Original Article

Is it Reliable to Make a Decision Based on Visual Changes in the Patient's Diaper in the Evaluation of Post Circumcision Bleeding?

Mustafa Akman

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

Abstract

Background: The most common complication of circumcision is bleeding. Monitoring bleeding by visual assessment of the diaper can cause errors due to the high absorbency of diapers. The patient may have had significant problems before the visible changes. The amount of liquid that wets the cloth does not necessarily lead to a visual change consistent with the amount, and the nature of the liquid contaminating the diaper may cause difficulties in terms of visual evaluation. Making a decision based on the visual changes in the patient's diaper cannot be considered as reliable. **Methods:** We planned to evaluate the visual changes that are caused by liquids of various volumes and contents that wet the diaper, according to measurable criteria. We aimed to emphasise the importance of the subject in circumcision practices of diapered children. Wetting of diapers with different volumes and variable blood load was performed utilising blood with different haematocrits and fluids. One hundred and sixty different diapers in four groups were moistened utilising the drip method. Visual changes in the soaked diapers were evaluated with the colorimetric method and five different colour criteria. The saturation and lightness values, which indicate the colour value, were obtained by using the numerical equivalents of the three main components, red, green and blue. Analysis was carried out by subjecting statistical evaluation within and between groups. **Results:** There was a significant difference between the control group and the study group. It was observed that visual changes caused by the moistened cloths with linear increase did not make the same linear interaction. There was not a significant difference between Group II and Group IV, which were soaked with the same amount of blood and different volume of fluid. In Group III, colour saturation changes were found to have a parabolic effect instead of a linear change. In two different analyses of moistened diapers in terms of volume and blood load; it was not determined that the expected linear changes between the groups were not observed. **Conclusion:** Visual changes in diapers related to volume or blood load effects of fluids may not be compatible with the amount of bleeding. Mistakes may occur when super absorbent wipes are used when determining the amount of bleeding from the use of colour changes in the diaper. Visual changes should not be relied on in bleeding due to circumcision. Rather, vital signs follow-up and measurable laboratory tests should be used as a basis.

Keywords: Bleeding, circumcision, complications

Introduction

Hypothesis

Bleeding after circumcision cannot be accurately visually evaluated due to the high absorbency and crystallisation capacity of new generation diapers. Before the blood and fluid absorption capacity of diapers are exceeded, the haemodynamics of patients may be impaired. The patient's haematocrit value or the combination of blood and urine may show variations in visual changes caused by the bleeding in the diaper. Increasing wetting of diapers may not result in visual changes consistent with the increase. In the evaluation of circumcision bleeding, it is not reliable to make a decision based on visual changes in the patient's diaper.

As long as circumcision, which is the oldest and most frequently applied surgical procedure in the world, continues,

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Address for correspondence: Prof. Mustafa Akman, Department of Pediatric Surgery, Faculty of Medicine, Medipol University, Nisa Hospital, Fatih Caddesi, Yenibosna, İstanbul 34197, Turkey. E-mail: drmustafaakman@yahoo.co.uk

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the efforts of physicians to reach the right application will continue. In addition, the probability of encountering new issues that have not previously been seen increases over time.[1,2] For example, as diaper absorbency increases, their positive contribution to the hygiene of the area also increases. However, this can bring unexpected issues. The fact that the liquid absorbency capacity significantly increases due to crystallisation decreases the frequency of diaper changes. The most vital complication following circumcision is bleeding. The necessity for fewer diaper changes due to increased diaper absorbency, as well as additional fluid trapping and the resulting unexpected visual changes, may lead to errors in the evaluation of post-circumcision haemorrhages. This may cause bleeding to be ignored and escape the attention of both parents and health professionals. Visual changes showing the amount of bleeding may occur after the deterioration of haemodynamic stability and may cause mortality.[2-5]

The study was planned to show that the diaper and bleeding relationship may not have a safe visual evaluation criterion. With an experimental model, we were eager to evaluate diaper bleeding using visual and measurable criteria. We aimed to emphasise the importance of the subject in circumcision practices of children who use diapers.[6,7]

Methods

Groups

Each group was formed from 41 samples, starting with the dry diaper [Picture 1].

