, although the left lateral position is preferred with pregnant women in the late second trimester and third trimester. However, in the studies selected in this review, similar recommendations regarding the use of the prone position in the treatment of pregnant patients with COVID-19 were not highlighted, which is subjectable to new robust research studies aimed at

evaluating the feasibility of this technique in pregnant women in the late second trimester and third trimester with respiratory failure related to infection by the new coronavirus.

In addition, although it is difficult to perform fetal assessment in the prone position, fetal ultrasound and fetal heart monitoring become necessary before and during any intervention, in order to early identify and intervene on any complication that may occur⁽²⁶⁾.

Given the above, nurses, who are the professionals responsible for care planning and coordination, should propose comprehensive, safe and holistic assistance strategies to be developed in the peri-operative period, given the need to monitor the safety of the pregnant woman and to assess fetal vitality when the prone position is applied, given the possible risks of the technique in different care contexts.

Using the prone position for pregnant women represents a care strategy that requires special attention by the multiprofessional team, since its management can result in potentially avoidable complications. Consequently, the need to implement care measures to prevent adverse events related to this procedure stands out, such as worsening of gas exchange and of the ventilatory parameters, development of pressure injuries, and decannulation of the endotracheal tube in patients under invasive mechanical ventilation.

Another necessary strategy, not addressed in the studies that comprised the sample, is the application of a checklist during the care directed to the pregnant woman who needs pronation. Using checklists based on scientific evidence corroborates the prevention and reduction of care errors, as well as it facilitates communication among the professionals⁽³²⁾. Such care tools must be properly implemented, concomitantly with permanent training of the health professionals, in order to ensure proper conduction of the procedure and patient safety during health care.

The following stand out as limitations of this review: the low level of evidence in most of the publications, as well as the absence of information, in most studies, related to the disadvantages or adverse events resulting from using the prone position in pregnant women, as well as the absence of studies that contemplated the elaboration, validation and evaluation of checklists to perform the procedure in this profile of patients.

As a contribution to the nursing and healthcare clinical practice, this study presents the availability of the benefits, risks, advantages and disadvantages of applying the prone position in pregnant women, especially in those with ARDS resulting from COVID-19 or other health conditions. It is worth mentioning that the research identified scientific gaps that may come to justify other

studies and raise questions to be answered by means of other research methods.

Conclusion

The prone position was considered safe, reliable and comfortable for its application in the clinical management of pregnant women, both in cases of ARDS related to COVID-19 infection, as well as when conducting surgical procedures. The following stood out as benefits of the prone position: improvement in the respiratory pattern, ventilation and gas exchange, as well as reduced uterine compression on the maternal vessels and reduced blood pressure in pregnant women with pre-eclampsia.

The specific care measures for the pregnant woman are related to gravid abdomen, which requires bone ends, thorax and pelvis to be padded, so that there is accommodation of the abdominal volume. In addition to that, fetal monitoring is relevant, which will allow inferences on placental circulation impairment.

Thus, it is believed that the prone position constitutes a potential therapeutic tool in the care of pregnant women, and it is therefore necessary that the health teams use protocols and checklists while implementing this procedure, in order to ensure safety both for professionals and for patients.

It is suggested to develop new randomized clinical trials to assess the best period of time for the application of the prone position in women at different gestational weeks, as well as its long term effects on blood pressure in pregnant women with pre-eclampsia. In addition to that, it is recommended to carry out methodological studies that seek to develop and validate protocols for the safe performance of this procedure in pregnant women, as well as systematic reviews aimed at classifying the level of evidence of the application of pronation in this population, in differentiated clinical contexts, especially in the COVID-19 pandemic scenario.

