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Which centers should be authorized to treat craniosynostosis? A plea for quality and not for quantity

Short title: Which centers should be authorized to treat craniosynostosis?

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ABSTRACT

Background: In centers for craniosynostosis surgery, the volume of activity does not necessarily reflect the quality of the treatment.

Objective: Our aim was to analyze a retrospective series of patients over a period of 6 years in a low-volume craniosynostosis surgery center, and to study indicators that reflect the quality of treatment.

Patients and methods: The analysis included all patients who underwent a craniofacial surgery for all forms of craniosynostosis during the period 2012–2017 (annual follow-up for 4 years). Data on the type of synostosis, sex, age, weight, type of surgery, duration of surgery, blood transfusion, postinterventional care, and total length of hospital stay were collected. Medical and surgical complications were recorded using the Leeds classification.

Results: Overall, 42 patients (33 male; 23 cases of scaphocephaly, 13 cases of trigonocephaly, 4 cases of coronal plagiocephaly, 1 case of lambdoid plagiocephaly, and 1 case of brachycephaly) underwent craniofacial surgery with a median age of 7.4 months [4.8; 10.4] and a mean weight of 8.40 ± 1.92 kg at surgery. The median hospital stay was 7 days [6; 7] with 1 day in the postinterventional care unit for 83% of patients. The global complication rate was 12% (95% CI: 4%–26%) with three minor cutaneous and two major (cardiovascular and septic) complications.

Conclusion: Complication rates reflect the quality of care in a center that treats craniosynostosis much more than do the number of procedures, mean hospital stay, and blood transfusion rates. It is essential to define new indicators capable of measuring the quality of life linked to surgical procedures and of using them to assess the competence of a center.

Keywords: craniosynostosis, complications, economics, pediatrics, quality of life.

1. Introduction

The qualification of “rare” can be ascribed to a disease if its incidence is 1/2000 persons. Overall, 3 million French citizens and approximately 25 million European citizens present one of the 7000 rare diseases known to date. Craniosynostoses are defined by the fusion of one or multiple cranial sutures of the calvaria and of the cranial base. They are the second most frequent etiology of craniofacial malformations. Their incidence is 1/2000 births, and hence they are classified as rare diseases [1,2]. Thanks to the actions of patient associations, rare diseases were recognized as a public health issue and gained the support of governmental bodies. Three French government plans were initiated during the periods 2005–2008, 2011–2016, and 2018–2022. The latter plan had the objective of innovating the means of diagnosis

and treatment of rare diseases. Naturally, the question of describing the criteria that define a reference center specialized in the care of a specific rare disease was raised. In fact, any center that did not comply with these criteria could lose the authorization to treat patients with rare diseases. Some centers tried to justify their legitimacy as reference centers through medico-economic indicators such as volume of activity [3]. It is important to keep in mind that the volume of activity (or the number of treated patients) does not necessarily reflect the quality of the treatment. The aim of this study was (a) to present and analyze our retrospective series of patients over a period of 6 years in a low-volume craniosynostosis surgery center and (b) to study indicators that reflect the quality of treatment.

2. PATIENTS AND METHODS

2.1 Patients

We included in this study all patients who underwent a craniofacial surgery for all forms of craniosynostosis in the 6-year period from 2012 to 2017 at the pediatric department of the public university hospital of Clermont-Ferrand.

2.2 Method

2.2.1 Data

Data collected for each patient included type of synostosis, sex, age, weight, type of surgery, duration of surgery, blood transfusion, postinterventional care, and total length of hospital stay (**Table 1**). We recorded all medical and surgical complications (**Table 2**) using the Leeds classification (**Table 3**) [4]. Since November 2012, we introduced a treatment protocol with the objective of reducing the blood transfusion rate. Our protocol comprised preoperative administration of erythropoietin (EPO) and iron as well as perioperative intravenous injection of tranexamic acid: oral iron supplementation – 5–10 mg/kg/day starting 1 month before

surgery; recombinant human erythropoietin injection – 500–600UI/kg, 1 injection every week for 3 weeks before surgery. All the children were followed up annually for a minimum of 4 years to detect late complications.

