Original Article

The Measurement of Different Diaper Parameters for the Evaluation of Postcircumcision Bleeding and their Significance for the İnfant's Health

M Akman

Department of Pediatric Surgery, Medipol University, Faculty of Medicine, Nisa Hospital, İstanbul, Turkey

Abstract

Background: Evaluation of circumcision bleeding cannot depend on the visual change in the diaper. Diapers have different product features and absorbency capacities. The apparent changes in the diapers may vary according to their absorbent capacity and may not be in parallel with the amount of bleeding. Before significant visual difference occurs, the patient's hemodynamics may be impaired. **Aim:** Aim of the study is to evaluate better circumcision bleeding. **Patients and Methods:** Patients were divided into groups according to 12 different brand diapers of the same size, containing super-absorbent material. The study started by 15/01/2022, and finished by end of 01/03/2022. Diapers with concealed brands were soaked with blood with equal hematocrit value in 100 ml with increments of 5 ml. 252 images were obtained by taking 21 images of each diaper with the same method. The diapers were evaluated colorimetrically, and numerical values were obtained showing the color differences in red, green, and blue and saturation and lightness. Working groups were formed according to 12 different brands of diapers of the same size, containing super-absorbent material. Standard statistical tests were performed using obtained values. **Result:** Dry diapers had different weights, volumes, and specific gravities; the diapers with the lowest unit weight were ranked ninth in terms of volume; the diapers with the highest specific gravity were ranked third in terms of thinness. There were significant differences in the blood on the diaper, and significant differences between some groups ($p < 0.005$); on the other hand, there was not any difference between some other groups ($p > 0.05$). There was a significant relationship in terms of Analysis of Variance (ANOVA) ($P < 0.05$ and $P < 0.01$). Visual graphic examination showed that linear but non-parallel color changes occurred. As the blood load increased, the visual and statistical differences between the diapers became more pronounced, and the curves diverged. **Conclusion:** Visual evaluation of the color change of the diapers may not give accurate results for bleeding follow-up. If necessary to use diapers after circumcision, it is more appropriate to prefer those with low absorbency capacity. Using fabric or cotton products in cases with bleeding risk may be recommended. If bleeding is suspected, hemogram control is the most appropriate option. Diaper manufacturers should warn consumers of the risk. In conclusion, we should be on the safe side for mortality and morbidity.

Keywords: *Bleeding, circumcision, color changes, diaper, follow-up*

Received: 12-Mar-2022;
Revision: 06-May-2022;
Accepted: 24-May-2022;
Published: 26-Oct-2022

Background

Today's diapers can trap up to 30 times their weight in fluid.[1] Increased absorbance capacity may cause visual changes in circumcision blood to be inconsistent with the amount of bleeding, and may lead

Address for correspondence: Prof. M Akman, Department of Pediatric Surgery, Fatih Caddesi, Yenibosna 34197, İstanbul, Turkey.
E-mail: drmustafaakman@yahoo.co.uk

How to cite this article: Akman M. The measurement of different diaper parameters for the evaluation of postcircumcision bleeding and their significance for the İnfant's health. Niger J Clin Pract 2022;25:1704-9.

Access this article online

Quick Response Code:

Website: www.njcponline.com

DOI: 10.4103/njcp.njcp_187_22

to misconceptions in the bleeding follow-up based on the visual evaluation. The more absorbency the fewer diaper changes, and these fewer diaper changes may lead to lesser diaper control, which in turn may contribute to an unexpected deterioration in hemodynamic stability. Indeed, deaths by this mechanism were reported in the literature.[2-5] The fact that each manufacturer produces diapers with different contents causes difficulties in establishing an evaluation standard.[6,7]

For the study; our hypotheses were as follows:

[1]Follow-up of the circumcision bleeding cannot be performed accurately regarding the visual changes in the diapers; [2]different brands of diapers may show different visual changes due to their different absorbency capacities; [3]before significant color changes occur in the diapers, the amount of blood that disrupts hemodynamics can be excessive.[8]

In our study, we planned to imitate varying amounts of bleeding by using different brand diapers. Visual changes in the diapers were evaluated colorimetrically and it was chosen to draw attention to possible complications.

