[b] *Ciber de Epidemiología y Salud Pública (CIBERESP) y Observatorio de Salud y Medio Ambiente de Andalucía (OSMAN), Escuela Andaluza de Salud Pública, Granada, Spain*
[c] *Unidad de Cuidados Intensivos, Hospital UniversitarioVirgen del Rocío, Servicio Andaluz de Salud, Sevilla, Spain*

* Corresponding author.
E-mail address: sebastornero@yahoo.es
(S. Tornero Patricio).

https://doi.org/10.1016/j.anpede.2019.04.017
2341-2879/

Analysis of red blood cells in children diagnosed with obstructive sleep apnoea syndrome☆

Análisis de la serie roja en niños con síndrome de apnea-hipopnea del sueño

To the editor

Sleep apnoea-hypopnoea syndrome (SAHS) is a disease that affects 2%–4% of the paediatric population.[1,2] It consists in the recurrent collapse of the airway during sleep with cessation or reduction of airflow resulting in cycles of hypoxia followed by reoxygenation that in the long term can trigger an inflammatory cascade with systemic effects.[2,3]

One of the differences between SAHS in children and in adults is the type of repercussions it has on health. Thus, in the paediatric population the most frequent repercussions are growth delay and neurocognitive complications, while daytime somnolence and cardiovascular complications are more frequent in adults.

One of the haematologic changes described in adults with SAHS is an increased haemoglobin concentration,[4,5] in some cases in the range of polycythaemia,[5] and such changes are believed to be secondary to an increased secretion of erythropoietin resulting from the recurrent hypoxia during sleep. Recently, some authors have started to analyse other factors,[5] as not every patient with severe SAHS exhibits these changes.

In addition, there is evidence of a directly proportional correlation between the severity of SAHS and the increase in the red blood cell distribution width (RDW).[3] The RDW is currently being investigated as a proinflammatory marker (not only in the context of cardiovascular disease), and probably increases as a result of oxidative stress and chronic inflammation, which cause the release of cytokines that could act on the bone marrow and affect erythropoiesis.[3] It has also been hypothesised that this association may be influenced by increased neurohormonal activity.[3]

Other factors that have been studied in the paediatric population include signs of metabolic disturbances, such as elevation of glycated haemoglobin in patients with SAHS, which is considered a marker of severity (independently of age and weight),[6] but the data on RBC laboratory test values are still insufficient. For this reason, we designed a study to assess whether the haematologic changes typically found in adult patients with severe SAHS are also found in children, with the purpose of identifying new screening tools that could help expedite the performance of sleep studies.

We conducted a retrospective study by reviewing clinical health records and preoperatory laboratory test results in patients operated for severe SAHS in our hospital between 2012 and 2016 and in controls of similar age that underwent surgery for other reasons.

We defined severe SAHS as an apnoea-hypopnoea index (AHI) greater than 10 in the sleep study. The variables we analysed were age, AHI or obstructive AHI, oxygen desaturation index (ODI), oxygen saturation nadir, sleep time spent with an oxygen saturation of less than 90% (T90), arousals, total sleep duration, sleep efficiency, percentage of deep sleep and REM sleep and red blood cell (RBC) test values (haemoglobin, haematocrit, mean corpuscular volume and RDW).

We selected a sample of 87 children with severe SAHS (mean age, $4.30 \pm 2{,}27$), diagnosed by means of polysomnography in 78 and by means of respiratory polygraphy in 9, and a control group of 88 children (mean age, 6.01 ± 3.68). The mean AHI in the SAHS group was 21.34 ± 12.80. Table 1 summarises the rest of the polygraphy/polysomnography values.

When we compared mean haemoglobin values, we found no significant difference between the SAHS group (12.92 ± 0.92) and the control group (13.09 ± 0.99), nor did we find any differences between groups in any other haematologic variable (Table 2).

Given the significant age difference between groups and the variation in haematologic observed through the different stages of childhood, we decided to carry out an additional analysis by age group (Table 2), which also did not find significant differences in haemoglobin or haematocrit values. In our study, in children aged less than 6 years we found a higher RBC count in the SAHS group compared to the control group, but paradoxically in older children this trend not only did not persist but reversed, with higher RBC counts in the control group, so we were unable to draw conclusions on this aspect. When it came to the RDW, we found that in children aged more than 6 years, RDW values were slightly higher in the control group compared to the SAHS group.

Therefore, in contrast to the adult population, we did not find significant differences in RBC test values in children that underwent surgery for treatment of SAHS compared to children of similar age operated for other reasons.

☆ Please cite this article as: Rodríguez-Catalán J, López Carnero J, Pérez Tejerizo G, Rodríguez Rodríguez P, Del-Río Camacho G. Análisis de la serie roja en niños con síndrome de apnea-hipopnea del sueño. An Pediatr (Barc). 2020;92:234–236.