Group I: The diapers were moistened with an increasing amount of 0.9% NaCl liquid as a control group. The visual effects of the volume change in the diaper caused by the liquid without blood were measured. The aim here was to imitate the effect of fluid on the diaper. This was the control group. Osmolarity of 0.9% saline is 308 mOsm/L, and urine osmolality can range from 50 to 1400 mOsm/. That is why saline is chosen for the test fluid.

Group II: The diapers were moistened using an increased amount of liquid (blood) with a haematocrit of 10%, and the visual effects of the changes in the diaper were measured. The scenario in which the patient's urine was mixed at the same time as the bleeding was imitated.

Group III: The visual effects of the changes in the diaper were measured by moistening the diapers with a constantly increasing amount of liquid (blood) with a haematocrit of 30%. The scenario in which the patient's urine did not mix at the same time as the bleeding was imitated.

Group IV: The visual effects of the changes in the diaper were measured by moistening the diapers with a constantly increasing amount of liquid (blood) with a haematocrit of 30%. The scenario in which the patient's urine did not mix at the same time as the bleeding was imitated. A volume of fluid (blood) equal to the blood load of the fluid in Group II was used (5 ml 10% Hct = 1.67 ml 30% Hct). The aim was to minimise the volume effect of the liquid.

Fluid volumes of Groups I, II and III: Blood loads of Groups II and IV were set synchronously and equally.

Study material

Blood

It was obtained from erythrocyte suspension that is not expired, not haemolysed. Some of the blood was to be destroyed after usage. A sufficient amount of liquid containing 30% and 10% haematocrit was obtained by diluting the erythrocyte suspension with a known haematocrit value with 0.9% NaCl solution.

Diaper

For the duration of the study, Molfix™ Midi No 3 Na-polyacrylate-polymer diapers were used, which all had the same production serial number (Batch number: MOK202148668802 Shipment date: 08.04.2021 No Expiry dates). Thus preventing variations in diapers from affecting the study.[8]

All materials used in the study were destroyed at the end per the medical waste procedure.

Moistening diapers

Diaper moistening was achieved from the center of the 25 cm × 15 cm study area using the drip method. The study began by measuring the crystallisation capacity of the diapers. The used diapers were moistened with 0.9% isotonic in 5 ml increments. When the total soaking volume reached 200 ml, it was observed that the maximum absorption capacity of the diaper was not exceeded and the liquid did not overflow from the edges. In addition, the administered maximum fluid volume was decided upon since 200 ml of blood loss is well above the level of fatality in the paediatric age group. This was evaluated alongside the capacity of the diaper. It was also taken into account that the amount of bleeding that would impair hemodynamic stability in newborns was approximately 54 ml and that this blood load would be exceeded with a minimum of 10% Hct and 200 ml.

Diaper moistening was terminated at approximately 200 ml in Groups I, II and III and 70 ml in Group IV.

Colorimetric evaluation

In the four study groups, a total of 160 diapers were each moistened with different volumes, and liquid content was evaluated. The image of each diaper was obtained to the same standard by using Samsung SM-G930F, White auto balance, ISO 500, 1/50s Exposure, Aperture F1.7, Focal Length 4.20 mm, autofocus, fixed tripod, and with no flash.

Since we planned to reveal the visuals, the study material was evaluated with colour changes. The acceptability of colorimetric measurements was confirmed by literature.[7-9]

In addition to saturation and lightness, which are the average colour values of the objects, a total of five different values were obtained, including the colour scale value of the three main colour components of red, green and blue.

Colour analysis

The numerical value was obtained by analysing the Average color Calculator Web, JAVA-based software.[10]

These determined values were confirmed by two different software measures with the same criteria.[11-14]

Statistical evaluation

SPSS 23.0/2021 (IBM Corp. Released 2021. IBM SPSS Statistics for Windows, Version 28.0. Armonk, NY: IBM Corp) software was used. Each group and each measurement criterion in each group were applied to each diaper separately and evaluated. Test of normality: Compliance with the conditions of using parametric tests was evaluated using Histogram, Coefficient of Variation, Detrended, Shapiro–Wilk test and Skewness/Kurtosis evaluation criteria. The presence of interaction between groups was evaluated with Bivariate Pearson Correlation analysis. Significance between groups was evaluated using the one-way repeated measures analysis of variance (ANOVA) test. $P < 0.05$ was considered statistically significant. Detailed descriptive evaluations were made.

