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ORIGINAL ARTICLE

Home parenteral nutrition in pediatric patients with intestinal insufficiency

Nutrición parenteral domiciliaria en pacientes pediátricos con insuficiencia intestinal

Yazmín Zapata Olivares[a], María Isabel Hodgson Bunster[a,b], María Luisa Cordero Bayón[c], Lorena Rodríguez Osiac[d], Jaime Cerda Lorca[e], Grupo Chileno para el estudio de la Nutrición Parenteral Prolongada en Pediatría

[a]Department of Nutrition, Diabetes and Metabolism, School of Medicine, Pontificia Universidad Católica de Chile, Santiago, Chile
[b]Division of Pediatrics, Gastroenterology, Hepatopatology and Nutrition Unit, School of Medicine, Pontificia Universidad Católica de Chile, Santiago, Chile
[c]Pediatric Nutrition Program, Pediatric Unit, Hospital Sótero del Río, Santiago, Chile
[d]Nutrition and Food Department, Ministerio de Salud, Chile
[e]Department of Public Health, School of Medicine, Pontificia Universidad Católica de Chile, Santiago, Chile

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Abstract

Introduction: Home parenteral nutrition (HPN) has been shown to offer important benefits for patients and the health system. In Chile, the number of patients who are receiving this type of treatment or who could be candidates for it is unknown. **Objective:** To determine the prevalence and clinical characteristics of patients with intestinal insufficiency (II) currently receiving HPN or who are candidates for it. **Patients and Method:** Cross-sectional descriptive study which included patients aged between 0 to 18 years with diagnosis of II who were receiving parenteral nutrition (PN) for over three months, either at home or in the hospital, with a stable clinical situation and a long-term venous catheter (CVC). Through a digitalized survey, the following variables were collected and studied: gender, birth history, indication to initiate parenteral nutritional support, age of initiation of PN, type of CVC, frequency of PN, nutritional status and feeding in the last control and complications associated with the use of PN. Data analysis was performed using the SPSS Statistics Software, Version 21, Macintosh. The descriptive analysis considered frequency analysis and central trend measures. The Chi-square and Fisher tests were used for comparison of proportions. **Results:** Data from 46 patients were recorded. The average age was 55.5 months. The main indication for initiating the PN was the decrease of the intestinal surface (78.3%). 63% of the patients were hospitalized. No significant differences were found between the place of treatment and the nutritional status and catheter infections variables in the last year. **Conclusions:** The prevalence of patients with long-term PN and their clinical characteristics were identified. No differences were found to support the administration of this treatment in the hospital over the home. Public policies must be developed to guarantee the option of receiving this treatment at home.

Keywords:
Long-term parenteral nutrition;
pediatric home parenteral nutrition;
intestinal insufficiency;
registry

Correspondence:
M. Isabel Hodgson
hodgson@med.puc.cl

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Introduction

Parenteral Nutrition (PN) is fundamental in the therapy of several pathologies. Its objective, in pediatrics, is to provide the sufficient nutrients necessary to achieve optimal growth, when oral or enteral feeding is not possible or insufficient. Its use has allowed the survival of patients who were previously considered without any treatment option[1].

Intestinal Failure (IF) is a good example of how Prolonged Nutritional Support is an essential part of the treatment these children receive. It is defined as the inability to achieve an adequate balance of protein, energy, water, electrolyte, and micronutrients due to a reduction in the functional enterocyte mass, preventing an adequate absorption and digestion of nutrients, either as a result of anatomical reductions in intestinal length (Short Bowel), neuromuscular pathologies of the gastrointestinal tract or alterations of the intestinal epithelium[1,2].

Although these types of diseases are rare, they have a high emotional, social and economic impact on the patient and their family, requiring specialized and multidisciplinary care, which often translates into long hospital stays.

For this reason, Home Parenteral Nutrition (HPN) represents an alternative to prolonged hospitalization for this type of patient and has been recognized as the best option to improve the quality of life of these children and their families[3]. The benefits of home care compared to hospital treatment have been fully described since a couple of decades now. These include: i) Social-emotional benefits: allowing the child's family and school insertion, as well as family integration; ii) Clinical benefits: represented by a lower number of infectious complications; iii) Health resource management benefits: where it is possible to evidence a reduction in the cost associated with treatment, reaching savings of almost 75%[4-9].