Methods

With the information available from the manufacturers, the diapers contain Na-polyacrylate-polymer. Patients were divided into 12 groups using the products of 12 different companies, produced for babies of 4-9 kg. Their brands were hidden and given a code number by a person not included in the study. An erythrocyte suspension planned to be destroyed and hematocrit adjusted to 35% with isotonic, was used. The diapers were soaked in 100 ml fluid with 5 ml increments.

Images were obtained at constant light and distance, with Samsung SM-G930F, Auto balance/Focus, ISO 500, 1/50s Exposure, Aperture F1.7, Focal Length 4.20 mm using the same standards. The first image was obtained from a dry diaper. 252 images were obtained by taking 21 from each group [Figure 1].

We preferred to measure the colorimetric changes in the diapers because we planned to reveal possible visual misconceptions. The acceptability of colorimetric measurements was confirmed.[9,10] Red, green, and blue which were appropriate for the hypotheses, and saturation and lightness measurement items, which give average color information, were used in the study. Color analysis was performed with Average color Calculator Web JAVA-based software. Findings were confirmed with two different software measuring the same criteria.[11-13] The study started by 15/01/2022, and finished by end of 01/03/2022.

SPSS 28.0.1/2022 software was used for statistical evaluations. After the descriptive test, each measurement criterion was applied to each group separately and the results were evaluated; compliance with the conditions for the parametric test was evaluated using the Shapiro-Wilk test and the Skewness/Kurtosis evaluation criteria. The relationship between the amount of fluid and the diaper groups was evaluated with Pearson correlation analysis. Significance between groups was evaluated by using a one-way dependent ANOVA test. $P \leq 0.05$ was considered significant.[14]

Ethical Approval and Consent to Participate

All requirements of "World Medical Association Declaration of Helsinki: Ethical principles for medical research involving human subjects" were obeyed, and standard techniques, principles and medications were used according to the literature and textbooks, and new medications and techniques were not used. In this study, all requirements of applications and medications were strictly obeyed according to National Ethics rules. National Ethics committee report and consent to participation forms were not needed.

Results

In the measurements of 5 x 5 cm pieces taken from the super-absorbent parts of the diapers; their weights were 1.718 g (1,259-2,566); their thicknesses were 1.95 mm (1.58-2.43); their volumes were 4875 mm3 (3950-6075); their specific gravities were 359.94 kg/m^3 (242,11-596,74). The diaper with the highest specific gravity and weight (2,566 g) was the 3rd thinnest diaper; the lightest diaper was in the 9th place in terms of volume [Table 1].

In the visual, simple, and subjective evaluation of the results; the differences occurring with the same quality and the same amount of blood are striking. In the graphical analysis of the data, the differences between

Table 1: Descriptive values

	n	Minimum	Maximum	Sum	Mean	Std Dev	Skewness	Kurtosis
Weight (5cm x 5cm; g)	12	1,259	2,566	20,619	1,718	0,35	1,403 Std Err=0,637	2,439 Std Err=1,232
Thickness (mm)	12	1,58	2,43	23,4	1,95	0,269	0,640 Std Err=0,637	-0,315 Std Err=1,232
Volume (mm^3)	12	3950	6075	58500	4875	673,44	0,640 Std Err=0,637	-0,315 Std Err=1,232
Specific weight (kg/m^3)	12	242,11	596,74	4319	359,94	96,481	1,304 Std Err=0,637	2,390 Std Err=1,232

Table 2: Pearson correlation coefficients (For red color)

