

THE FREQUENCY OF NASAL INJURY IN NEWBORNS DUE TO THE USE OF CONTINUOUS POSITIVE AIRWAY PRESSURE WITH PRONGS¹

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Continuous positive airway pressure (CPAP) with prongs is the ventilatory support most used in newborns. Nasal injuries are complications that may arise due to the prolonged use of this device. This study aimed to determine the frequency of nasal injuries in newborns through the use of continuous positive airway pressure with prongs. A convenience sample composed of hospitalized newborns using prongs for more than two days was used. Data were collected through a structured form. Lesions were observed in all newborns, which were classified as: mild (79.6%), moderate (19.7%) and severe (0.7%). The conclusion is that the use of prongs for more than two days represents a risk factor for the lesions to develop.

DESCRIPTORS: wounds and injuries; infant, newborn; continuous positive airway pressure; nose; nasal cavity

LA FRECUENCIA DE LESIÓN NASAL EN NEONATOS CAUSADA POR LA PRESIÓN POSITIVA CONTINUA EN LAS VÍAS AÉREAS CON PRONGS

La presión positiva continua en las vías aéreas con prongs es la asistencia ventiladora más utilizada en neonatología. Las lesiones nasales son complicaciones que pueden surgir debido al uso prolongado de ese dispositivo. Este estudio tuvo por objetivo determinar la frecuencia de las lesiones nasales en neonatos causadas debido al uso de presión positiva continua en las vías aéreas utilizando un prong. El muestreo fue por conveniencia, constituido de recién nacidos internados y usando prongs, y se excluyeron aquellos que utilizaban el dispositivo por un período inferior a dos días. Los datos fueron recolectados a través de un formulario estructurado. Se observaron lesiones en todos los recién nacidos, clasificadas en: ligera (79,6%), moderada (19,7%) y severa (0,7%). Se concluyó que el tiempo de permanencia de las prongs, por más de dos días, es un factor de riesgo para la evolución de las etapas de las lesiones nasales.

DESCRIPTORES: heridas y traumatismos; recién nacido; presión de las vías aéreas positiva continua; nariz; cavidad nasal

FREQUÊNCIA DE LESÃO NASAL EM NEONATOS POR USO DE PRESSÃO POSITIVA CONTÍNUA NAS VIAS AÉREAS COM PRONGA

A pressão positiva continua nas vias aéreas com pronga é a assistência ventilatória mais utilizada em neonatologia. Lesões nasais são complicações que podem surgir pelo uso prolongado desse dispositivo. Este estudo objetivou determinar a frequência de lesões nasais em neonatos por uso de pressão positiva contínua nas vias aéreas com pronga. A amostragem foi por conveniência, constituída de recém-nascidos internados e em uso de pronga, e excluiu-se aqueles que utilizavam o dispositivo por período inferior a dois dias. Os dados foram coletados através de um formulário estruturado. Observaram-se lesões em todos recém-nascidos, graduadas em: leve (79,6%), moderada (19,7%) e severa (0,7%). Concluiu-se que o tempo de permanência de pronga, por mais de dois dias, é fator de risco para a evolução do estágio das lesões nasais.

DESCRIPTORES: ferimentos e lesões; recém-nascido; pressão positiva contínua nas vias aéreas; nariz; cavidade nasal

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INTRODUCTION

Pulmonary disorders represent an important cause of morbimortality in the neonatal period. However, with the advancement of intensive therapy techniques better results are achieved in the treatment of these diseases and improved clinical development of newborns have been observed⁽¹⁾.

Among the several types of ventilatory support for newborns aiming to improve the exchange of gases and reduce respiratory effort is the Continuous Positive Airway Pressure (CPAP). It is a mechanical ventilation in which positive transpulmonary pressure is continuously applied into the airways during a respiratory cycle so as to avoid the complete elimination of inspired gas and maintain functional residual capacity, increasing the intra-alveolar pressure and its stability, improving gases exchange and preventing the collapse of the airways during respiratory effort⁽²⁾.