2.2.2 Statistical analysis

Statistical analysis was performed using Stata software (version 15; StataCorp, College Station, TX, USA). All tests were two-sided, with a Type I error set at 0.05. Categorical variables are expressed as number of patients and associated percentages, and quantitative variables are expressed as mean \pm standard deviation or median [1st quartile; 3rd quartile], according to the statistical distribution. Baseline hematocrit levels were compared between independent groups (patients who received EPO and iron vs. patients who did not) with the Mann–Whitney test. Among the patients who received EPO and iron supplementation, the evolution of the hematocrit level between before and after supplementation was assessed with the Wilcoxon signed-rank test. The global complication rate is expressed with a 95% confidence interval (CI).

2.2.3 Ethics

This retrospective study was approved by our institutional review board (*Comité de protection des personnes*, VI CHU Clermont-Ferrand); it did not raise any ethical issues and fell outside the scope of the rules governing biomedical research (articles L.1121-1-1 and R1121-3 of the Code of Public Health).

3. RESULTS

3.1 Patient characteristics

Overall, 42 patients underwent craniofacial surgery at our center from February 2012 to September 2017 (see **Table 1**). Of these, 33 patients (79%) were male. The median age at surgery was 7.4 [4.8; 10.4] months and the mean weight was 8.40 ± 1.92 kg. In total, 23 (55%) patients presented with scaphocephaly and underwent surgery at a median age of 4.8 [3.8; 7.5] months with a mean weight of 7.50 ± 1.30 kg. A further 13 (31%) patients presented with trigonocephaly and underwent surgery at a median age of 8.7 [7.0; 9.9] months and a mean weight of 9.06 ± 1.60 kg. Four (10%) patients presented with coronal plagiocephaly (2 left-sided, 2 right-sided) and underwent surgery at a median age of 16.1 [13.7; 20.9] months and a mean weight of 9.45 ± 1.72 kg. One patient (13.4 months old; weight 9.7 kg) underwent surgery for lambdoid plagiocephaly and one patient (5.9 years old; weight 15 kg) underwent surgery for brachycephaly. Three patients presented with three different comorbidities: Saethre–Chotzen syndrome (that was associated with coronal plagiocephaly, bilateral complete cleft lip and palate, and 2–3 left toe syndactyly) in one patient; interatrial communication in one patient; and cerebral palsy due to neonatal distress in one patient.

3.2 Surgical data

Scaphocephaly was surgically treated by strip craniectomy before November 2012 and by cranial vault reconstruction thereafter (see **Table 1**). The median operative time in the overall study population was 158 min [130; 190]. Median surgical times for scaphocephaly, trigonocephaly, and coronal plagiocephaly were 130 min [90; 180], 180 min [165; 210] and, 263 min [203; 270], respectively. The duration of surgery was 220 min for lambdoid plagiocephaly and 160 min for microcephaly. The median operative time for scaphocephaly using the strip craniectomy technique was 135 min [130; 150] in 2012 ($n=5$). After using the cranial vault reconstruction technique for scaphocephaly, the median operative time was 200 min [190; 210] in 2013 ($n=2$), 135 min [110; 180] in 2014 ($n=6$), 90 min [90; 90] in 2015 ($n=5$), 150 min [130; 180] in 2016 ($n=3$), and 60 min [60; 60] in 2017 ($n=2$).