Normality and descriptive evaluations of each group of measurements were separately made [Figure 1 and Table 1].

As part of the normality assessment of the data, the Shapiro–Wilk test was applied with the amount of data <50.

Results

In the groups with no missing values, no outliner data were detected that would abnormally affect the analysis.

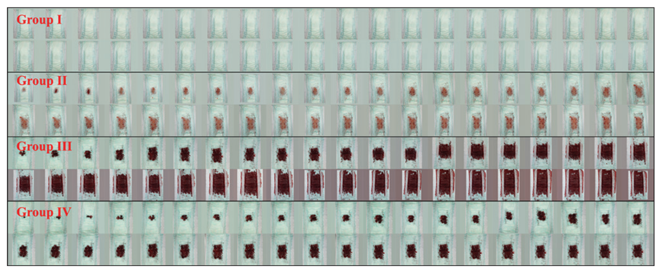
Skewness Kurtosis values were found to be between −1.5 and + 1.5 per literature, and as a result of a histogram, QQ Plot and Detrended evaluations, it was found that normal distribution was found showing compliance with parametric tests[13,15] [Figure 2 and Table 2].

Evaluation of the Pearson's correlation coefficient

The relevant measurement data of each group were compared. The following findings were prominent:

According to the saturation data

- Group I: A strong negative correlation was found with Groups II and IV and a weak one with Group III
- Group II: There was a strong negative relationship with Group I, a strong positive relationship with Group IV and a weak positive relationship with Group III
- Group III: Negative and positive correlations were found with Groups I and IV and weak ones with Group II
- Group IV: There was a weak correlation with Group I in