References

1. Rocha FEV, Moreira FF, Ribeiro DC, Bini ACD. The use of the prone position in patients diagnosed with COVID-19: a systematic review. *FisiSenectus*. 2020;8(1):133-42. doi: <https://doi.org/10.22298/rfs.2020.v8.n1.5403>
2. Organização Pan-Americana da Saúde (OPAS). Epidemiological Update Coronavirus disease (COVID-19), 18 September 2020. [Internet]. 2020. [cited 2020 Dec 05]. Available from: https://www.paho.org/en/file/73304/download?token=SnUc7_M1
3. Ministério da Saúde (BR). Secretaria de Vigilância em Saúde. Boletim epidemiológico especial: doença pelo Coronavírus COVID-19 – Semana epidemiológica 50. [Internet]. 2020 [cited 2020 Dec 19]. Available from: https://www.gov.br/saude/pt-br/media/pdf/2020/dezembro/17/boletim_covid_41_17dez20_final2.pdf
4. Takemoto MLS, Menezes MO, Andreucci CB, Nakamura-Pereira M, Amorim MM, Katz L, et al. The tragedy of COVID-19 in Brazil: 124 maternal deaths and counting. *Int J Gynecol Obstet*. 2020;151:154-6. doi: <https://doi.org/10.1002/ijgo.13300>
5. Souto SA, Albuquerque RS, Prata AP. Fear of childbirth in time of the new coronavirus pandemic. *Rev Bras Enferm*. 2020;73(Suppl. 2):e20200551. doi: <http://dx.doi.org/10.1590/0034-7167-2020-0551>
6. Allotey J, Stallings E, Bonet M, Yap M, Chatterjee S, Kew T, et al. Clinical manifestations, risk factors, and maternal and perinatal outcomes of coronavirus disease 2019 in pregnancy: living systematic review and meta-analysis. *BMJ*. 2020;370:m3320. doi: <https://doi.org/10.1136/bmj.m3320>
7. Zambrano LD, Ellington S, Strid P, Galang RR, Oduyebo T, Tong VT, et al. Update: Characteristics of Symptomatic Women of Reproductive Age with Laboratory-Confirmed SARS-CoV-2 Infection by Pregnancy Status - United States, January 22–October 3, 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69:1641-7. doi: <http://dx.doi.org/10.15585/mmwr.mm6944e3>
8. Medeiros KS, Sarmiento ACA, Martins ES, Costa APF, Eleutério J Júnior, Gonçalves AK. Impact of SARS-CoV-2 (COVID-19) on pregnancy: a systematic review and metaanalysis protocol. *BMJ Open*. 2020;10:e039933. doi: <http://dx.doi.org/10.1136/bmjopen-2020-039933>
9. Alhazzani W, Møller MH, Arabi YM, Loeb M, Gong MN, Fan E, et al. Surviving Sepsis Campaign: guidelines on the management of critically ill adults with Coronavirus Disease 2019 (COVID-19). *Intensive Care Med*. 2020;46(5):854-87. doi: <https://doi.org/10.1007/s00134-020-06022-5>
10. Wiggermann N, Zhou J, Kumpar D. Proning Patients With COVID-19: A Review of Equipment and Methods. *Human Factors*. 2020;62(7):1069-76. doi: <https://doi.org/10.1177/0018720820950532>
11. Munshi L, Del Sorbo L, Adhikari NKJ, Hodgson CL, Wunsch H, Meade MO, et al. Prone position for acute respiratory distress syndrome. A systematic review and metaanalysis. *Ann Am Thorac Soc*. 2017;14(suppl. 4):S280-8. doi: <https://doi.org/10.1513/annalsats.201704-343ot>
12. Winearls S, Swingwood EL, Hardaker CL, Smith AM, Easton FM, Millington KJ, et al. Early conscious prone positioning in patients with COVID-19 receiving continuous positive airway pressure: a retrospective analysis. *BMJ Open Resp Res*. 2020;7:e000711. doi: <http://dx.doi.org/10.1136/bmjresp-2020-000711>
13. Dennis AT, Hardy L, Leeton L. The prone position in healthy pregnant women and in women with preeclampsia