3.3 Blood transfusion and EPO protocol

A total of 32 patients (76%) received blood transfusion with a median volume of transfusion of 13.69 mL/kg [10.30; 19.83] (see **Table 1**). All the patients operated on after November 2012 (36/42) received EPO and iron supplementation. Before the beginning of the protocol, there were no differences in hematocrit levels between patients receiving EPO or not (36.11 ± 3.47 vs. 35.90 ± 2.25 respectively; $p=0.88$). Patients who received iron and EPO showed an increase in hematocrit level preoperatively in comparison with their baseline level (40.61 ± 3.55 vs. 35.86 ± 3.52 ; $p<0.001$). From the subgroup that received EPO ($n=36$), 14 patients with scaphocephaly (67%) received blood transfusion with a median volume of 13.33 mL/kg [10.29; 15.42]. Nine patients (90%) presenting with trigonocephaly received blood transfusion with a median volume of 19.46 mL/kg [10.99; 20.32]. All patients with plagiocephaly received blood transfusion, with a median volume of 15.91 mL/kg [11.91; 29.90] for coronal plagiocephaly and 10.31 mL/kg for lambdoid plagiocephaly. Regarding weight in the same EPO subgroup, 76% of low-weight (≤ 8 kg) patients (13/17) received blood transfusion and 79% of patients with elevated weight (> 8 kg) (15/19) received blood transfusion.

3.4 Hospital stay and complications

The median hospital stay was 7 days [6; 7] with 1 day in the postinterventional care unit for 83% of patients (see **Table 2**). The global complication rate was 12% (95% CI: 4%–26%). There were two serious complications. The first case was perioperative: a cardiorespiratory arrest at the end of lambdoid plagiocephaly surgery, which had a favorable postoperative outcome. The other serious complication was postoperative: a patient with trigonocephaly suffered from a venous access infection that worsened to sepsis and was retransferred to the postinterventional care unit for 3 more days. The sepsis resolved without further complications.

There were several minor complications. Two patients with scaphocephaly needed a second operation for cutaneous complications: one patient presented with skin necrosis that required debridement 20 days after surgery and rehospitalization of 26 days. In the other patient, a botryomycoma developed on the scar that was operated on twice at 4 and 5 months after the index surgery. Finally, we report a minor complication of a hematoma that was drained percutaneously. These minor complications did not increase the length of hospital stay.

4. DISCUSSION

This body of work reports the experience of our low-volume center. We performed 42 interventions in 5 years, the majority of which were cases of scaphocephaly (55%) and trigonocephaly (31%). Our global complication rate according to the Leeds classification was 12%.

4.1 Epidemiology and operative time

The epidemiologic data in our series are similar to those in the published medical literature: The most frequent type of craniostenosis was sagittal suture, followed by metopic suture and coronal suture. Moreover, the predominant male sex ratio reported in our series is also similar to published series [5–7]. Additionally, the upward trend in the frequency of metopic synostoses described by Di Rocco et al. [7] was also found in our series (55% scaphocephaly, 31% trigonocephaly, and 17% plagiocephaly). We compared the operative times of scaphocephaly procedures. The median operative time using the strip craniotomy technique was 135 min in 2012. The change of the operator and technique (cranial vault reconstruction technique) in 2013 resulted in an increase in the median operative time to 200 min. However, the operative time decreased to 60 min in 2017 thanks to the experience gained by the operator.