Picture 1: Moistened diapers

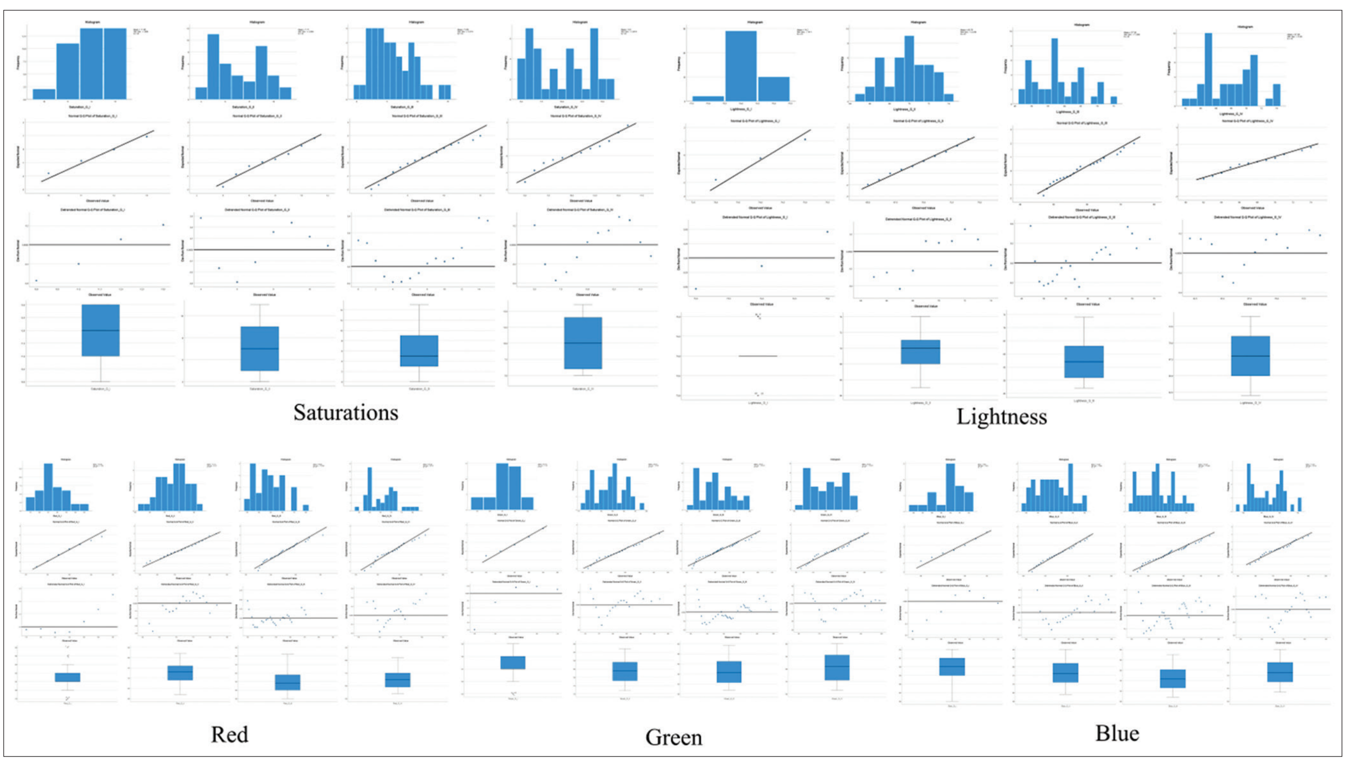


Figure 1: Tests of normality

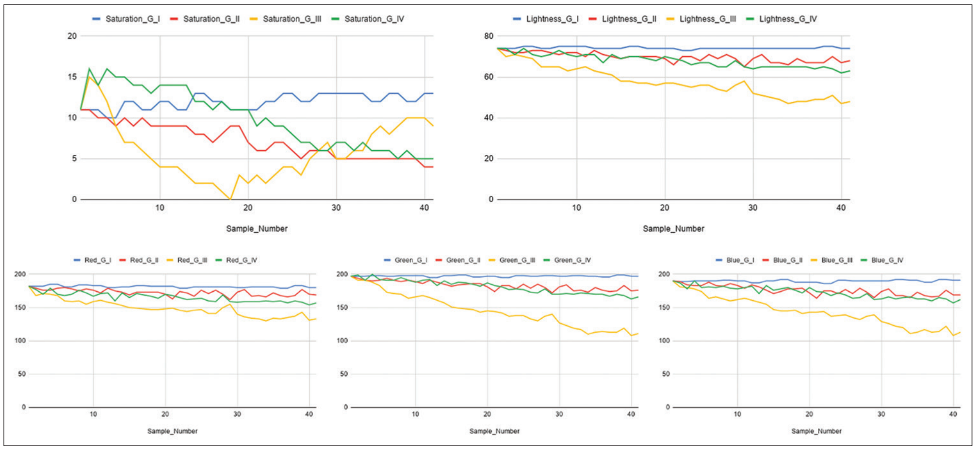


Figure 2: Saturation, lightness and colour changes

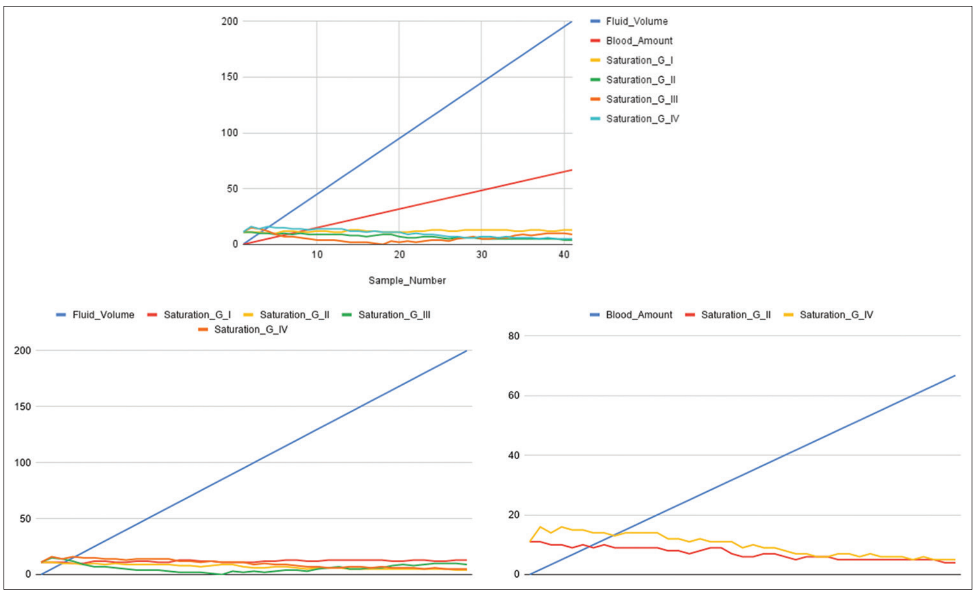


Figure 3: Saturation changes in fluid volume and blood load changes

a negative direction, with Group II in a positive direction, and with Group III also in a positive direction.