Table 1 Descriptive analysis of the group of patients with severe SAHS (measures of central tendency and dispersion).

	N	Mean	SD	Median	Q1	Q3
AHI	87	21.34	12.80	17.70	12.90	23.90
Nadir	85	79.08	10.64	83.00	74.00	87.00
ODI	87	25.45	16.09	21.70	14.65	30.75
T90	87	4.09	7.46	0.90	0.10	4.60
Arousals/h	73	13.72	9.10	11.00	7.45	18.90
TST, %	77	7.42	2.67	7.27	6.79	7.68
N3, %	70	34.81	8.59	35.10	29.30	40.62
REMS, %	70	14.27	5.19	14.75	11.00	17.85
Efficiency, %	74	86.93	7.90	88.70	83.65	92.05

AHI, apnoea-hypopnoea index; N3, slow wave sleep; ODI, oxygen desaturation index; REMS, rapid eye movement sleep; SAHS: sleep apnoea-hypopnoea syndrome; SD, standard deviation; T90, time spent with oxygen saturation <90%; TST, total sleep time.

Table 2 Comparison of patients with severe SAHS and controls, overall and stratified by age group.

Group	Variable	SAHS	No SAHS	*P*
Total ($N = 175$)	Age	4.30 ± 2.27	6.01 ± 3.68	< .05
	RBC	4.82 ± 0.35	4.80 ± 0.41	.62
	Hb	12.92 ± 0.914	13.09 ± 0.99	.24
	Hct	38.46 ± 2.60	39.24 ± 3.09	.08
	MCV	79.40 ± 6.83	81.52 ± 5.10	.02
	MCH	26.87 ± 1.59	27.32 ± 2.10	.11
	RDW	13.69 ± 1.14	13.75 ± 2.44	.83
< 6 years ($n = 117$)	RBC	4.85 ± 0.37	4.67 ± 4.38	.02
	Hb	12.81 ± 0.94	12.74 ± 0.94	.68
	Hct	38.26 ± 2.67	38.08 ± 2.93	.74
	MCV	79.18 ± 3.87	80.87 ± 4.96	.04
	MCH	26.50 ± 1.51	27.05 ± 1.92	.09
	RDW	13.92 ± 1.12	14.10 ± 3.15	.70
$\geq$ 6 years ($n = 58$)	RBC	4.74 ± 0.27	4.94 ± 0.31	.02
	Hb	13.34 ± 0.66	13.52 ± 0.87	.46
	Hct	39.27 ± 2.18	40.63 ± 2.71	.07
	MCV	80.26 ± 13.22	82.3 ± 5.22	.53
	MCH	28.27 ± 1.03	27.65 ± 2.27	.16
	RDW	12.79 ± 0.68	13.32 ± 0.97	.04

Total sample with 175 patients: 87 with severe SAHS (69 aged < 6 years, 18 aged $\geq$ 6 years) and 88 controls (48 aged < 6 years, 40 aged $\geq$ 6 years).
Hb, haemoglobin concentration (g/dL); Hct, haematocrit; MCH, mean corpuscular haemoglobin (pg); MCV, mean corpuscular volume (fL); RBC, red blood cell count ($\times 10^6/\mu L$); RDW, red blood cell distribution width; SAHS: sleep apnoea-hypopnoea syndrome.

This is probably due to a lower degree of hypoxia (frequent cases with a T90 of 0% despite significant SAHS) and a shorter duration of the disease. Thus, based on our findings, this is not a useful tool for screening purposes. However, we believe that further research on the subject is required, conducting studies on larger samples, with better matching for age and analysing other comorbidities and clinical parameters (not only haematologic, but also anthropometric and metabolic) that could also have an impact on RBC test values.

References

1. Serebrovskaya TV, Xi L. Intermittent hypoxia in childhood: the harmful consequences versus potential benefits of therapeutic uses. Front Pediatr. 2015;3:44.
2. Alonso-Álvarez ML, Canet T, Cubell-Alarco M, Estivill E, Fernández-Julián E, Gozal D, et al. Documento de consenso del síndrome de apneas-hipopneas durante el sueño en niños. Arch Bronconeumol. 2011;47 Supl 5:2–18.
3. Yousef AM, Alkhiary W. The severity of Obstructive Sleep Apnea Syndrome is related to red cell distribution width and hematocrit values. J Sleep Disord Ther. 2015;4:2.
4. Choi JB, Loredo JS, Norman D, Mills PJ, Ancoli-Israel S, Ziegler MG, et al. Does obstructive sleep apnea increase hematocrit? Sleep Breath. 2006;10:155–60.
5. Pathak R, Giri S, Karmacharya P, Aryal MR. Obstructive sleep apnea syndrome and secondary polycythemia: analysis of the nationwide inpatient sample. Sleep Med. 2015;16:205–6.
6. Peña-Zarza JA, de la Peña M, Yañez A, Bauça JM, Morell-García D, Caimari M, et al. Glycated hemoglobin and sleep apnea síndrome in children: beyond the apnea-hypopnea index. Sleep Breath. 2018;22:205–10.

