

Barriers and Facilitators perceived by the health team for the implementation of pre and post ductal saturometry as a method of detection of congenital heart diseases in newborns, prior to discharge

Barreras y Facilitadores percibidos por el equipo de salud para la implementación de saturometría pre y post ductal como método de detección de cardiopatías congénitas en recién nacidos, previo al alta

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Abstract

Objective: To describe the main barriers and facilitators perceived by the health care workers for the implementation of Pre- and Post-Ductal Oxygen Saturation (SPPD) as a detection method of Congenital Heart Disease in newborns, prior to hospital discharge. **Material and Method:** From a constructivist research paradigm, a case study was carried out in three public hospitals in the Metropolitan Region, Chile, two of them are high-complexity hospitals. The first one, the NEW Hospital, has recently started its activity, and the second one, the OLD Hospital, has been operating for many years. The third one, the RURAL Hospital, is a low-complexity institution, located near Santiago. Data were collected through individual semi-structured interviews and focus groups to Nursing Technicians (TENS), Midwives and Physicians. The interviews were recorded and transcribed. Thematic content analysis is performed using the NVivo11 qualitative software. The investigation was approved by the Ethics Committee recognized by the hospitals involved. **Results:** In the NEW Hospital, where the SPPD was implemented more than a year ago, barriers are detected at execution level, especially in oximeter inputs and on weekends. In the OLD Hospital and the RURAL Hospital, in which the SPPD was not implemented, the main perceived barriers are concentrated in insufficient knowledge about their usefulness, economic aspects, work overload, and organizational aspects. In the NEW Hospital, the main facilitators for the application of SPPD were its simplicity, economy, and the fact that it is an important contribution to the safety of newborns discharged. **Conclusion:** The disposition regarding the practice of PPDS as a screening, varies in the 3 hospitals explored. To achieve this goal it is recommended to overcome organizational, management and economic barriers. Although there is a need to train the personnel in charge of screening, there is good disposition given the importance for the health of the RN. The flow of referral after screening for positive SPPD is quite clear.

Keywords:

Congenital Heart Diseases;
Pre and Post Ductal Oxygen Saturation;
Neonatal Screening of Congenital Heart Diseases;
Newborns

Introduction

Severe congenital heart diseases (CHD) have a 2.5 to 3 incidence per 1000 live newborns (NB) and are one of the main causes of morbidity and mortality in NB. CHD are the group of congenital malformations that cause the highest avoidable mortality in this group of children. The critical point in reducing neonatal mortality due to CHD is the early prenatal or postnatal diagnosis, which both determine the survival and future quality of life through early treatment. However, some severe CHD are asymptomatic and undetectable to physical examination during the neonatal stage and show up abruptly at home, without giving time to treat them¹. Approximately 40% of CHD are diagnosed after discharge and in 50% of cases, children return to the hospital in shock². An undiagnosed CHD can lead to severe hypoxemia, acidosis, and shock. Possible sequelae include brain, kidney and myocardial parenchymal damage and even NB death². The most commonly used methods for CHD screening are prenatal ultrasound at 22 to 24 weeks of pregnancy and clinical examination of the NB, however, both have low sensitivity³. Although the gold standard for the diagnosis of CHD in NB is the postnatal echocardiography, it is not suitable as a screening method due to its high cost, the need for specialists, and the time required⁴. Instead, the pre-and post-ductal oxygen saturation (SpO₂) in the NB before discharge has proven to be a simple and effective technique⁴, with a 77.7% sensitivity, a 99.9% specificity, 25.9% positive predictive value, and a 99.9% negative predictive value for the detection of severe congenital heart diseases⁴⁻⁷.

The pre-and post-ductal SpO₂ is a non-invasive, fast, economical, and easy to perform method, of recognized value in the international medical literature for CHD screening^{5,8} that has been implemented in several countries and centers, reducing the morbidity and mortality of NB with CHD⁹.

In Chile, the Manual of Procedures for the Care of the Newborn of 2013¹⁰ recommends to perform pre-and post-ductal SpO₂, and although some centers follow this recommendation, they are a minority and there is a lack of official registration.