According to the lightness and red colour data: Positive correlations were found in all of the intergroup evaluations.

According to Green Colour data: Negative relations were found in the evaluation of Group II with Group III, positive relations were found in other comparisons.

According to the blue colour data

Negative relations of Group I with other groups and positive relations were determined in the evaluation of other groups.

Testing the significance of the correlation coefficient

The relevant measurement data of each group were compared. The following findings were found to be prominent.

According to the saturation data

Group II is dissimilar to Group IV, and there is a significant difference between them.

There was no significant difference between Groups II and III, but they displayed strong similarities.

It was determined that Group III did not differ significantly from Group II and Group IV, but it displayed strong similarities.

According to lightness data

There was a significant difference between Group II and Group III–Group IV.

It was determined that there was a significant difference between Group III and Group IV.

According to the red colour data

There was a significant difference between Group II and Group III–Group IV.

It was determined that there was a significant difference between Group III and Group IV.

Table 1: Descriptive and test of normality

	Mean (SE)	95% CI for mean		5% trimmed mean	Median	Variance	SD	Minimum	Maximum	Range	*I* range	Skewness (SE)	Kurtosis (SE)
		Lower bound	Upper bound										
Saturation													
Group I	11.98 (0.142)	11.69	12.26	12.03	12	0.824	0.908	10	13	3	2	−0.372 (0.369)	−0.852 (0.724)
Group II	7.17 (0.326)	6.51	7.83	7.13	7	4.345	2.084	4	11	7	4	0.214 (0.369)	−1.322 (0.724)
Group III	5.98 (0.558)	4.85	7.1	5.81	5	12.774	3.574	0	15	15	6	0.632 (0.369)	−0.124 (0.724)
Group IV	9.9 (0.565)	8.76	11.04	9.84	10	13.09	3.618	5	16	11	8	0.136 (0.369)	−1.45 (0.724)
Lightness													
Group I	74.2 (0.08)	74.03	74.36	74.22	74	0.261	0.511	73	75	2	1	0.312 (0.369)	0.309 (0.724)
Group II	69.76 (0.349)	69.05	70.46	69.78	70	4.989	2.234	65	74	9	4	−0.173 (0.369)	−0.691 (0.724)
Group III	57.56 (1.156)	55.23	59.9	57.32	57	54.752	7.399	47	74	27	13	0.413 (0.369)	−0.704 (0.724)
Group IV	67.98 (0.509)	66.95	69	67.94	68	10.624	3.26	62	74	12	6	0.169 (0.369)	−1 (0.724)
Red													
Group I	181.46 (0.24)	180.98	181.95	181.41	181	2.355	1.535	179	185	6	2	0.465 (0.369)	−0.069 (0.724)
Group II	172.71 (0.742)	171.21	174.21	172.81	173	22.562	4.75	162	182	20	7	−0.245 (0.369)	−0.494 (0.724)
Group III	148.95 (1.953)	145	152.9	148.45	148	156.398	12.506	130	182	52	20	0.509 (0.369)	−0.149 (0.724)
Group IV	165.39 (1.055)	163.26	167.52	165.1	165	45.594	6.752	154	182	28	11	0.49 (0.369)	−0.468 (0.724)
Green													
Group I	197.24 (0.17)	196.9	197.59	197.27	197	1.189	1.09	195	199	4	1	−0.515 (0.369)	−0.082 (0.724)
Group II	183.37 (1.028)	181.29	185.44	183.3	184	43.338	6.583	172	197	25	12	0.043 (0.369)	−0.913 (0.724)
Group III	145.22 (3.972)	137.19	153.25	144.52	143	646.726	25.431	108	197	89	45	0.334 (0.369)	−0.834 (0.724)
Group IV	181.02 (1.617)	177.76	184.29	180.92	182	107.174	10.353	163	200	37	21	0.061 (0.369)	−1.264 (0.724)
Blue													
Group I	189.8 (0.255)	189.29	190.32	189.89	190	2.661	1.631	186	192	6	3	−0.687 (0.369)	−0.108 (0.724)
Group II	175.95 (1.107)	173.71	178.19	175.84	176	50.248	7.089	164	190	26	13	0.144 (0.369)	−0.891 (0.724)
Group III	143.29 (3.41)	136.4	150.18	142.83	143	476.812	21.836	108	190	82	38	0.22 (0.369)	−0.769 (0.724)
Group IV	172.61 (1.365)	169.85	175.37	172.43	172	76.444	8.743	157	190	33	16	0.172 (0.369)	−1.002 (0.724)