	Fluid**	Diaper_1	Diaper_2	Diaper_3	Diaper_4	Diaper_5	Diaper_6	Diaper_7	Diaper_8	Diaper_9	Diaper_10	Diaper_11
Diaper_2	-0,972	0,969										
Diaper_3	-0,978	0,978	0,943									
Diaper_4	-0,951	0,959	0,929	0,921								
Diaper_5	-0,982	0,974	0,950	0,972	0,923							
Diaper_6	-0,950	0,931	0,949	0,92	0,844	0,929						
Diaper_7	-0,991	0,978	0,966	0,971	0,911	0,975	0,969					
Diaper_8	-0,989	0,980	0,968	0,972	0,914	0,978	0,975	0,991				
Diaper_9	-0,941	0,945	0,902	0,946	0,877	0,945	0,912	0,926	0,953			
Diaper_10	-0,967	0,960	0,942	0,949	0,906	0,953	0,922	0,962	0,968	0,916		
Diaper_11	-0,938	0,936	0,940	0,934	0,874	0,946	0,938	0,943	0,964	0,915	0,908	
Diaper_12	-0,994	0,986	0,964	0,965	0,934	0,968	0,951	0,987	0,98	0,935	0,947	0,912

**Significance <,001

Table 3: ANOVA test, P values comparing the groups (For red color)

	Diaper_1	Diaper_2	Diaper_3	Diaper_4	Diaper_5	Diaper_6	Diaper_7	Diaper_8	Diaper_9	Diaper_10	Diaper_11
Diaper_2	0,001										
Diaper_3	0,025	0,006									
Diaper_4	0,037	0,001	0,001								
Diaper_5	0,009	0,001	0,001	0,001							
Diaper_6	0,008	0,001	0,001	0,011	0,001						
Diaper_7	0,207	0,727	0,587	0,77	0,229	0,041					
Diaper_8	0,001	0,002	0,001	0,013	0,001	0,009	0,034				
Diaper_9	0,001	0,001	0,001	0,001	0,001	0,014	0,027	0,006			
Diaper_10	0,078	0,003	0,001	0,001	0,001	0,001	0,691	0,681	0,059		
Diaper_11	0,301	0,001	0,002	0,001	0,009	0,001	0,069	0,005	0,036	0,692	
Diaper_12	0,002	0,001	0,001	0,001	0,001	0,001	0,002	0,021	0,001	0,498	0,003