4.2 Type of center, complications, blood transfusions, and hospital stay

Chattha et al. [3] classified therapeutic centers as low-volume centers, intermediate-volume centers, and high-volume centers if they performed 1–13, 14–34, or ≥ 35 interventions per year, respectively. Consequently, our center with 42 procedures in 5 years is considered a low-volume center according to Chattha's classification. The rate of major complications in our series (4.8%) is similar to the rates reported for centers with the same volume in Chattha's series [3]. One must bear in mind that these rates vary according to the adopted definition of "major complication." In Chattha's series, only deep vein thrombosis, pulmonary embolus, hematoma, wound dehiscence, hemorrhage, seroma, infection, bleeding, urinary tract infection, acute kidney injury, bleeding, acute coronary event, and cerebrovascular accident were taken into account. We reported the complications in our series according to the Leeds classification [4] (**Table 3**) since we believe it is more comprehensive. This classification has several advantages when compared with others that arbitrarily define complications and esthetic results [8–15]. It takes into account the perioperative complications, short-term complications, and long-term complications and classifies them into two categories: those requiring hospital readmission or not. Shastin et al. published a report in 2017 of their series of an intermediate-volume center (103 patients and 108 procedures in 5 years) [4]. The global complication rate reported in this series was 35.92% (37/103 patients), and thus greater than our global complication rate (12%). We compared the types of complications in our series with published series. We reported one perioperative complication and two (4.8%) short-term complications (one requiring longer hospital stay) versus 0 perioperative and 24 (47%) short-term complications in the Shastin series [4]. Moreover, we reported one (2%) long-term complication that required readmission and surgery at 4 months postoperatively versus six cases (11%) in the Shastin series [4]. Chattha et al. [3] reported a mean hospital stay of 3.31, 3.07, and 2.96 days in low-volume, intermediate-volume, and high-volume centers, respectively. In comparison,

mean hospital stay in the Shastin series [4] was 4.1 days and thus longer than the reported values by Chattha [3]. Chattha and colleagues considered that mean hospital stay reflects the economic efficiency of the center. The mean hospital stay in our series may appear excessive (1 day in postinterventional care unit and 6 days in conventional hospitalization unit) but it is a deliberate institutional choice that undeniably reduces short-term and long-term complication rates as per the Leeds classification. In fact, short-term (category 2A + 3A + 3C) and long-term (category 2B + 3B + 3D) complication rates were 9.7 times (0% vs. 9.71%) and 6 times (2.4% vs. 14.56%) lower, respectively, than in the Shastin series [4]. It is impossible to compare complication rates in our series with Chattha's series since they counted only serious complications [3]. In our opinion, considering only mean hospital stay and treatment costs as efficacy indicators of a center while neglecting minor complications and readmission rates seems inadequate.

Moreover, considering blood transfusion quantity as an efficacy indicator of a center as suggested by Chattha et al. [3] does not seem to be pertinent in our opinion. Shastin reported [4] a global blood transfusion rate of 75.9%, of which 56.6% occurred perioperatively at a mean volume of 11.2 mL/kg. This is similar to our results: 76% global blood transfusion rate at a mean volume of 13.69 mL/kg. The blood transfusion rate in our series was higher for patients with trigonocephaly than for those with scaphocephaly (18 vs. 16.8 mL/kg). This is not surprising since trigonocephaly surgical treatment requires extensive craniotomies. Weight was not statistically correlated with the blood transfusion rate. This can be explained by technical considerations: craniotomies in young patients do not require separation of the bone from the periosteum, which significantly reduces bleeding, in contrast to older (and thus heavier) patients. In general, scaphocephaly craniotomies are usually performed at younger ages. When these craniotomies are performed late, they require periosteal separation and more extensive bone remodeling (fronto-orbital remodeling). In November 2012, we introduced a treatment protocol with the objective of reducing the blood transfusion rate. Our protocol comprised preoperative

administrations of EPO and iron as well as perioperative intravenous injection of tranexamic acid. Unfortunately, this protocol did not reduce the blood transfusion rate.