To apply this pressure system, three components are essential: continuous flow of a heated and humidified gas mixture (compressed air and oxygen); a system connecting the device to the patient's airway such as facial masks, nasal prongs, nasopharyngeal or endotracheal tubes and a mechanism of positive pressure generation in the system⁽²⁻³⁾.

A nasal prong is the most used device in connecting airways because it is a less invasive way of supplying CPAP⁽²⁾, it is available in different sizes and made of light and flexible material⁽³⁾. Despite its advantages, this device can harm the nostrils and cause discomfort and disfiguration in the long term⁽⁴⁾. Research classifies nasal injuries caused by the use of prongs in three stages: mild, moderate and severe. The mild stage is described as redness or nasal hyperemia; the moderate presents bleeding injuries and the severe stage refers to injuries with necrosis⁽⁵⁾.

Nasal lesions caused in newborns due to misuse of prongs vary from simple hyperemia of the nasal mucosa, bleeding, formation of crusts, and necrosis up to total destruction of the anterior part of the septum (columella)⁽⁶⁻⁷⁾ and nasal septum^(5,8).

The occurrence of nasal lesions in some newborns due to the use of CPAP with prongs was observed during the author's nursing residence in the neonatal program at the neonatal unit of the Santa Mônica Maternity School – MESM, which motivated the development of this study that aimed to determine

the frequency of nasal lesions in newborns due to the use of CPAP with prongs.

METHOD

This is a quantitative, descriptive and cross-sectional study⁽⁹⁾. It was carried out in the Neonatal Unit of Santa Monica Maternity, Macéio, AL, Brazil. The study was approved by the Research Ethics Committee at the State University of Health Sciences of Alagoas (UNCISAL) according to Resolution 196/96 of the National Health Council (Protocol 766/2007).

A convenience sample was used⁽⁹⁾. The study included newborns hospitalized at the maternity's neonatal unit who underwent CPAP with prongs. Newborns undergoing CPAP with prongs for less than two days were excluded from the sample. The sample size of 147 newborns was defined considering a 25%⁽⁸⁾ frequency of nasal lesions caused by the use of CPAP with prongs; an absolute precision of 7% and 5% of significance level were considered.

The main researcher collected data between October 2007 and February 2008 until she reached the sample estimated for the study. The adults legally responsible for the newborns were approached weekly at the nursing wards where children were hospitalized and at the neonatal unit. Individuals were invited to voluntarily participate and allow the newborns' data to be collected and included in the study.

After the free and informed consent agreement was presented and read to the adults legally responsible for the newborns, data were collected through a form developed by the researcher. Individuals were not evaluated twice.

To collect and establish lesions caused by the CPAP with prongs, the stage of lesions, use of protection, number and type of prongs used at the moment of data collection, the researcher had to take the prong out of newborns' nostrils for a brief moment, check their nostrils and immediately put it back after observation and collection of necessary data so as to avoid any alteration in newborns' general condition. Another source of data collection was the individuals' files where complementary data were extracted from the neonatology charts, medical evolution records and nursing files.

After data collection, these were included and tabulated in an electronic spreadsheet. The Statistical Package for the Social Sciences - SPSS version 15.0

was used to perform the descriptive analysis. Results are presented in the text and tables.

RESULTS

We observed in the results that the gestational ages of 123 (83.7%) newborns out of 147 were below 37 weeks⁽²⁾.

The type of prong used in all studied newborns was the *Inca - Ackrad*[®], and its size was considered adequate for 29 (19.73%) patients. There were 118 (80.27%) prongs considered inadequate and all were smaller than they were supposed to be.

Nasal protection was observed in 142 (96.6%) newborns: 141 (96%) had a common dressing and only one (0.6%) patient had protection with a disposable adhesive for the neonatal pulse oximeter sensor. None of the patients had hypoallergenic or hydrocolloid tape for nasal protection.

Analyzing the models of protection, 59 (40.14%) newborns presented "patches", 83 (56.46%) had "pig snout" type protection, while five of them did not have any protection. Fifty-five out of 59 newborns using patches presented mild lesions and four had moderate lesions. Fifty-eight out of 83 individuals with pig snout type protection presented mild lesions, 24 moderate and one presented a severe lesion.