It is vital to implement it in public Chilean hospitals, for which it is necessary to have a study of our reality that allows knowing the setting to carry it out. The main objective of this study is to identify the perceptions of the different members of the Neonatal and Maternity health team in three hospitals regarding the barriers and facilitators for the routine implementation of pre-and post-ductal SpO₂ in the Chilean hospital network, given the impact that timely diagnosis of neonatal and infant morbidity and mortality can have.

The purpose of this work is to inform the scien-

tific community, neonatal health teams, and decision makers in the healthcare context about the factors that could facilitate the successful implementation of this measure in Chilean hospitals.

Material and Method

Type of study

From the constructivist paradigm of research, with a qualitative approach, the methodological approach is the Multiple Case Study^{11,12}. This study is part of the National Health Research and Development Fund (FONIS) Project *Barriers and/or facilitators of the neonatal health team on the implementation of a screening method to detect CHD, from a translational perspective*. In this context, it is defined as barriers to those obstacles and difficulties for the implementation of the pre-and post-ductal SpO₂, and as facilitators to those measures that tend to favor its successful implementation.

Procedures

The study was carried out in three hospitals in the Metropolitan Region, with very different characteristics in terms of years of service and the population they serve, among other factors. These institutions were selected propositionally in order to cover different realities. In order to protect the identity of the participants, we use the names of OLD, NEW, and RURAL to refer to these Hospitals.

Semi-structured individual and focus group (FG) interviews were conducted with neonatal and maternity staff during 2016. Barriers and Facilitators to the Implementation of pre-and post-ductal SpO₂ as a screening method for CHD were investigated. Appendix 1 contains the interview scripts applied and adapted to each type of participant. The FG allows observing the Neonatology and Maternity staffs in each Hospital, in order to reveal interactions between the participants. Work, organizational, practical and economic elements related to the eventual implementation of the pre-and post-ductal SpO₂ as a screening method were explored.

Participants

Neonatal and maternity staff were contacted using the snowball sampling technique. In the RURAL and OLD Hospitals, the pre-and post-ductal SpO₂ was not performed, and in the NEW one, the screening is already implemented. The inclusion criteria for the participants were: to be over 18 years old and to maintain a formal working relationship with the selected Hospitals. The sample consisted of 47 participants.

The final number of interviews was defined according to information saturation criteria for each of the

Hospitals¹¹. The results were confirmed with three participants of similar characteristics.

Qualitative Analysis

All the obtained information was transcribed verbatim and subjected to thematic analysis¹² using NVivo 11 software.

Scientific rigor criteria and Ethical Considerations

The scientific rigor criteria were met, including (i) recognition of the researcher's own assumptions about the phenomenon under study; (ii) confirmation of results with three participants, a Neonatologist, a Midwife and a Nursing Technician (TENS); (iii) to have a Community and Academic Advisory Committee. The study was approved by the local ethics committees of the studied hospitals and by the Conicyt Ethics Committee, National Commission for Research, Science and Technology, Government of Chile.

Results

1. Facilitators in new hospital

The beginning of working life in a new context is perceived as an opportunity to generate changes: *A New hospital, a new life*. The staff training in the importance of screening, the formation of joint work teams between Neonatology and Maternity departments and additionally a climate of cooperation and trust are perceived as facilitators.

The implementation of the pre-and post-ductal SpO₂ is perceived as a central objective. There was a staff training from the beginning of the Maternity and Newborn activities, a period of low workload, where tasks were being distributed.

It was a facilitator that childcare was initially in charge of Neonatology, which enabled to promote the importance and the technique of the pre-and post-ductal SpO₂ to the Maternity staff. Once the Maternity department was in charge of the childcare, the pre-and post-ductal SpO₂ was already incorporated into the daily routines.

Teamwork is valued transversally by the group; "P: Look, the *Neo* team belongs to the children's CR and the *Mater* team belongs to the women's CR so that we are enemies. I: (Laughs). P: But in practice, we have established links and bonds that are super deep!" ... "So we're all part of the team, that's the way we've organized ourselves, which is not the same as in other hospitals where there's a person who cares puerperium every day, here not!" (FG NEW Hospital).