4.3 Which indicator reflects the quality of healthcare in facio-cranioostenosis surgery?

Pediatric pathologies are complex for several reasons. First, cranioostenosis is generally encompassed in syndromic diseases with multiple malformations and organ dysfunctions. Second, these associated conditions may impeach on the child's growth. Finally, this chronic and multifaceted evolution requires a holistic care plan, hence rendering counterproductive the treatment of each pathology separately without concerted effort. Consequently, the Maternal and Child Bureau's Division of Services for Children with Special Healthcare Needs proposed, in 1995, the concept of children with special healthcare needs and defined which children require special healthcare needs and also which children have an important risk of developing a physical, emotional, developmental, or behavioral chronic disease. This bureau also stated which healthcare services, and at which frequency, are needed by these children [16]. Therefore, there seems to be consensus that these children require a new holistic care plan centered on the patient and their family. Ascertaining the quality of care of this new plan requires specific indicators different from the indicators usually attributed to acute and less complex diseases. Therefore, new health indicators called "patient-reported results" in which the patient and the caregiver report their health status were created; for example, self-evaluated health indicators that comprise functional capacity and health-related quality of life [17, 18]. Few studies took interest in the health-related quality of life of children and adolescents with non-syndromic craniofacial pathologies and of their family members [19]. In fact, most studies disregard the quality of life and evaluate surgical success in adults [20] or in patients with

syndromic craniostenosis [21, 22]. As such, it is paramount to evaluate the impact of surgical treatment with regard to the quality of life of the patient and their family. Some studies aimed to evaluate the quality of life of craniostenosis patients using child and mother self-reported assessments of behavior, self-image, emotional well-being, parental satisfaction, and social support [23]. Other studies failed to identify differences in the psychological, behavioral, and social development between normal children and children with craniofacial pathologies after statistical adjustments for confounding factors such as socioeconomic environment, familial support, and intellectual quotient [24–28]. To our knowledge, no prospective and multicenter study has focused on the impact of surgery on the quality of life of pediatric patients with craniostenosis.

5. Conclusion

Our work underlines some important issues to keep in mind in the advent of a new French plan for the certification of centers as qualified for treating craniostenosis. Classic indicators such as the number of procedures (or volume of activity), mean hospital stay, and blood transfusion rate that are generally used to determine the qualification of a center to treat craniostenosis are, in our opinion, not pertinent. By contrast, we believe that complication rates reflect the quality of care of a center. All complications must be listed with exhaustive detail. We consider the Leeds classification as the most appropriate for craniostenosis. It is also mandatory to define new indicators capable of measuring the quality of life related to surgical procedures and to use such indicators to evaluate the competence of a center. In fact, the quality of life of patients and their families is more relevant clinically and reflects more truly the quality of care than does the mean hospital stay or the blood transfusion rate.