Although there are institutions in Chile that provide this treatment option, it is not performed universally and does not require notification, so it is unknown how many patients are currently with HPN or are candidates for this treatment modality, being possibly hospitalized for long periods.

Therefore, it is essential to know the number of patients who are candidates for this type of treatment, which would allow the implementation of public policies and have a national HPN program in the future.

The objective of this study was to determine the prevalence and describe the clinical and demographic profile of pediatric patients diagnosed with IF who were receiving prolonged PN as part of their treatment.

Patients and Method

Cross-sectional descriptive study that includes data from high-complexity hospitals belonging to the Public Health Care Network and the UC Christus Private Health Network. The institutions were contacted by telephone and/or e-mail through the Chief of Units.

We included patients between 0 and 18 years of age, who were dependent on PN (total or partial) for more than three months, that were at home or hospitalized in conditions of home discharge, defined as a stable clinical situation and with long-duration Central Venous Catheter (CVC) in situ.

The data were collected from July 2016 to July 2017, through a digitized instrument of 23 questions, based on the survey "Sustain Baseline Data Collection Form, ASPEN 2014", to be filled out by the treating physicians. The studied variables were: sex, birth data, diagnosis, indication to initiate parenteral nutritional support, age of PN onset, type of venous catheter used, PN frequency, nutritional status at last control, feeding at last control, and complications associated with the use of PN.

The z-score was used for the evaluation and interpretation of anthropometric data. The considered parameters were: weight-for-height (W/H) and height-for-age (H/A) in children under five years of age, which were calculated using the WHO Anthro statistical software (version 2.1.1, January 2011). In those older than five years, the z score of the indicators Body Mass Index-for-age (BMI/A), and Height-for-age (H/A) were considered, which were calculated with the WHO Anthro Plus statistical software. A joint analysis of the z-values was carried out, using the criteria for nutritional status classification proposed by the WHO. In patients of less than 32 weeks of gestation at birth, the chronological age was corrected until the 24 months of age, and in those patients born between 32 and 36 weeks of gestation, the chronological age was corrected until the 12 months of age, according to the formulas established by the Ministry of Health of Chile[10,11].

Data published by the National Health Fund (FONASA) in August 2017 were used to describe average bed-day costs.

For the analysis of the relationship between the variables catheter infection in the last year and nutritional status according to the place of treatment, we considered only those patients who had spent more than six months in the hospital or home according to each case.

The SPSS Statistics software Version 21 for Macintosh was used for data analysis. The descriptive analysis considered frequency analysis and measures of central tendency. The Chi-square and Fisher tests were used for the comparison of proportions.

Ethical considerations

This study was approved by the ethics committee of the Faculty of Medicine of the Pontifical Catholic University of Chile, giving a waiver of informed consent for the data withdrawal, as well as by the Undersecretary of Welfare Networks and the Department of Food and Nutrition of the Ministry of Health of Chile.

Results

1. Neonatal and clinical history

We contacted 27 high-complexity public hospitals that had a regional reference Pediatric Service. Out of these, 48.2% (n = 13) had one or more patients who met the inclusion criteria. Of the total number of participating centers, 53.8% (n = 7) are located in the Metropolitan Region and the remaining percentage corresponds to hospitals located in other regions of the country.

46 patients were included in the database. 84.8% (n = 39) came from some public institutions in the country and the remaining 15.2% (n = 7) came from a private institution. Of the total number of patients, 56.5% were female (n = 26). The average age at the time of the study was 55.5 months (± 48.8 SD), with a minimum of six months and a maximum of 18 years of age, where 52% (n = 24) of them were in the age group of preschoolers (two to five years of age).

In terms of neonatal history, 10.9% (n = 5) of patients were born before 32 weeks gestational age (GA), 4.3% (n = 2) had a birth weight (BW) lower than 1000 grams, and 34.8% (n = 16) were small for gestational age (SGA) (table 1).