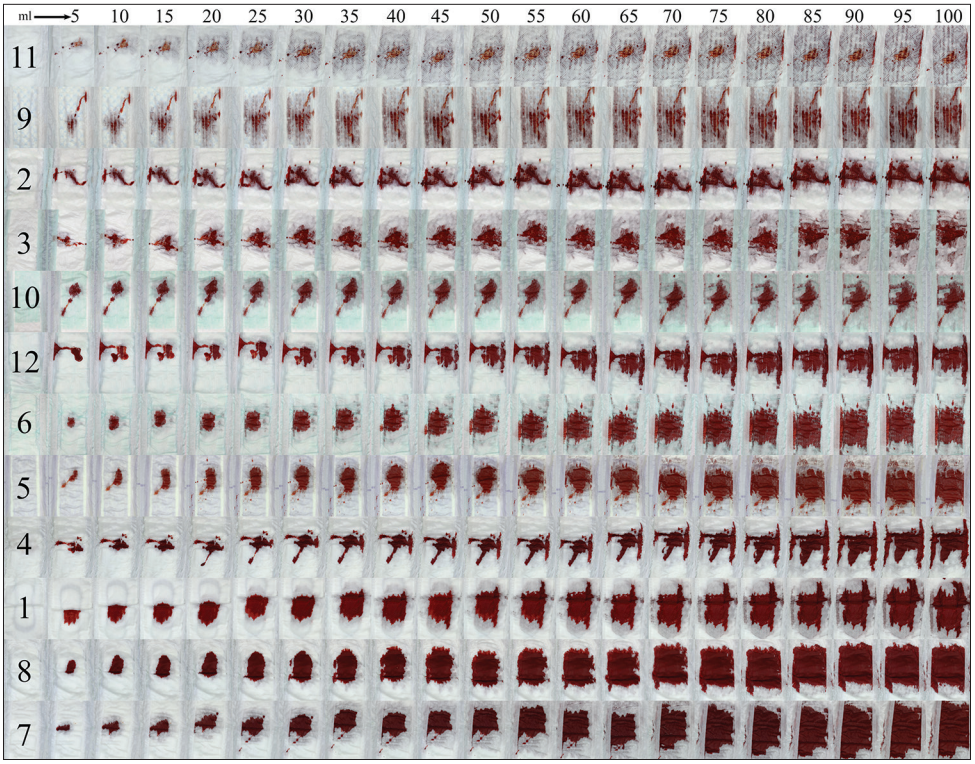

Figure 1: Color changes

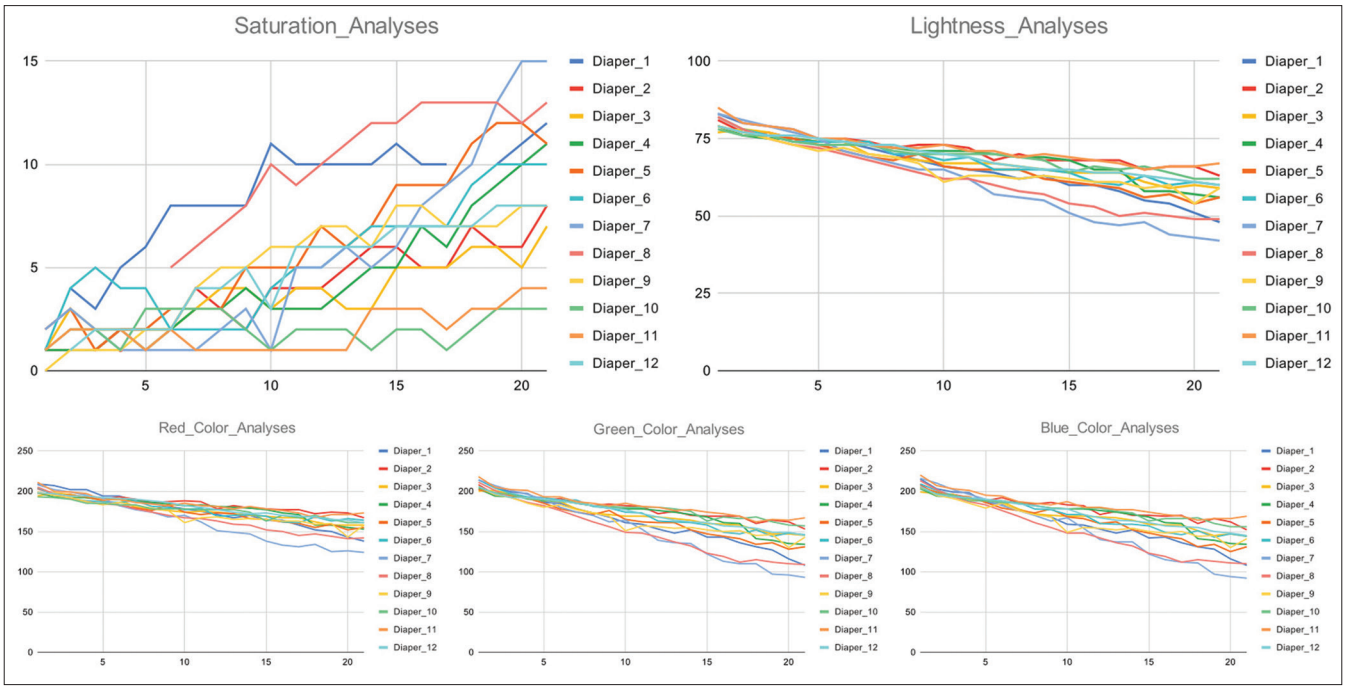

Figure 2: Graphic changes of saturation, lightness, and major color groups

the groups increase when the value that will disrupt the hemodynamics is close [Figures 1 and 2].

In the visual graphics, as the blood load increased, we observed linear but unparallel changes with different slopes between groups. The change in the saturation graph was atypical and positive, while in the other graphs, it was negative and linear. When the amount of bleeding reached a level that would affect the infant hemodynamically, the difference became obvious [Figure 2].

Missing and outlier values were not present. The data were normally distributed, indicating compliance with parametric tests. Wetting the diapers with blood caused significant changes in the diapers; changes varied between groups; a strong and significant relationship was demonstrated by Pearson correlation analysis [Table 2]. Pearson correlation coefficient between -1 and +1 in Pearson analysis, mean p= − 0.968 (− 0.994 to − 0.938) when comparing fluid and groups; in evaluating the groups with each other, it was found close to the +1 level. In evaluating the groups, the mean P = 0.994 (0.844 to 0.991) was found.