REFERENCES

- [1] Bennis Y, Wolber A, Vinchon M, et al. [Non syndromic craniosynostosis]. *Ann Chir Plast Esthet* 2016;61:389–407.
- [2] Prevost R, Keribin P, Batut C, et al. Management of non-syndromic craniosynostoses in France in 2015: A national survey. *J Craniomaxillofac Surg* 2019;47:556–60.
- [3] Chattha A, Bucknor A, Curiel DA, et al. Treatment of Craniosynostosis: The Impact of Hospital Surgical Volume on Cost, Resource Utilization, and Outcomes. *J Craniofac Surg* 2018;29:1233–6.
- [4] Shastin D, Peacock S, Guruswamy V, et al. A proposal for a new classification of complications in craniosynostosis surgery. *J Neurosurg Pediatr* 2017;19:675–83.
- [5] Tønne E, Due-Tønnessen BJ, Wiig U, et al. Epidemiology of craniosynostosis in Norway. *Journal of Neurosurgery: Pediatrics* 2020;26:68–75.
- [6] Cornelissen M, Ottelander B den, Rizopoulos D, et al. Increase of prevalence of craniosynostosis. *J Cranio-Maxillofac Surg* 2016;44:1273–9.
- [7] Di Rocco F, Arnaud E, Renier D. Evolution in the frequency of nonsyndromic craniosynostosis. *J Neurosurg Pediatr* 2009;4:21–5.
- [8] Wes AM, Paliga JT, Goldstein JA, et al. An evaluation of complications, revisions, and long-term aesthetic outcomes in nonsyndromic metopic craniosynostosis. *Plast Reconstr Surg* 2014;133:1453–64.
- [9] Taylor JA, Paliga JT, Wes AM, et al. A critical evaluation of long-term aesthetic outcomes of fronto-orbital advancement and cranial vault remodeling in nonsyndromic unicoronal craniosynostosis. *Plast Reconstr Surg* 2015;135:220–31.
- [10] Tahiri Y, Paliga JT, Wes AM, et al. Perioperative complications associated with intracranial procedures in patients with nonsyndromic single-suture craniosynostosis. *J Craniofac Surg* 2015;26:118–23.
- [11] Wong RK, Emelin JK, Meltzer HS, et al. Nonsyndromic craniosynostosis: the Rady Children’s Hospital approach. *J Craniofac Surg* 2012;23:2061–5.
- [12] Pearson GD, Havlik RJ, Eppley B, Nykiel M, Sadove AM. Craniosynostosis: a single institution’s outcome assessment from surgical reconstruction. *J Craniofac Surg* 2008;19:65–71.
- [13] Lee HQ, Hutson JM, Wray AC, et al. Analysis of morbidity and mortality in surgical management of craniosynostosis. *J Craniofac Surg* 2012;23:1256–61.
- [14] Goobie SM, Zurakowski D, Proctor MR, et al. Predictors of clinically significant postoperative events after open craniosynostosis surgery. *Anesthesiology* 2015;122:1021–32.
- [15] Bottero L, Lajeunie E, Arnaud E, et al. Functional outcome after surgery for trigonocephaly. *Plast Reconstr Surg* 1998;102:952–8; discussion 959–60.
- [16] Newacheck PW, Rising JP, Kim SE. Children at risk for special health care needs. *Pediatrics* 2006;118:334–42.
- [17] Valderas JM, Ferrer M, Alonso J. [Health-related quality of life instruments and other patient-reported outcomes]. *Med Clin (Barc)* 2005;125 Suppl 1:56–60.
- [18] Griebisch I, Coast J, Brown J. Quality-adjusted life-years lack quality in pediatric care: a critical review of published cost-utility studies in child health. *Pediatrics* 2005;115:e600–14.
- [19] Ryall JJ, Xue Y, Turner KD, et al. Assessing the quality of life in infants with deformational plagiocephaly. *J Cranio-Maxillofac Surg* 2021;49:29–33.
- [20] Mazzaferro DM, Naran S, Wes AM, et al. Quality of Life in Adults with Nonsyndromic Craniosynostosis. *Plast Reconstr Surg* 2018;141:1474–82.

- [21] Sakamoto Y, Takenouchi T, Miwa T, et al. Assessment of long-term quality of life in patients with syndromic craniosynostosis. *J Plast, Reconstr Aesthet Surg* 2021;74:336–40. h
- [22] Lloyd MS, Venugopal A, Horton J, et al. The Quality of Life in Adult Patients With Syndromic Craniosynostosis From Their Perspective. *J Craniofac Surg* 2016;27:1510–4.
- [23] Speltz ML, Morton K, Goodell EW, et al. Psychological functioning of children with craniofacial anomalies and their mothers: follow-up from late infancy to school entry. *Cleft Palate Craniofac J* 1993;30:482–9.
- [24] Kapp-Simon KA, Collett BR, Barr-Schinzel MA, et al. Behavioral adjustment of toddler and preschool-aged children with single-suture craniosynostosis. *Plast Reconstr Surg* 2012;130:635–47.
- [25] Cloonan YK, Collett B, Speltz ML, et al. Psychosocial outcomes in children with and without non-syndromic craniosynostosis: findings from two studies. *Cleft Palate Craniofac J* 2013;50:406–13.
- [26] Knudsen E, Maltese G, Tarnow P, et al. Parental estimation of early psychological development in children operated on for single suture synostosis. *J Plast Surg Hand Surg* 2012;46:152–4.
- [27] van der Vlugt JJB, van der Meulen JJNM, Creemers HE, et al. The risk of psychopathology in children with craniosynostosis. *Plast Reconstr Surg* 2009;124:2054–60.
- [28] Boltshauser E, Ludwig S, Dietrich F, et al. Sagittal craniosynostosis: cognitive development, behaviour, and quality of life in unoperated children. *Neuropediatrics* 2003;34:293–300.