CI: Confidence interval, SD: Standard deviation, SE: Standard error

Table 2: The significance of inter-group relations

	Group I	Group II	Group III	Group IV
Saturation				
Group I				
Pearson correlation	1	−0.685**	−0.147	−0.678**
Significance (two-tailed)		0.000	0.361	0.000
Group II				
Pearson correlation	−0.685**	1	0.068	0.927**
Significance (two-tailed)	0.000		0.674	0.000
Group III				
Pearson correlation	−0.147	0.068	1	−0.037
Significance (two-tailed)	0.361	0.674		0.819
Group IV				
Pearson correlation	−0.678**	0.927**	−0.037	1
Significance (two-tailed)	0.000	0.000	0.819	
Lightness				
Group I				
Pearson correlation	1	0.196	0.261	0.318*
Significance (two-tailed)		0.219	0.099	0.043
Group II				
Pearson correlation	0.196	1	0.772**	0.703**
Significance (two-tailed)	0.219		0.000	0.000
Group III				
Pearson correlation	0.261	0.772**	1	0.909**
Significance (two-tailed)	0.099	0.000		0.000
Group IV				
Pearson correlation	0.318*	0.703**	0.909**	1
Significa nce (two-tailed)	0.043	0.000	0.000	
Red				
Group I				
Pearson correlation	1	0.304	0.525**	0.578**
Significance (two-tailed)		0.054	0.000	0.000
Group II				
Pearson correlation	0.304	1	0.611**	0.538**
Significance (two-tailed)	0.054		0.000	0.000
Group III				
Pearson correlation	0.525**	0.611**	1	0.853**
Significance (two-tailed)	0.000	0.000		0.000
Group IV				
Pearson correlation	0.578**	0.538**	0.853**	1
Significance (two-tailed)	0.000	0.000	0.000	
Green				
Group I				
Pearson correlation	1	−0.079	0.013	0.05
Significance (two-tailed)		0.624	0.934	0.754
Group II				
Pearson correlation	−0.079	1	0.862**	0.826**
Significance (two-tailed)	0.624		0.000	0.000
Group III				
Pearson correlation	0.013	0.862**	1	0.945**
Significance (two-tailed)	0.934	0.000		0.000
Group IV				
Pearson correlation	0.05	0.826**	0.945**	1
Significance (two-tailed)	0.754	0.000	0.000	

Contd...

Table 2: Contd...

	Group I	Group II	Group III	Group IV
Blue				
Group I				
Pearson correlation	1	−0.131	−0.225	−0.139
Significance (two-tailed)		0.416	0.157	0.387
Group II				
Pearson correlation	−0.131	1	0.826**	0.741**
Significance (two-tailed)	0.416		0.000	0.000
Group III				
Pearson correlation	−0.225	0.826**	1	0.905**
Significance (two-tailed)	0.157	0.000		0.000
Group IV				
Pearson correlation	−0.139	0.741**	0.905**	1
Significance (two-tailed)	0.387	0.000	0.000	

*Correlation is significant at the 0.05 level (two-tailed), **Correlation is significant at the 0.01 level (two-tailed)