71.7% of patients (n = 33) started parenteral nutritional support before the first month of life. The main indication for this was the reduction of the intestinal surface in the 78.3% of cases, the remaining percentage corresponded to pathologies causing alteration of intestinal motility or extensive involvement of the intestinal epithelium (table 2).

The most prevalent diagnosis was gastroschisis in 32.7%, which may or may not be associated with volvulus or intestinal atresia.

Table 2 shows the characteristics of the remaining intestine.

Table 1. Neonatal characteristics of patients (n = 46)

	Frequency (N)	Percentage (%)
Gestational age (weeks)		
< 32	5	10.9
32 – 36	20	43.5
> 36	21	45.7
Birth Weigth Classification		
SGA	16	34.8
AGA	29	63.0
LGA	1	2

SGA: Small for getational age (BW < 10th percentile); AGA: Appropiate for gestational age (BW 10-90th percentile); GEG: Large for gestational age (BW > 90th percentile).

Table 2. Clinical characteristics and diagnoses of patients (n = 46)

	Frequency (N)	Percentage (%)
Indications for Parenteral Nutrition		
Short Bowel	36	78.3
Extensive involvement of the intestinal epithelium	5	10.9
Gastrointestinal motility disorder	5	10.9
Diagnósticos		
Gastroschisis*	15	32.6
Intestinal atresia	6	13.0
Intestinal Volvulus	7	15.2
Necrotizing enterocolitis	4	8.7
CIP** and other motility disorders	5	10.9
Others	9	19.6
Characteristics of the remnant intestine		
Presence of Ileocecal valve	19	41.3
Presence of colon	43	93.5
Presence of ostomy	17	37

*With or without Atresia or Intestinal Volvulus. **CIP: Chronic intestinal pseudo-obstruction. "Other" pathologies: Chronic granulomatous disease, Neurogenin 3 deficiency, Microvillus inclusión disease, multiple spontaneous intestinal perforations, intestinal neuronal dysplasia, autoimmune enteropathy and Abetalipoproteinemia.

2. Place of treatment, days of hospitalization, and possibility of attending formal education

63% of the patients (n = 29) were hospitalized at the time of the study, the remaining 37% were receiving their treatment at home, which was provided by a nurse from an external company or by parents previously trained in management. Out of the patients who were at home (n = 17), seven were treated in the private health system.

The average parenteral support time, regardless of the place of treatment, was 1365 days (SD ± 1272.3 days) at the time of the study. The average number of hospitalization days for children receiving treatment in hospital was 791 days (SD ± 579.7; min: 102, max: 2374 days), and 927 days (SD ± 815.8; min: 166, max: 3025 days) of hospitalization, waiting before home discharge, for those patients who were at home.

48% of the hospitalized patients were preschoolers, and in the home treatment group, this age range reached 58.8%.

In relation to the incorporation into the educational system of those patients of preschool or school age (n = 34), 47.1% (n = 16) of them were not involved

in any type of school activity, such as attendance at kindergarten or school, hospital school or stimulation by the reference center programs. Out of these, 56.3% (n = 9) were hospitalized.

3. Current food and nutritional status

71.7% (n = 33) of the patients were receiving PN daily, and 19.9% were receiving PN four or less days a week.

Most of the children were receiving PN plus mixed feeding and supplementation with polymeric (n = 21) or elemental (n = 9) formula. Table 3 shows these details.

In those patients with significant gastrointestinal loss (n = 7), fluid replacement was performed daily in four of them (57.1%), the remaining percentage needed less than three times per week.

For the analysis of current nutritional status, 45 patients of the total were considered since one patient (infant) presented severe marasmus (W/H Indicator -6.02 SD) due to a venous accesses exhaustion; which suggests that the PN was suspended for prolonged periods, thus it was excluded from the global analysis.

62.2% of patients are in a nutritional state appropriate for their height. However, 53.3% of patients were below normal height, with a mean for the z H/A variable of -2.16 (± 1.78 SD) (table 4).

4. Catheter, infections and other associated complications

87% (n = 40) of the patients had a tunneled catheter for PN, the remaining 13% were using a peripherally inserted central catheter (n = 4) or a Port-a-Cath one (n = 2). 78.3% (n = 36) had at least one catheter infection in the past year, of which 63.9% (n = 23) were hospitalized.