All newborns using CPAP with prongs for the minimum period of two days presented lesions. These were classified as mild, moderate and severe as presented in Table 1.

Table 1 – Sample distribution regarding the stage of lesions. Maceió, 2008

Lesions Stage	Frequency	Percentage (%)
Mild	117	79.6
Moderate	29	19.7
Severe	1	0.7
Total	147	100

Of those lesions considered mild, 58 (39.46%) presented only hyperemia, while 59 (40.14%) presented hyperemia with erosion.

Of those classified moderate, 14 (9.52% of the sample) presented bleeding and 15 (10.2% of the sample) presented both bleeding and erosion in the nostrils. The one classified as severe presented necrosis in addition to bleeding and erosion.

In regard to the quality of gases (oxygen and compressed air) offered to these patients, we observed that all (100%) newborns in CPAP with prongs had humidifiers, though, only 127 (86.4%) were heated.

DISCUSSION

Nasal lesions in newborns caused by continuous positive airway pressure with prongs is a little discussed issue in the Brazilian literature. However, research, especially international studies in the field, emphasizes that nasal complications secondary to prongs are present mainly in preterm and low-weight newborns due to their pulmonary immaturity and therefore need of CPAP very early on^(7-8,10-11).

This is confirmed in this study in which the age of 123 (83.7%) of newborns submitted to CPAP with prong was below 37 weeks and 51 (34.7%) presented low weight showing that lesions caused by the use of prongs more frequently compromise preterm newborns with low weight.

Authors report that prongs are classified in three types: *Hudson*[®], *Argyle*[®] *Sherwood* and *Inca Ackrad*[®], while the ideal size for each newborn depends on his(er) current weight. The *Hudson*[®] type presents the following sizes: 0, 1, 2, 3, 4 and 5, which correspond to the following weights: less than 1000g, between 1000g and 1500g, between 1500 and 2000g, between 2000 and 3000g and above 3000g. The sizes for the *Argyle*[®] *Sherwood* type are: extra small, small and large and the sizes for the *Inca Ackrad*[®] type are: 7.5 and 9 for newborns below 700g, 10.5 for newborns between 701g and 1000g, 12 for newborns between 1001g and 1300g, and 15 for newborns above 1300g⁽²⁾. Some researchers consider that the ideal prong is the one not so large to the point it distends the nostrils and not so small to the point it lets extra space between the prong and nostrils⁽⁸⁾.

As for its positioning, a well-positioned prong is that which does not deform the newborn's face and its bridge does not touch the nasal septum and does not allow the device to move inside the nostrils⁽⁸⁾. Thus, prongs' inappropriate size and fixation are harmful factors that determine the formation of lesions, especially prongs smaller than they are supposed to be because they do not properly fit into the newborns' nostrils, causing friction between the

device and the nostrils and also encouraging air leakage⁽¹⁰⁻¹¹⁾.

Prongs type Inca *Ackrad*[®] were used in all studied newborns and the majority of them were smaller than the ideal size according to newborns weight at the time of the initial placement of the device. It is worth mentioning that in addition to a single type of prong, the quantity available was insufficient to meet the demand of newborns. These prongs were only disinfected before reuse and we observed that the exchange and sterilization of the system was not performed every two days as recommended in the literature⁽⁸⁾. Routine disinfection of prongs available in the sector is probably wearing the material out and making it less flexible, which can also be a risk factor in the development of nasal lesions. It is urgent to provide prongs of different sizes and in quantity sufficient to appropriately meet the demand of this clientele with quality.

When the cap is larger than the newborn's head, it causes the tube to move and consequently it presses the prongs into the nostrils. Hence, it is advisable to ensure adequate cap sizes better suited to newborns' heads so that pressure on the nostrils is minimal⁽¹¹⁾.

Another method to avoid such pressure is to wet the prongs in water or saline solution and bend it down so as to facilitate its adaptation in the nostrils^(2,8). Although this was not this study's objective, we also observed that the caps were of various sizes and often times they needed to be fixed with a common patch so as to adjust them to the newborns' heads. In the absence of caps, bandages were fixed around the head with patches with the same function: immobilizing the prongs.