- a pilot study. *BMC Pregnancy Childbirth*. 2018;18(1):445. doi: <https://doi.org/10.1186/s12884-018-2073-x>
14. Hosseini MM, Hassanpour A, Eslahi A, Malekmakan L. Percutaneous Nephrolithotomy During Early Pregnancy in Urgent Situations: Is It Feasible and Safe? *Urol J*. 2017;14(6):5034-7. doi: <https://doi.org/10.22037/uj.v14i6.3617>
15. Ardaillon H, Laviv Y, Arle JE, Kasper EM. Lumbar disk herniation during pregnancy: a review on general management and timing of surgery. *Acta Neurochir (Wien)*. 2018;160(7):1361-70. doi: <https://doi.org/10.1007/s00701-017-3098-z>
16. Souza MT, Silva MD, Carvalho R. Integrative review: what is it? How to do it?. *Einstein*. 2010;8(1):102-6. doi: <https://doi.org/10.1590/s1679-45082010rw1134>
17. Lockwood C, Porrit K, Munn Z, Rittenmeyer L, Salmond S, Bjerrum M, et al. Chapter 2: Systematic reviews of qualitative evidence. In: Aromataris E, Munn Z, editors. *Joanna Briggs Institute [Internet]*. 2017 [cited 2020 Jun 13]. Available from: <https://reviewersmanual.joannabriggs.org>
18. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred Reporting Items for Systematic Reviews and MetaAnalyses: The PRISMA Statement. *PLoS Med*. 2009;6(7):e1000097. doi: <http://dx.doi.org/10.1371/journal.pmed.1000097>
19. Stetler CB, Morsi D, Rucki S, Broughton S, Corrigan B, Fitzgerald J, et al. Utilization-focused integrative reviews in a nursing service. *Appl Nurs Res*. 1998;11(4):195-206. doi: [http://doi.org/10.1016/s0897-1897\(98\)80329-7](http://doi.org/10.1016/s0897-1897(98)80329-7)
20. Donzelli M, Ippolito M, Catalisano G, Renda B, Tarantino F, Diquattro O, et al. Prone positioning and convalescent plasma therapy in a critically ill pregnant woman with COVID-19. *Clin Case Rep*. 2020;00:1-7. doi: <https://doi.org/10.1002/ccr3.3426>
21. Oxford-Horrey C, Savage M, Prabhu M, Abramovitz S, Griffin K, LaFond E, et al. Putting It All Together: Clinical Considerations in the Care of Critically Ill Obstetric Patients with COVID-19. *Am J Perinatol*. 2020;37(10):1044-51. doi: <https://doi.org/10.1055/s-0040-1713121>
22. Vogel JP, Tendal B, Giles M, Whitehead C, Burton W, Chakraborty S, et al. National COVID-19 Clinical Evidence Taskforce. Clinical care of pregnant and postpartum women with COVID-19: Living recommendations from the National COVID-19 Clinical Evidence Taskforce. *Aust N Z J Obstet Gynaecol*. 2020. doi: <https://doi.org/10.1111/ajo.13270>
23. Barile L, Cerrano M, Locatelli A, Puppo A, Signorile AF, Barzaghi N. Prone Ventilation in a 27 Week Pregnant Woman with COVID-19 Severe ARDS. *Signa Vitae*. [Internet]. 2020 [cited 2020 Nov];16(1):199-202. Available from: <https://www.signavitae.com/articles/10.22514/sv.2020.16.0028>
24. Oliveira C, Lopes MAB, Rodrigues AS, Zugaib M, Francisco RPV. Influence of the prone position on a stretcher for pregnant women on maternal and fetal hemodynamic parameters and comfort in pregnancy. *Clinics (São Paulo)*. 2017;72(6):325-32. doi: [https://doi.org/10.6061/clinics/2017\(06\)01](https://doi.org/10.6061/clinics/2017(06)01)
25. Vandse R, Cook M, Bergese S. Case Report: Perioperative management of a pregnant poly trauma patient for spine fixation surgery. *F1000Res*. 2015;29;4:171. doi: <https://doi.org/10.12688/f1000research.6659.2>
26. Speirs E, Wiles M, Bacon A, Radley S. Positioning a proned patient with cauda equina syndrome who presents at 15 weeks gestation: a case report. *F1000Res*. 2014;27;3:117. doi: <https://doi.org/10.12688/f1000research.3310.1>
27. Samanta S, Samanta S, Wig J, Baronia AK. How safe is the prone position in acute respiratory distress syndrome at late pregnancy? *Am J Emerg Med*. 2014 Jun;32(6):687.e1-3. doi: <https://doi.org/10.1016/j.ajem.2013.12.021>
28. Kenn S, Weber-Carstens S, Weizsaecker K, Bercker S. Prone positioning for ARDS following blunt chest trauma in late pregnancy. *Int J Obstet Anesth*. 2009;18(3):268-71. doi: <https://doi.org/10.1016/j.ijoa.2009.02.003>
29. Nakai Y, Mine M, Nishio J, Maeda T, Imanaka M, Ogita S. Effects of maternal prone position on the umbilical arterial flow. *Acta Obstet Gynecol Scand*. [Internet]. 1998 [Cited Nov 23, 2020];77(10):967-9. Available from: [https://linkinghub.elsevier.com/retrieve/pii/S0301-2115\(14\)00027-X](https://linkinghub.elsevier.com/retrieve/pii/S0301-2115(14)00027-X)
30. Guérin C, Albert RK, Beitler J, Gattinoni L, Jaber S, Marini JJ, et al. Prone position in ARDS patients: why, when, how and for whom. *Intensive Care Med*. 2020;46(12):2385-96. doi: <https://doi.org/10.1007/s00134-020-06306-w>
31. Tolcher MC, McKinney JR, Eppes CS, Muigai D, Shamshirsaz A, Guntupalli KK, et al. Prone positioning for pregnant women with hypoxemia due to Coronavirus Disease 2019 (COVID-19). *Obstet Gynecol*. 2020;136(2):259-61. doi: <https://doi.org/10.1097/aog.0000000000004012>
32. Santos VB, Aprile DCB, Lopes CT, Lopes JL, Gamba MA, Costa KAL, et al. COVID-19 patients in prone position: validation of instructional materials for pressure injury prevention. *Rev Bras Enferm*. 2021;74(Suppl 1):e20201185. doi: <http://dx.doi.org/10.1590/0034-7167-2020-1185>

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