Regarding complications associated with prolonged parenteral nutrition, 50% of patients had cholestasis or transient alteration of liver tests, as reported by their treating physicians. 43.5% (n = 20) reported had had other complications, where venous thrombosis was the most frequently mentioned (n = 5), followed by vitamin D deficit, CVC rupture or self-removal, cholelithiasis, and extravasation of venous lines.

5. Relationship between place of treatment, current nutritional status and catheter infections

No significant differences in neonatal or clinical history were found between inpatients versus those at home (table 5).

There were also no significant differences in relation to nutritional status and catheter infections in the last year according to the place of treatment (table 6).

Table 3. Type of feeding at last control

Type of feeding	Frequency (N)	Percentage (%)
Exclusive PN	4	8.7
PN + Trophic feeding*	5	10.9
PN + Enteral Formula	7	15.2
PN + Mixed feeding + Formula	30	65.2

PN: Parenteral Nutrition. *The volumen of feeding considered trophic is 10-20 ml/kg /d with human milk, polymeric or elemental formula.

Table 4. Nutritional Status at the last control (n = 45)

	Frequency (N)	Percentage (%)
Nutritional		
Severe or moderate malnutrition	3	6.7
Mild malnutrition	7	15.6
Eutrophic	28	62.2
Overweight	7	15.6
Height		
Stunted	24	53.3
Normal	20	44.4
Tall	1	2.2

Nutritional indicators at the last control (n = 45)			
Z score	N	Media	SD
H/A at last control	45	-2.16	± 1.78
W/H at last control	32	-0.28	± 1.19
BMI at last control	13	-0.33	± 0.95

H/:A Height/age. W/H: Weight/Height. BMI: Body mass index.

Discussion

The use of Prolonged Parenteral Nutrition is a practice that has allowed to extend the survival of patients previously considered out of therapeutic reach. However, it is not enough to increase life expectancy in number of years if the quality of life is not assured. This is how the Home Parenteral Nutrition indication emerges as a valuable alternative when it comes to pursuing both objectives.

The organization of home nutritional support varies according to the country where it is implemented. Spain, like Canada, has a single national registry (Registry of NADYA-SENPE Group) that provides information on adult and pediatric patients with HPN. In

Table 5. Clinical and neonatal characteristics according to treatment place (n = 39)*

	Treatment place				P value
	Hospital		Home		
	Frequency (N)	Percentage (%)	Frequency (N)	Percentage (%)	
Gender					
Male	9	34.6	5	38.5	1.000
Female	17	65.4	8	61.5	
Gestational age					
< 32	4	15.4	1	7.7	0.640
> 32	22	84.6	12	92.3	
Birt Weight /Gestational age					
SGA	10	38.5	5	38.5	1.000
AGA	16	61.5	8	61.5	
Indications for Parenteral Nutrition					
Short Bowel	21	80.8	10	76.9	0.944
Extensive involvement of the intestinal epithelium	3	11.5	2	15.4	
Gastrointestinal motility disorder	2	7.7	1	7.7	

*For the analysis of these variables, we consider those patients who will be 6 months or more in a treatment place (hospital or home). SGA: Small for gestational age (Weight < 10th percentile); AGA: Appropiate for gestational age (Weight 10-90th percentile).

Table 6. Catheter infection in the last year and nutritional status according to place of treatment (n = 38)**

	Treatment place				P value
	Hospital		Home		
	Frequency (N)	Percentage (%)	Frequency (N)	Percentage (%)	
Catheter infection					
No	6	23.1	3	23.1	1.000
Yes	20	76.6	10	76.9	
Nutritional Status					
Undernutrition	4	16	2	15.4	0.597
Eutrophy	16	64	10	76.9	
Overnutrition	5	20	1	7.7	

*For the analysis of these variables, we consider those patients who will be 6 months or more in a treatment place (hospital or home). **For Nutritional Status, a patient with a highly deteriorated nutritional status was excluded.