Implementing the pre-and post-ductal SpO₂ in a participatory and common way has made the work of all the staff visible, enhancing the value of individual

work, in a collective manner; "P: I believe that a solid work team has already been established" ... "Solid! Clearly, they are a cornerstone here, so in the *Neo*, everyone has a lot of respect for them" ... "They have formed work teams. ... Consolidated, so I think that is a huge advantage that we have as, as a team of, of work of Neonatology and Maternity" (FG NEW Hospital).

The interviewees, including doctors, midwives and TENS, pointed out that the procedure is simple and quick and agreed on the usefulness of having implemented the pre-and post-ductal SpO₂. Likewise, the Pediatric Cardiologist consulted gives an enthusiastic response regarding the application of the pre-and post-ductal SpO₂ as screening method: "if you want to make a project with this pre and post saturation, I super Agree! I would include to it... I don't know, I mean, the ultrasound for me is fundamental" ... "To assess to everyone or to those who have the pre and post saturation" (09, Pediatric Cardiologist).

2. Barriers in new hospital

The main difficulties perceived in the hospital that carries out the pre-and post-ductal SpO₂ (NEW Hospital) were the deterioration of the equipment sensors and the occasional failure of the saturometer, whose repair is slow. Secondly, problems on weekends due to staff shortage.

Difficulty with inputs and saturometer repair

The main difficulties are perceived with the saturator sensor, which lasts longer than indicated by the manufacturer; "the only problems we have had are with the input of the saturator sensor. That the equipment that we are currently using, they are giving us uh.... sensors that are disposable and last seven days. But the hospital doesn't renew the sensor every seven days either! Then we have to make it last until the sensor dies definitively, that is to say, it lasts about twenty days" (01 NEW Hospital).

Administrative difficulties; weekends and dependency

The organization of weekend shifts gives *many activities to a few actors*, which makes it difficult, although it is carried out anyway; "P: there, on the weekend, the routine that we have super clear and tidy from Monday to Friday gets a little messier" ... (FG NEW Hospital).

The pre-and post-ductal SpO₂ is a method that is of particular interest of Neonatology Department and must be implemented in the Maternity Department, which could be a barrier in another hospital. "I think one of the problems is that the people who are most eager to implement it are the Neonatologists and the place where it needs to be implemented (Maternity or Childcare)... I think that's one of the problems!" (06 NEW Hospital).

3. Barriers old hospital and rural hospital

The perception of the Hospitals where the pre-and post-ductal SpO₂ has not been implemented as Screening (OLD and RURAL) is very different from that described for the NEW Hospital.

Unawareness of the usefulness of the pre-and post-ductal SpO₂ and skepticism about its use

The main barrier detected was the unawareness, which was more pronounced in the OLD Hospital, where uncertainty and amazement prevailed, including doubts about the usefulness of performing such examination. In this regard, a Midwife says, "But this... this pre-and post-ductal thing, is it proven?" "Pre and post saturation, never!" (05 OLD Hospital) Another participant says, "What is the procedure! I mean, I don't know, I don't know how it is going to be performed, I mean I know, it takes ten minutes, ten minutes of monitoring, I didn't do it uh... I don't know what it consists of" (FG OLD Hospital).

In the RURAL Hospital, participants were unaware of the Screening, although they react favorably to the explanation; "I did my internship at the Fricke, uh the Fricke Hospital, and there we did it for all the newborns at discharge, we saturated them in the right and in the right foot too"... (FG RURAL Hospital)

Participants of the RURAL Hospital are open to learn and contribute to the health of the NB; "The more things or advances in medicine for your son I think you will always say yes and for us too because it will be less demands that that mother goes to the emergency room due to ignorance or if she comes to the emergency room saying that her baby, I don't know! Her or his lips were purple and she's going to know about my, my baby has a heart disease, it's going to be something like... uh to anticipate to something that may happen in time, it's like a prevention of something" (07 RURAL Hospital).