There were significant ANOVA differences between the groups, according to the results of the pairwise analyses ($p < 0.05$ and $P < 0.001$). Changes were nonhomogeneous between the groups. This was with Group 7 and Group 1, 2, 3, 4, 5, 10, 11; Group 1 and Groups 10 and 11; Group 8 and Groups 10 and 11 were significant ($p < 0.05$) [Table 3].

Discussion

Evaluation of bleeding is prominent in the follow-up of patients after circumcision. As noted by David A, Bolnick DA, and Bollinger, D *et al*.,[3,15] surprise bleeding after circumcision is a primary concern of practitioners. It is essential to detect bleeding as early as possible, before hemodynamics is impaired, and calculate the amount of bleeding correctly. Follow-up of the circumcision and recovery is left to the parents.

If the bleeding is relatively severe and for a long time, especially in the newborn, the hemoglobin level may drop suddenly without being noticed, and the blood volume lost is difficult to measure accurately using the diaper image, so blood counts should be performed. Bleeding that is rapidly absorbed by the diaper may cause the practitioner to underestimate the actual blood loss. Indeed, David A Bolnick and Martin Koyle Assaf drew attention to this issue. Babies followed by Supersuckers may bleed more than they seem.[2,15]

Mense L *et al*.[2] drawing attention to the high absorbency capacity of the diapers, stated that it is an appropriate method to control the hemoglobin values of the patient.

Dan Bollinger, who stated that using cotton cloths instead of diapers would prevent possible fatalities, did not find using super-absorbent cloth diapers appropriate today. The mortality due to 3 circumcision bleedings reported in the USA was due to the unpredictability of bleedings due to high absorbent capacity, and he added that this number should be much higher than the 2010 data.[3,16]

Newborns are more susceptible to bleeding due to their relatively lower blood volumes. Schellpfeffer and Howie SRC *et al*.,[16] who are among the studies on this subject, stated that shock will occur with acute loss of 20-25% of total blood volume; a newborn with a blood volume of 70-82 ml/body weight has a blood volume of 270 ml and the amount of bleeding that would shock the newborn would be around 54 ml.[17-19]

Mense L, a New Generation baby diaper, is a polymer that contains sodium polyacrylate-containing absorbent filler and can trap 30 times its weight in liquid. This structure means that the diaper stores a large amount of blood without causing visual changes.[2]

All the diapers we used in our study absorbed the liquid without leaking up to 200 ml, and no leakage was apparent. Considering the total blood volume of the newborn, the importance of accurate follow-up of bleeding increases. It means that serious problems may arise when the physician or parent following the bleeding after circumcision determines the amount of bleeding according to the appearance of the diaper.

It is noted that the situation becomes more complicated if blood is mixed with urine. For this reason, we should avoid using super-absorbent diapers in the early circumcision care stages. It is seen that the relationship between diapers and bleeding has not yet been given importance in institutional publications such as AAP or EU, where post-circumcision care is explained in detail. The danger in this direction continues in the follow-up of bleeding in diapered babies.[20-22]

In our first study, which inspired this study, we did not detect any color change compatible with bleeding when the diapers were exposed to the increasing amounts of blood, so evaluations made according to the color change may yield erroneous statistical results.[23] In this study, however, the responses of different brands of diapers to bleeding were not parallel, and in our model, the differences between the diapers became more pronounced as the bleeding increased.