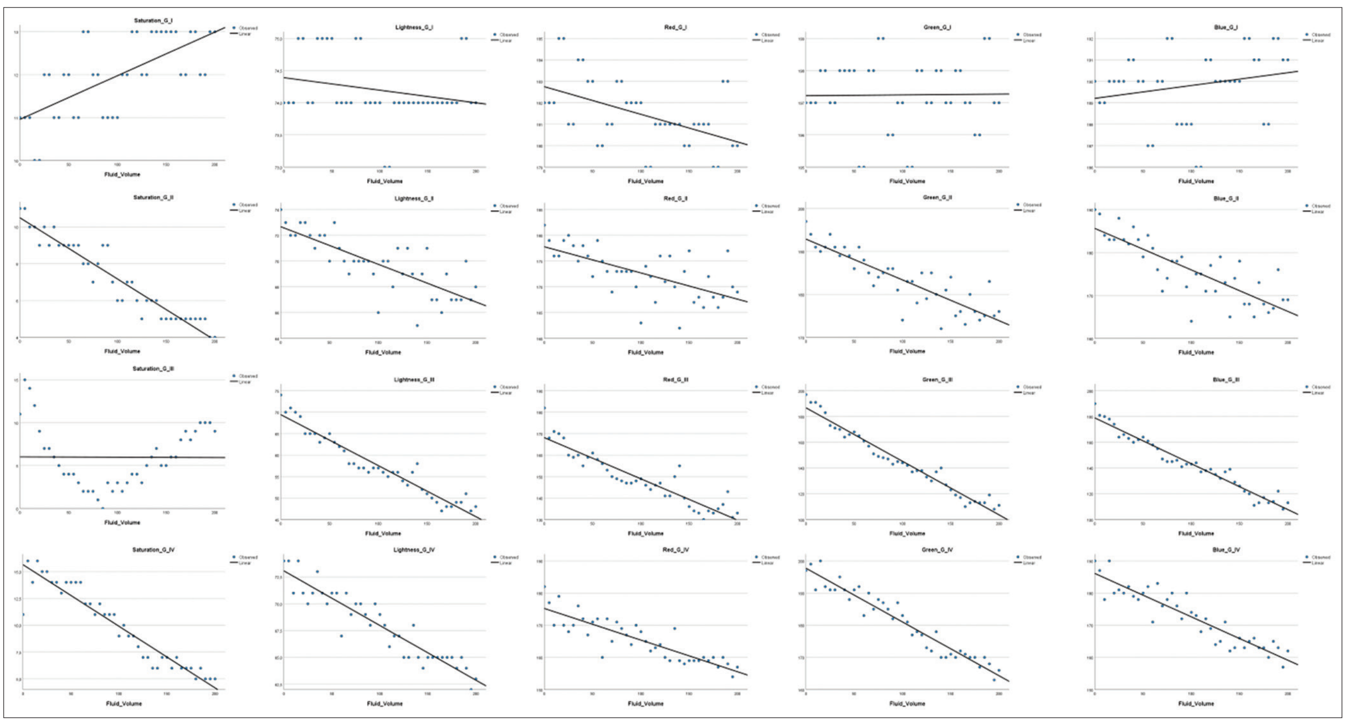


Figure 4: Value and trends

According to the green colour data

There was a significant difference between Group II and Group III–Group IV.

It was determined that there was a significant difference between Group III and Group IV.

According to the blue colour data

There was a significant difference between Group II and Group III–Group IV.

It was determined that there was a significant difference between Group III and Group IV.

Analysis of variance

The results of the paired evaluation were interpreted as follows.

According to the saturation data

Group II and Group III were similar and did not make a significant difference.

Group II and Group IV made a significant difference.

Group III and IV were similar and did not make a significant difference.

According to lightness, red, green and blue data

There is a significant difference between Group II, Group III and Group IV.

To indicate the compatibility of colour changes with increasing blood load and volume by using a graph displaying all groups and all colour analyses, it can be said that the colour changes are incompatible with the increase in volume and blood load. However, a standard and linear change is not observed.[16]

In the colour change analysis of Groups II and IV, which were soaked with the same blood load, a graphic appearance compatible with increased blood load was not detected [Figure 3].

Group III saturation analysis

According to the ANOVA curve estimation calculation, when the group analysis data were evaluated, it showed decreasing linearity with different slope ratios. While in the Group III saturation graph, which is the colour average saturation sign, a difference and a parabolic curve were determined. When the volume of approximately 90 ml is reached, the bottom point of the parabola has been reached.[16]

Colour analysis

In the colour analysis charts made between groups.

In Group II and Group IV, colour change curves consistent with increasing blood load did not occur.

In the common colour change curve of the four groups, it was determined that there were no more changes in the red colour change curve, where the most changes were expected than the green and blue [Figure 4].