Table 1. Patient characteristics

	Scaphocephaly (n=23)	Trigonocephaly (n=13)	Coronal plagiocephaly (n=4)	Lambdoid plagiocephaly (n=1)	Brachycephaly (n=1)	Total (n=42)
Male sex	21 (91.3)	9 (69.2)	2 (50.0)	0 (0.0)	1 (100.0)	33 (78.6)
Age (months)	4.8 [3.8; 7.5]	8.7 [7.0; 9.9]	16.1 [13.7; 20.9]	13.4	70.7	7.4 [4.8; 10.4]
Weight (kg)	7.50 ± 1.30	9.06 ± 1.60	9.45 ± 1.72	9.70	15.0	8.40 ± 1.92
Operative time (min)	130 [90; 180]	180 [165; 210]	263 [203; 270]	220	160	158 [130; 190]
Blood transfusion	16 (69.6)	11 (84.6)	4 (100.0)	1 (100.0)	0 (0.0)	32 (76.2)
Volume (ml/kg)	13.3 [10.5; 17.8]	17.7 [10.0; 20.3]	15.9 [11.9; 29.9]	10.31	–	13.7 [10.3; 19.8]
Hospital stay (days)	7 [6 ;7]	7 [7 ;8]	7 [7 ;7]	11	4	7 [6 ;7]
PICU stay						
1 day	20 (87.0)	12 (92.3)	2 (50.0)	0 (0.0)	1 (100.0)	35 (83.3)
≥2 days	3 (13.0)	1 (7.7)	2 (50.0)	1 (100.0)	0 (0.0)	7 (16.7)

Data are presented as number of patients (percentages), mean ± standard deviation, or median [1st quartile; 3rd quartile]. PICU: postinterventional care unit.

Table 2. Detailed description of surgical complications according to the Leeds classification

	<i>n</i> (%)	Leeds	Rehospitalization
Minor complication			
Cutaneous complications	3 (7.1%)		
Hematoma	1 (2.4%)	1A	0
Skin necrosis	1 (2.4%)	1C	1 (26 days)
Scar botryomycoma	1 (2.4%)	2B	2 (2 days and 7 days)
Major complications			
Cardiovascular arrest	1 (2.4%)	0B	0
Sepsis	1 (2.4%)	1A	0 (3 days in PICU)
Total complications	5 (11.9%)		
Total surgeries	42 (100%)		

PICU: postinterventional care unit

Table 3. Leeds classification of complications in craniosynostosis surgery

Type	Description
0	Perioperative occurrence
A	Excessive blood transfusion (>60 mL/kg)
B	Significant anesthetic instability or complications
C	Unplanned surgical intervention during index admission
1	Inpatient complications
A	w/ normal LOS (w/in 2 SD)
B	w/ prolonged LOS (>2 SD)
C	w/ exceptionally prolonged LOS (>2 weeks)
2	Outpatient complications not requiring readmission
A	≤30 days since discharge
B	>30 days since discharge
3	Complications requiring readmission
A	Nonsurgical, ≤30 days since discharge
B	Nonsurgical, >30 days since discharge
C	Surgical, ≤30 days since discharge
D	Surgical, >30 days since discharge
4	Unexpected long-term deficit
A	Resolved by 6 months
B	Present at 6 months
5	Mortality
A	Inpatient or ≤30 days since discharge
B	>30 days since discharge

LOS: length of stay; SD: standard deviation

Figure Legends

Figure 1: Comparison of our series with Shastin's according to the Leeds classification in term of complications.

In blue our data, in yellow Shastin's data.

Figure 1