Conclusion

It is not correct to check the bleeding by simply looking at the diaper of the patient who uses super-absorbent diapers in the circumcision follow-up. If it is necessary to use a diaper after circumcision, it would be more appropriate to choose a diaper with a low absorbency capacity and to change the diaper more often than usual. It may be recommended to use fabric or cotton instead of baby containing super-absorbent. If bleeding is suspected, hematological evaluation and hemogram control are the most appropriate options. Diaper manufacturers should alert consumers to the tracking and identification of bleeding. By combining all these, the safe side will be preferred in-patient follow-up.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Seval Uyanik S, Baykal PD. Bebek Bezi Üretimi. Çukurova Üniversitesi Mühendislik-Mimarlık Fakültesi Dergisi. 2016. doi: 10.21605/cukurovaummfd. 310309.
2. Mense L, Ferretti E, Ramphal R, Daboval T. A newborn with simmering bleeding after circumcision. Cureus 2018;10:e3324.
3. Bollinger, D. Lost boys: An estimate of U.S. circumcision-related infant deaths. Thymos: J Boyhood Stud 2010;4:78-90.
4. Nadeem-ul-Nazeer, Mohsin M. Stitch granuloma of the penis: A very rare complication after male circumcision. Intern J Plast Surg 2008;5. DOI: 10.5580/227d.
5. CDC Wonder. Mortality: Underlying cause of death. Atlanta, Georgia: Centers for Disease Control and Prevention. 2012. Retrieved from: http://wonder.cdc.gov/cmf-icd10.html. [Last visited 2022 Mar 11].
6. Arango-Escorcia G, Cabrera-Elizalde S, Quecholac-Piña X, Sotelo-Navarro PX, Espinosa-Valdemar RM, Vázquez-Morillas A, *et al*. Assessment of gardening wastes as a Co-substrate for diapers degradation by the fungus pleurotus ostreatus. Sustainability 2015;7:6033-45.
7. Khoo SC, Phang XY, Ng CM, Lim KL, Lam S. Recent technologies for treatment and recycling of used disposable baby diapers. Process Saf Environ Prot 2019;123:116-29.
8. Kosemund K, Schlatter H, Ochsenhirt JL, Krause EL, Marsman DS, Erasala GN. Safety evaluation of superabsorbent baby diapers. Regul Toxicol Pharmacol 2009;53:81-9.
9. Watanabe A, Kinoshita K, Muramoto T, Nakai M, Suzuki Y. Evaluation of colorimetric pH strips for wild animal meat using image analysis. Anim Sci J 2021;92:e13602.
10. McGann PT, Tyburski EA, Oliveira V, Santos B, Ware RE, Lam WA. An accurate and inexpensive color-based assay for detecting severe anemia in a limited-resource setting. Am J Hematol 2015;90:1122-7.
11. JavaScript application to get the average color of an image. Available from: https://matkl.github.io/average-color
12. JavaScript application to get the average color of an image. Available from: https://azer.io/average-color/.
13. JavaScript application to get the average color of an image. Available from: https://www.imgonline.com.ua/eng/get-dominant-colors-result.php.
14. George D, Mallery M. SPSS for Windows Step by Step: A Simple Guide and Reference, 17.0 update. 10a ed. Boston: Pearson; 2010.
15. Bolnick DA, Koyle M, Yosha A. Editors Surgical Guide to Circumcision. Springer-Verlag London; 2012. p49.
16. Schellpfeffer MA. Improved neonatal outcome of vasa previa with aggressive intrapartum management. A report of two cases. J Reprod Med 1995;40:327-32.
17. Howie SRC. Blood sample volumes in child health research: Review of safe limits. Bull World Health Org 2011;89:46-53.
18. Mendelson J. Emergency department management of pediatric shock. Emerg Med Clin North Am 2018;36:427-40.

19. Inaba AS, Boychuk RB. Case Based Pediatrics For Medical Students and Residents. Chapter XIV.8. Department of Pediatrics, University of Hawaii John A. Burns School of Medicine. Trauma; 2004. p. 480.
20. NurseReview. The neonate at 2 hours to 2 days of age. Beverly Hills, California: Nurse Review; 2010. 6 p.
21. American Academy of Pediatrics. Circumcision policy statement. Task force on circumcision. Pediatrics 2012;130:585-6.
22. EAU Guidelines. Edn. presented at the EAU Annual Congress Amsterdam. 2022.
23. Akman M. Is it reliable to make a decision based on the visual changes in the patient's diaper in the evaluation of circumcision bleeding? Afr J Paediatr Surg. In Press [Last accessed on 2021 Dec 13].