Based on the above, we suppose that the formation of nasal lesions is related to health professionals inappropriately fixing the prongs into the newborns' nostrils. They introduce the entire prongs stems into the nostrils so that the bridge of this device is in direct contact with the columella. Additionally, it is possible the prongs, smaller than the ideal size, cause the device to move inside the nostrils, clamping the septum.

Some health professionals spend 24 hours taking care of the details of the CPAP. They insert the prong very carefully so that the bridge does not touch the columella⁽¹¹⁾ and septum and also report that inserting it one or two millimeters is

already sufficient to provide the desirable pressure⁽¹²⁾. Others affirm that harm in the nostrils' lateral walls and nasal septum can be avoided as long as the device is kept straight and does not pressure the nasal septum⁽¹³⁾. We observed in this study that prongs were inserted beyond the recommended millimeters, the bridge touched the columella and septum so as to produce sufficient pressure to the CPAP system and impede air leakage. This practice probably encouraged early nasal lesions.

The literature indicates that resistance to the device is inversely proportional to its radius, that is, the larger the prong (larger diameter/radius) the lower the resistance and, consequently, the better the pressure⁽¹¹⁾. Prongs with the correct diameter reduce air leakage⁽¹³⁾ and prevent harm in the nasal tissues⁽¹¹⁾.

The frequency of nasal lesions caused by the use of CPAP with prong was 100%, contradicting the study hypothesis that the traction exerted by the tube weight jointly with the device is responsible for 25% of nasal lesions⁽⁸⁾.

Time was significant in relation to the evolution of stages of nasal lesions caused by the use of prongs, confirming the theory that the prolonged duration of CPAP with prongs is a risk factor for the development of nasal injuries and traumas⁽¹⁰⁾.

Aiming to alleviate and prevent lesions, nostrils are protected by adhesive tapes, such as common patches, hypoallergenic tapes and hydrocolloid dressings⁽¹⁰⁻¹¹⁾, used to avoid direct friction between the prongs and the columella and septum.

The hydrocolloid is currently the most reported material used as a preventive measure⁽¹⁰⁾, especially in the international literature. Even though lesions are still observed with its use, they are presented in a smaller proportion. This fact makes clear that cost-benefit issues should be reevaluated in the use of prongs.

Models of nasal protection used in the studied institution included: common dressings in form of patches (cut into strips and adhered to the columella) and in form of a pig snout, which covers both the columella and the nostrils edges. Among those using the pig snout type protection, one individual had a protection creatively devised by professionals, made of adhesive material to fix the

pulse oximeter in the limbs. The protections did not interfere in the formation of lesions, since all newborns presented lesions after using the device for two days.

There were heating devices and humidifiers for a great number of the studied individuals, ensuring the quality of provided gases. Periodically monitoring the level of the humidifier jar is required in order to adjust the heating to obtain an output temperature between 34 and 36° C⁽²⁾.

Based on the above, we concluded that the frequency of lesions with the use of CPAP with prongs after a minimum period of two days was 100% and time was a risk factor for the development of lesions. These events are distributed in Figure 1 showing that the longer the device is used, the more severe the lesions.

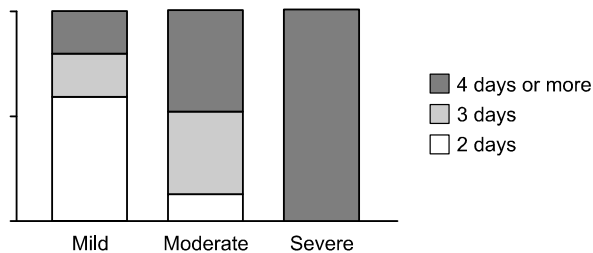


Figure 1 – Stages of nasal lesions related to the duration of device use. Maceió, 2008

Weight, type of prong and model of nasal protection are not significant in relation to the formation of nasal lesions.

The installation of the CPAP differs from that recommended by the international literature. The technique to fix the system, the prong fixation and size, cap size, the presence of nasal protection and permanent surveillance regarding the position of the device in the newborns' nostrils are factors that, when properly used, can prevent the development of nasal lesions.