Economic and work overload barriers

Participants perceive financial barriers that prevent the hiring of sufficient staff, with the consequent work overload; "No! *From above* they don't release the quotas in order to pay another salary"... "There is no interest because in the end one does the work anyway" (01 OLD Hospital).

On the other hand, the cost of the pre-and post-ductal SpO₂ sensor is high, "We occupy here in the maternity to saturate the babies, it is called Neonatal Sensor eeh... we buy two types, one for the term babies and another one for the premature baby, each one costs fifteen thousand (Chilean pesos)..., at this moment we are more or less buying eeh... twenty of each one monthly" (02 OLD Hospital).

The lack of time to add another procedure to the

long routine of the NB is often mentioned, all of them with multiple records; "Then there you write down everything, ..., you write down here, write down here, write down here, in six parts in total, among all the records in order to avoid that in the end the baby leaves or without a vaccine or that we vaccinate him or her twice because the baby can't tell us... Oh, I've already been vaccinated! ... (02 OLD Hospital).

Several participants have the feeling of working to the limit; "Yes, because ultimately we used to only care about the mother and from one day to the next is the mother and the baby and the baby needs breastfeeding support, physical examination, perform lab test, we have to show the results, to do a lot of things, to discharge a baby" (01 OLD Hospital).

The perception of over-demand increases due to sick leaves and vacations. The actual number of staff is less than the number on the payroll; "out of staff who already have a gap.... all the people who work on shift and have many years of seniority have many vacations days. So throughout the year, there are scheduled vacations... and also sick leaves or compensated absences, then from a total of nine technicians that we can have, we can easily reach seven or six quickly" (FG OLD Hospital).

A transversal finding is the *barrier of the weekend* and the holidays, days in which only urgent procedures are performed; "from Monday to Friday from eight to five..., I have to take care of everything that happens up there, to receive the babies, to have the clothes, everything, of everything that is done up there, whether it's a private system delivery or a public system delivery or a public system C-section or a pension system C-section eeh... and on the weekends... Everything! In charge of everything... there's only one technician on the weekends" (09 RURAL Hospital). This barrier is perceived as solvable through changes in coordination.

"Maternity versus Neonatology Culture" Barrier

The interest in implementing the pre-and post-ductal SpO₂ emerges from Neonatology, but the test should be done in Maternity. Both are independent departments in terms of leadership, staff, budgets, objectives, and goals. The interviewees of the OLD Hospital perceive a disconnection between both departments and even some antagonism or different "cultures", a climate that is reflected in the expressions of the interviewees; "I: What contact do you have with the people of the *Neo*? What, what kind of information do you share with each other? P: Nothing... I don't even know where *Neo* is, I think it's on the eighth floor?" (01 OLD Hospital).

Management of NB with positive CHD screening

The question regarding the flow of positive the pre-and post-ductal SpO₂ Screening referral is investigated

in a targeted manner, given the lack of specialists in pediatric cardiology; “how to proceed with children who have had their examination altered if they do not have enough cardiologist hours That’s it! That part is probably the one you need... eehh.. that if you implement it, for example from the ministry you have to know very clear! What is going to be done” ... (FG RURAL Hospital).

When consulting with the pediatric cardiologist in the studied hospitals, he points out how important it is to implement the pre-and post-ductal SpO₂ and to perform the diagnostic confirmation in the positive cases; “We were trying to do a project and it was based on this”... “You see, children go home quietly but it is difficult for a single cardiologist to do all that”... [In relation to the referral flow of positive pre-and post-ductal SpO₂ Screening] “Then I report it and it’s like, I mean, they have to call them in the first sixty days”... “We must solve this problem quickly” (09, Pediatric Cardiologist).

The pediatric cardiologist would receive the patients with positive pre-and post-ductal SpO₂ Screening, considering it a contribution to save the life of NB that could have a CHD undetected at birth.