Discussion

Unexpected bleeding following circumcision is the primary concern of practitioners. Early detection of bleeding and accurate calculation of the volume should be made before haemodynamic stability deteriorates.[17] How can correct discharge and follow-up procedures be achieved in the presence of superabsorbent diapers?[5,6,17]

As David A Bolnick emphasises, if there is a bleed, it can quickly be absorbed by the diaper and that leads to an underestimation of the actual blood loss by the practitioner. Likewise, Mense *et al*. who drew attention to the high absorbent capacity of diapers, stated that the amount of patients' blood loss cannot be predicted and that regular control of the patient's haemoglobin values is the most accurate method.[5,6,17-19]

Dan Bollinger, in his study, compared the use of super-absorbent diapers and cotton diapers and stated that mortality due to the use of new generation diapers can be prevented. Bollinger stated that the reported three mortality cases due to circumcision bleeding in the USA were caused due to the unpredictability of bleeding because of the high absorbent capacity of diapers. In addition, he stated that the actual complication and mortality rates after circumcision cannot be known. According to Bollinger, the actual number is higher than stated and the amount in 2010 could have been 47.[20,21]

The relationship between diapers and bleeding is not mentioned in the American Academy of Paediatrics and European Urology Association guidelines.[22-24]

Newborns' blood volumes are the reason they are more susceptible to the consequences of bleeding. The primary cause of neonatal shock is attributed to haemorrhagic shock. The volume of blood to be lost, which is thought to be necessary for the shock to occur, is in the range of 20%–25% of the total blood volume. The average infant has approximately 75–80 ml of blood per kilogram of body weight, and the average birth weight of singletons is 3298 g. According to this data, the total blood volume of newborns is 270 ml and the amount of bleeding that will cause shock in a newborn is around 50 ml.[24-29]

New-generation diapers contain Na-polyacrylate-polymer absorbent material and can trap 30 times their weight in liquid. This structure means that the diaper can store a large amount of blood without causing any visual changes. It was determined that the diaper which we used in our study absorbed 200 ml of liquid without leakage. Considering that the total blood volume of the newborn is approximately 270 ml, a potential large problem could occur.[3,4]

Considering that parents and health professionals who observe the patient after circumcision make decisions according to the appearance of diapers, diaper absorbency becomes crucial. Two important components of the discharge criteria after circumcision are the presence of pain and bleeding.

According to 'Nurse Review's 2010 nursing care plan the neonate at 2 h to 2 days of Age', the situation becomes more complicated when blood is mixed with urine. For this reason, it may be appropriate to avoid the use of super-absorbent diapers in the early stages of circumcision care.[18]

If bleeding is excessive or prolonged, it is important to perform a blood count as the hemoglobin level of the newborn may suddenly drop and it may be difficult to accurately measure the amount of blood lost in the diaper.[5,6,17]

In circumcised patients, there should be no hesitation in making measurable and objective evaluations such as vital signs follow-ups and haemoglobin follow-ups at the slightest suspicion.[5,6,17]

Conclusion

After circumcision is performed under local anaesthesia, late follow-ups are not performed in the health institution. The follow-up of these patients is left to the parents. Bleeding and pain in the early period following circumcision are areas that should be given importance. The findings, obtained from our study, were incompatible with the increase in volume and blood load in colour analysis, both in inter-group and in-group evaluations.

Visual changes of diapers soaked with a similar volume but with an increasing amount show visual changes inconsistent with increasing volume. Changes in diapers soaked with a similar blood load but in an increased amount show visual changes inconsistent with increased blood load. In the analysis separated into two groups, volume and blood load, it was determined that the expected changes between the groups were not observed.

Accordingly, it was concluded that the correct detection of haemorrhages, in which both the increase in fluid volume and the increase in blood load occur, cannot be made accurately by diaper appearance.

Importance of the study

In the study, it has been revealed that visual assessments cannot be trusted in the fight against post-circumcision complications. In the study, it was shown that circumcision complications may change in the future with the use of new techniques and materials.

Future studies

The study should be detailed with different bleeding and urine volumes and rates. Detailed studies should be made using physiological fluids.

Limitations

Isotonic was used, urine which is a physiological fluid was not used. When the amount of bleeding increases, renal blood flow decreases and, the factor of the decrease in urine volume was not evaluated. Urine and blood volume evaluations at different flow rates were not performed. Physiological blood was not used, liquid obtained from erythrocyte suspension was used.

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Conflicts of interest

There are no conflicts of interest.

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