France, the state provides the necessary funds to a limited number of specialized centers. However, in other countries such as the United States, there is no centralization and each institution has the freedom to create Home Nutrition programs if it considers it relevant to the population it serves. In Latin America, Argentina centralizes this treatment in a single hospital[12-18].

In Chile, there are no defined agencies in charge of providing this type of care. The HPN is also not included in the health benefits guaranteed by the state or private institutions. For this reason, the possibility of going home for treatment is rather unequal and depends on the efforts of family members, health teams and hospitals.

This study identified 46 patients, from 13 public hospitals and one private institution, who were receiving prolonged HPN, or who were hospitalized and could be candidates for this type of treatment. As in

other reports, the decrease of the intestinal surface is, in more than two-thirds of patients, the main motivation to initiate parenteral support. Gastroschisis, intestinal atresia, and volvulus are the most frequent underlying pathologies. This could be related to the increase in gastroschisis diagnoses in our country in recent years[19]. The age group that concentrated the higher number of patients was preschoolers. This result is different from that described in other international cohorts, for example, the French one, where patients are concentrated in the group of children under one year of age[20,21]. It is important to mention that this difference in the distribution of age groups could be due to that in developed countries intestinal transplantation is a treatment option for intestinal failure[22,23].

Regarding patients of preschool or school age, about half of them were not involved in any type of school activity. Out of the total number of patients not attending school, over 50% were currently hospitalized. This could be detrimental to their stimulation, cognitive development and capacity for social development.

All patients had a stable clinical situation at the time of the study, most of them had adequate nutritional status. It stands out the height commitment identified in 53.3% of patients, regardless of the place of treatment. This could be due to inadequate nutrient supply in the early stages of the disease or at times of accelerated growth, or it could be the result of transient suspensions of nutritional support due to venous access loss for variable periods during the course of the disease[24].

More than half of the patients were receiving PN at the hospital. The average hospital stay is close to two years (792 ±579.7 days) in those children who were hospitalized and two and a half years (927 +815.8 days) of hospital waiting for those patients who were already at home.

In Chile, according to data issued by FONASA in 2017, the daily cost of hospitalization in a Pediatric Service in a High-Complexity Public Hospital reaches $36,360 CLP (Chilean pesos) ($55.67 USD approx.), this without considering parenteral support (which has a variable cost in each patient) or the eventual hospitalization in a bed of a Pediatric Intensive Care Unit (PICU) in case of complications. Considering only the bed-day, the average cost of hospitalized patients could reach amounts close to $28,797,120 CLP and even exceed $100,000,000 CLP if the maximum stay of one of the registered patients is considered. The various reports are clear in pointing out that regardless of the country's health modality, it is possible to achieve savings that exceed 60% of health resources by training the family and transferring the child to his or her home. This without estimating the indirect cost of having a child hospitalized, such as transportation, medical leave, loss of workforce, etc.[5-9], especially considering that of the total number of hospitalized patients, 23.9% required transfer from their hometown to the treatment center.

On the other hand, probably one of the greatest fears of treating teams, and possible limiting factors when considering the option of treatment at home, are the nutritional status deterioration and recurrent catheter infections, which could eventually mean the venous accesses loss. For this reason, we assessed whether there were differences between these variables (Nutritional Status/Catheter Infections in the past year) and the place of treatment of the patients. In terms of nutritional status, most patients, regardless of where they are treated, have adequate nutritional status. It should be noted that a large number of patients diagnosed with malnutrition by excess are hospitalized. This could be explained by two reasons: the belief in the treating teams that it is better to keep these patients in a nutritional state over the normal range in case they lose any venous access; or by the lack of physical activity associated with prolonged hospitalizations. However, these patients should not be considered exempt from the risk of childhood obesity, as in other overweight or obese hospitalized children[25].

Regarding the presence of catheter infections in the past year, the results are identical in both groups; this suggests that in this group of patients, the infection risk is similar in the hospital and at home. It would have been valuable to evaluate whether or not this infection meant the venous access loss since on several occasions, and depending on the experience of the health teams, it is possible to control the infection without the need to remove the catheter[26].

From a clinical point of view, no significant evidence was found to support the administration of this treatment in the hospital over the home.