Although experts affirm it is unlikely that the incidence of nasal lesions is reduced to zero despite prevention measures, risk factors can and should be minimized through the employment of correct device and technique. However, for the successful use of CPAP with prongs, much more than just material resources is necessary. The nursing team has to be constantly committed to adequate set up, to maintaining the system and especially to keeping surveillance on the newborns.

Trainings and educational programs are strategies that can improve care to newborns in CPAP with prongs, so as to make this practice safe and avoid complications as a consequence of its use.

Further studies in this line of research are needed so as to develop new devices and fixation methods that reduce nasal traumas.

REFERENCES

1. Lima MRO, Freire ALG, Andrade LB, Santos LG. Comparação dos níveis de pressão positiva contínua nas vias aéreas através de dois sistemas. *J Pediatría*. 2004 jun [Acesso 09 jun 2004];80(5):[401-406]. Available from: <http://www.paulomargotto.com.br/documentos/disserta%C3%A7%C3%A3o%20PDF.pdf>
2. Kopelman BI, Santos AMN, Goulart AL, Almeida MFB, Miyoshi MH, Guinsburg R. Diagnóstico e tratamento em neonatologia. In: Miyoshi MH, Yada M, editors. *CPAP – Pressão positiva contínua em vias aéreas*. São Paulo (SP): Atheneu; 2004. p. 139-47.
3. Falcão MC. Uso da pressão positiva contínua das vias aéreas (CPAP) no período neonatal. *Rev Ensaio Reviews* 1997; 9(3):207-12. Disponível em: <http://www.scielo.br/pdf/jped/v80n5/v80n5a11.pdf>
4. Campbell DM, Shah OS, Shah V, Kelly EN. Administração de pressão positiva contínua nas vias aéreas (CPAP) nasal com cânula de alto fluxo versus pronga nasal em recém-nascidos pré-termos. *J Perinatol* 2006 setembro; 26:546-9.
5. Buettiker V, Hug MI, Baenziger O, Meyer C, Frey B. Advantages and disadvantages of different nasal cpap systems in newborns. *Neonat Paediatr Intensive Care* 2004 March; 30:926-30.
6. Millet V, Lacroze V, Bártoli JM, Unal D. Necrose de la columelle nasale secondaire à la pression positive continue (PCC) nasale. *Arch Pediatr* 1997; 4:485-8.
7. Bernadette C, Loftus MD, Jeffrey Ahn MD, Joseph Haddad MD. Neonatal nasal deformities secondary to nasal continuous positive airway pressure. *Laryngoscope* 1994 August; 104:1019-22.
8. Malta MV, Zaconeta CA, editors. Verificação da técnica de CPAP nasal e dos parâmetros oferecidos aos recém nascidos em quatro hospitais da rede pública do Distrito Federal. [monografia na Internet]. Distrito Federal: Residência Médica em Pediatria; 2005. Disponível em: <http://www.paulomargotto.com.br/documentos/disserta%C3%A7%C3%A3o%20PDF.pdf>
9. Hulley SB, Cummings SR, Browner WS, Gracly D, Hearst N, Newman TB. Delineando a pesquisa clínica – uma abordagem epidemiológica. Porto Alegre (RS): Artmed; 2003.
10. Yong SC, Chen SJ, Boo NY. Incidence of nasal trauma associate with nasal prong versus nasal mask during continuous positive airway pressure treatment in very low birthweight infants: a randomized control study. *Arch Dis Child Fetal Neonat* 2005 June; 90:480-3.

11. Robertson NJ, McCarthy LS, Hamilton PA, Moss ALH. Nasal deformities resulting flow driver continuous positive airway pressure. *Arch Dis Child Fetal Neonat* 1996 August; 75:209-12.
12. Zaconeta CA, Margotto PR. Cpap nasal no ano de 2006: Indicação e Atualização. Apresentado ao 5o

Simpósio Internacional de Neonatologia do Rio de Janeiro; 2006 Setembro 28-30; Rio de Janeiro; Rio de Janeiro; 2006.

13. De Paoli AG, Morley C, Davis PG. Nasal CPAP for neonates: what do we know in 2003? *Arch Dis Child Fetal Neonat* 2003 May; 88:168-72.