Jesús Rodríguez-Catalán[a,*], Juan López Carnero[a], Gloria Pérez Tejerizo[b], Paula Rodríguez Rodríguez[c,d], Genoveva del-Río Camacho[a,d]

[a] *Servicio de Pediatría, Hospital Universitario Fundación Jiménez Díaz, Madrid, Spain*
[b] *Servicio de Cirugía Pediátrica, Hospital Universitario Fundación Jiménez Díaz, Madrid, Spain*
[c] *Servicio de Neumología, Hospital Universitario Fundación Jiménez Díaz, Madrid, Spain*
[d] *Unidad Multidisciplinar del Sueño, Hospital Universitario Fundación Jiménez Díaz, Madrid, Spain*

* Corresponding author.
E-mail address: jesus.rodriguez@fjd.es
(J. Rodríguez-Catalán).

6 November 2018 25 February 2019

https://doi.org/10.1016/j.anpede.2019.02.007
2341-2879/

Initial experience with the use of a portable 3-dimensional scanner☆

Experiencia inicial con el uso de unescáner tridimensional portátil

Dear Editor:

The recent development of three-dimensional (3D) imaging techniques has led to new applications in the field of medicine. Scanners and image-processing software have both become more accessible and simpler, allowing their use outside the fields of engineering and industry.[1]

Surface imaging contributes very useful information for a variety of complaints in the paediatric age group and has the advantage of image acquisition taking only a few seconds, which is of vital importance in very young patients.[2]

The purpose of this letter is to present our initial experience with a handheld 3D scanner for assessment of chest wall deformities.

In our hospital, we have started to use the PocketScan™ scanner (Mantis Vision Inc.). It is an infrared light system that automatically triangulates the position of different points on a surface, generating a 3D shape. The device measures 12 × 6 cm and weighs 250 g, and it can be connected to a computer with a standard USB cable. Its image-processing software can refine the resulting images and take any measures the user requires. Its price is of approximately 3500 €, and the funding for its purchase came from a research grant.

In the framework of a project whose objective is to validate these instruments and extend their use to other specialities, we started to perform body surface scans in patients with pectus carinatum and pectus excavatum managed in the Paediatric Surgery Clinic after obtaining the informed consent of their parents. We also assess these patients by magnetic resonance imaging (MRI) restricted to the region of interest with the intention of validating the 3D imaging method using the MRI scans as reference once we have carried out a sufficient number of evaluations.

We have performed an initial analysis of our experience with the first 10 patients, which we summarise below.

The sample consisted of 10 children and adolescents aged 7 to 17 years, 7 male and 3 female. Seven patients had pectus excavatum and 3 had pectus carinatum. The malformation was mild in 6 patients, moderate in 2 and severe in 2. Four of the patients were undergoing conservative management of their malformation at the time of the analysis. In case of children with pectus carinatum, conservative management involved the use of a chest brace following the Calgary protocol, and in case of pectus excavatum, the use of the vacuum bell method as described by a research group based in Basel.[3,4]

The rest of the patients, either due to their age or due to the low severity of the deformity, were managed with postural interventions and specific exercises per the protocol of our hospital.

All the scans involved acquisition of images over 3 to 4 s, thus capturing data during inspiration as well as expiration for future investigation. There were no problems during the scan in any case; the obtained images were good and all children, as well as their parents, expressed satisfaction with the test and considering that it had no disadvantages.

We exported the obtained 3D images for subsequent processing and to make specific measurements to determine the severity of chest wall deformity and to identify potential 3D measurements that could be useful for the diagnosis or definition of this type of problem (Fig. 1).

We consider our early experience with the 3D scanning system satisfactory, although we ought to admit that the image-processing software has not been developed with medicine in mind and thus health care professionals may need specific training to familiarise themselves with this system. The images obtained were highly accurate. The process for 3D image acquisition is fast and does not involve exposure to radiation, both of which we consider essential in paediatrics. Furthermore, compared to the subjective measures commonly used in clinical practice to assess these malformations, 3D scanning provides objective and accurate measurements. We also consider this essential in the follow-up of patients that are growing or undergoing conservative treatment to be able to detect changes over time or assess the response to different interventions. The cost of these devices is decreasing as this technology develops, making them more accessible to the public health care sector.

In conclusion, 3D scanning is a quick, radiation-free and accurate method, so it could have a broad range of applications in the field of paediatrics as a new tool in diagnostic imaging.

☆ Please cite this article as: Fuentes S, Damián F, Berlioz M, Pradillos JM, Lorenzo T, Experiencia inicial con el uso de un escáner tridimensional portátil. An Pediatr (Barc). 2020;92:236–237.