The number of registered patients may seem small, however, this clinical event should be considered a rare situation. Nevertheless, this study includes a significant number of patients compared to the results of other publications[12-18].

Conclusion

After an exhaustive data collection and analysis, which included the participation of 12 health institutions in our country, it was possible to identify 46 pediatric patients with IF who receive prolonged PN. Most of them are receiving PN at the hospital.

The results of this study do not show significant differences in the variables catheter infection in the past year and nutritional status depending on the place of

treatment. Therefore, these variables should not be limiting when considering this treatment option.

Evaluating the possibility of administrating the HPN is part of the Rights of the Hospitalized Child[27] and is a successful practice that has been carried out since the seventies in Europe and the United States and since 1985 in Argentina. The HPN has demonstrated, with broad scientific solvency, to be the best option for improving the quality of life of these patients and their families, in addition to contributing to a reduction in the cost associated with treatment.

In view of the above, the administration of home parenteral support appears to be clinically feasible. However, it is necessary to develop a single national register of patients with intestinal insufficiency, which will allow us to know the incidence of these cases and have updated access to their clinical situation. It is also necessary to evaluate the implementation of a national program to ensure material, human and health training resources in order to provide safe and universal parenteral nutritional support at home.

Ethical Responsibilities

Human Beings and animals protection: Disclosure the authors state that the procedures were followed according 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 state that the information has been obtained anonymously from previous data, therefore, Research Ethics Committee, in its discretion, has exempted from obtaining an informed consent, which is recorded in the respective form

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Authors state that no economic support has been associated with the present study.

Conflicts of Interest

Authors declare no conflict of interest regarding the present study.

Contributors

Chilean Group for the study of Prolonged Parenteral Nutrition in Pediatrics: Gigliola Alberti Reus, Rosa María Antilef, Paulina Balboa, Carolina Cors, Graciela De la Fuente, Jessica Delgado, Ana Fritis, Mercedes Guevara, Catalina Le Roy, Aída Maggi, Francisco Moraga, Beatriz Morales, Alexa Puchi, María Jesús Rebollo, K. Walewska Schilling, Marcia Teitelboim, Mario Vildoso, Rossana Villalobos, J. Carlos Villalobos, Carolina Wong.