In conclusion, the preparation or willingness to implement the pre-and post-ductal SpO₂ as a screening method in the three studied hospitals is heterogeneous. The recommended barriers to overcome are organizational, management and economic. Although there is a lack of training for those involved in the NB care, there is a willingness to implement this examination, given the importance of avoiding consequences and advancing in their care. The subsequent referral flow is quite clear and is also open to this implementation.

Discussion

The facilities included in this study have in common the fact that they are public hospitals, located in the Metropolitan Region and they serve a large number of patients. At the same time, those hospitals have important differences in history, organizational complexity, age and type of population served. This diversity of hospital settings allowed us to investigate the perceptions of the maternity and neonatology team members, about barriers and/or facilitators for the implementation of the pre-and post-ductal SpO₂ in different realities of the public health system.

The NEW and the OLD Hospital are high complexity hospitals and serve an urban population. The RURAL Hospital is of low complexity and serves agricultural areas.

Regarding the formation of work teams, in the NEW Hospital, such groups were recently formed. In

the OLD Hospital, the work teams have a long professional career, with an average of 12 years of service. In contrast, the interviewees at the RURAL Hospital have very varied work careers.

In the focus groups, a field ethnography was carried out. The environment that is perceived in each Hospital has specific characteristics that are evident in the barriers and facilitators to implement a new method, such as the pre-and post-ductal SpO₂. In the NEW Hospital with newly formed work teams, whose functions are not yet established in time, team members are flexible in the face of changes. Members of Neonatology and Maternity Departments maintain frequent contact, they are proud of forming a team and consider the implementation of the pre-and post-ductal SpO₂ as one of their achievements. In the OLD Hospital, which is an institution with a history and a great identity of leadership, the staff has defined roles. For them, any modification is compared to what has traditionally been done and is more resistant to changes. Implementing the pre-and post-ductal SpO₂ is not recognized as a necessity, its usefulness is unknown, and there is fear of a higher work overload.

In the RURAL Hospital, the human group is heterogeneous in every sense and has a spirit of improving tasks. The reduced physical spaces allow for coexistence and interaction between the neonatal and maternity staff. Although they were not aware of the usefulness of the pre-and post-ductal SpO₂, there is a positive attitude towards its possible implementation.

From the opinions that emerged from the set of interviews and focus groups in this study, the facilitators and barriers found are summarized as follows:

Barriers

The main barrier was the unawareness of the importance of the method on the part of the work teams, which would lead to a higher work overload. These perceptions are similar to some found in the literature^{6,13}.

On the other hand, there is mistrust about financial support for extra staff, equipment, and supplies and about the availability of specialists for the NB that would be positive.

Facilitators

The interviewees transversally agreed on the health contribution that would mean implementing an early detection technique for CHD, which coincides with the available literature⁴⁻⁷. The first recommendation was to conduct theoretical training in the benefits and characteristics of the pre-and post-ductal SpO₂ and to disseminate its importance in the community.

The procedure is perceived as simple and fast, and its low cost, simplicity, and quick implementation are

recognized as advantages, which would make it easier to implement.

Another facilitator would be to have a Ministry of Health (MINSAL) Guide and regulation that provides complete process instructions, execution and referral for positive CHD Screening. On the other hand, a relevant facilitator is to have a policy for the purchasing, replacement, and repair of equipment and supplies, since negative experiences about these aspects frequently emerged in the interviews.

Finally, given the experience of the NEW Hospital, where the pre-and post-ductal SpO₂ is implemented, it seems to us that encouraging teamwork, integrating neonatology and maternity staff in joint training and implementation is an important part of the strategy, in order to facilitate the success.

Ethical Responsibilities

Human Beings and animals protection: Disclosure the authors state that the procedures were followed ac-

ording to the Declaration of Helsinki and the World Medical Association regarding human experimentation developed for the medical community.

Data confidentiality: The authors state that they have followed the protocols of their Center and Local regulations on the publication of patient data.

Rights to privacy and informed consent: The authors have obtained the informed consent of the patients and/or subjects referred to in the article. This document is in the possession of the correspondence author.

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Conflicts of Interest

Authors declare no conflict of interest regarding the present study.

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