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References

1. O'Keefe SJD, Buchman AL, Fishbein TM, Jeejeebhoy KN, Jeppesen PB, Shaffer J. Short bowel syndrome and intestinal failure: Consensus definitions and overview. Clin Gastroenterol Hepatol 2006;4 (1):6-10.
2. Alberti G, Le Roy C, Cofré C, Pattillo JC, Domínguez B, Guerra C, et al. Actualización en el manejo de pacientes con insuficiencia intestinal. Rev Chil Pediatr 2014;85 (2):148-146.
3. ESPGHAN. Home Parenteral Nutrition. J Pediatr Gastroenterol Nutr 2005; 41:70-5.
4. Culine S, Chambrier C, Tadmouri A, et al. Home parenteral nutrition improves quality of life and nutritional status in patients with cancer: A French observational multicentre study. Support Care Cancer 2014; 22(7):1867-74.
5. Gottrand F, Staszewski P, Colomb V, Loras-Duclaux I, Guimber D, Marinier E, et al. Satisfaction in different life domains in children receiving home parenteral nutrition and their families. J Pediatr 2005;146(6):793-7.
6. Melville CAS, Bisset WM, Long S, Milla PJ. Counting the cost: Hospital versus home central venous catheter survival. J Hosp Infect 1997; 35(3):197-205.
7. Colomb V, Fabeiro M, Dabbas M, Goulet O, Merckx J. Central venous catheter-related infections in children on long-term home parenteral nutrition: incidence and risk factors. Clin Nutr 2000; 19(5):355-9.
8. Marshall J, MD MSc; Gadowsky S, MsAC and DA. Economic Analysis of Home vs Hospital-Based Parenteral Nutrition in Ontario, Canada. J Parenter Enter Nutr 2005;29(4):266-9.
9. Winkler M, Smith C. Clinical, Social, and Economic Impacts of Home Parenteral Nutrition Dependence in Short Bowel Syndrome. J Parenter Enter Nutr 2014;38(1):32S-37S.
10. Engle WA. Age terminology during the perinatal period. Pediatrics 2004;114(5): 1362-4.
11. Ministerio de Salud de Chile; Norma Técnica para la supervisión de niños y niñas de 0 a 9 años en la Atención Primaria de Salud, Programa Nacional de Salud de la Infancia. En: Strain H, Moncada JL, Editores. Santiago, Chile; 2014. p. 215-29.
12. Russo T, Arendt B, Teterina A, et al. Changes in Home Parenteral Nutrition Practice Based on the Canadian Home Parenteral Nutrition Patient Registry. J Parenter Enter Nutr 2017;41(5):830-6.
13. Wanden-Berghe C, Villarés J, Moreno Compés M, et al. Nutrición Parenteral Domiciliaria en España 2011 y 2012; informe del grupo de nutrición artificial domiciliaria y ambulatoria NADYA. Nutr Hosp 2014;29(6):1360-5.
14. Fabeiro M, Dalieri M, Martínez M, et al. Nutrición parenteral domiciliaria (NPD): Factibilidad de implementación desde un hospital público. Nutr Hosp 2011;26(6):1435-9.
15. Moreno JM, Shaffer J, Staun M, et al. Survey on legislation and funding of Home Artificial Nutrition in different european countries. Clin Nutr 2001; 20(2):117-23.
16. Mundi MS, Pattinson A, McMahon MT, Davidson J, Hurt RT. Prevalence of Home Parenteral and Enteral Nutrition in the United States. Nutr Clin Pract 2017; 23(6):799-805.
17. Fernandes G, Kaila B, Jeejeebhoy KN; Canadian Home Parenteral Nutrition (HPN) Registry: Validarion and Patient outcomes. J Parenter Enter Nutr 2012;36(4): 407-14.
18. Wanden-Berghe C, Campos C, Cuerda C, Gómez C, et al. Nutrición Parenteral Domiciliaria en España durante 2015; informe del grupo de nutrición artificial domiciliaria y ambulatoria NADYA. Nutr Hosp 2016;33(6):1487-90.
19. Nazer J, Karachon L, Cifuentes L, Assar R; Gastroschisis: A pandemic with increasing rates? ECLAMC experiencia in Chile 1982-2015. Rev Chil Pediatr 2016; 87(5):380-6.
20. Colomb V, Dabbas M, Goulet O, et al; Long- term outcome of children receiving home parenteral nutrition: a 20 year single center experience in 302 patients. J Pediatr Gastroenterol Nutr 2007; 44(3):347-53.
21. Gandullia P, Lugani F, Costabello L, et al; Long- term home parenteral nutrition in children with chronic intestinal failure: A 15 year experience at a singleItalian centre. Dig Liver Dis 2011; 43(1):28-33.
22. Lacaille F, Irtan S, Dupic L, et al. Twenty-eight years of intestinal transplantation in Paris: experience of the oldest European center. Transpl Int 2017; 30(2):178-86.
23. Martínez A, Wales PW. Intestinal transplantation in children: current status. Pediatr Surg Int 2016; 32(6):529-40.
24. Colomb V, Dabbas M, Goulet O, Talbotec C, Corriol O, Ricour C. Prepuberal growth in children with long-term parenteral nutrition. Horm Res 2002; 58 (1):2-6.
25. Bechard L, Rothpletz P, Touger R, Duggan C, Mehta N. N Influence of Obesity on Clinical Outcomes in Hospitalized Children. JAMA Pediatr 2013;176(5):476-82.
26. Oliveira C, Nasr A, Brindle M, Wales PW. Ethanol locks to prevent catheter-related bloodstream infections in parenteral nutrition: a meta-analysis. Pediatrics 2012;129(2): 318-29.
27. Ministerio de Salud de Chile; Programa Nacional de Salud de la Infancia con Enfoque Integral. En: Leyton B, Becerra C, Castillo C, Strain H, Santander S, Editores. Santiago, Chile: Editorial Valente; 2013. p. 84-6.