Research Article

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Pediatric Emergency Care and Medicine: Open Access

2016
Vol. 1 No. 1: 4

Video-Distraction System to Reduce Anxiety and Pain in Children Subjected to Venipuncture in Pediatric Emergencies

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Citation: Miguez-Navarro C, Guerrero-Marquez G. Video-Distraction System to Reduce Anxiety and Pain in Children Subjected to Venipuncture in Pediatric Emergencies. Pediatr Emerg Care Med Open Access. 2016, 1:1.

Abstract

We researched the efficacy of distraction with videos in reducing anxiety and pain in children subjected to venipuncture in pediatric emergency. Secondary objectives were to analyze the associations between anticipatory anxiety, real anxiety, perceived pain level and previous history of venipuncture, and between children's and parents' anxiety. We also investigated risk factors for moderate/severe pain.

This was a prospective, randomized, controlled study in children from 3 to 11 attended to in the emergency department of one hospital. Recruited patients in 3 subgroups of age (3-5, 6-8 and 9-11) were randomized in one of two groups, video-distraction or non-video-distraction (control). We used scales to assess anxiety and pain.

A total of 140 children were enrolled, 70 per group. Levels of anticipatory and real anxiety ($p<0.001$) and also pain level ($p<0.001$) were lower in the video-distraction group. There were differences in anticipatory anxiety and previous venipuncture history ($p=0.001$), but not in pain level and previous venipuncture. There were no gender-based differences in anxiety or pain level. We found age-based differences in pain level, this being higher in children 3-5 years old ($p=0.007$). There was strong positive correlation between anticipatory and real anxiety (rho=0.6) and between anticipatory anxiety and perceived pain (rho=0.5). Moreover, the higher the real anxiety, the higher the perceived pain (rho=0.8). There was a poor correlation (rho=0.22) between parents' stress and children's anticipatory anxiety.

Keywords: Anticipatory anxiety; Real anxiety; Children; Guardian

Received: February 05, 2016; **Accepted:** March 08, 2016; **Published:** April 01, 2016

Introduction

One of the most common painful procedures in Pediatrics, including in Emergency, is venipuncture. The WHO and several Pediatric Societies advocate improving the approach to pain and anxiety in children in a medical environment [1]. In the last fifty years many studies have been carried out on the prevention and treatment of anxiety and pain in medical procedures in children. In pediatric emergencies punctures for blood analysis are the primary cause of pain, followed by angiocatheterisms [2-4]. Venipuncture is one of the most feared, distressing and painful invasive procedures in Pediatrics [5]. Owing to a natural fear of needles, almost all children feel anxiety before and during venipuncture, and also pain [6]. Traumatic experiences connected with venipuncture can produce extreme anxiety. Treatment and prevention of pain and anxiety in children are important for their immediate well-being and future development [7,8], including harmful effects on the immune and neurological system, behavior and mental health [9]. Painful experiences in early childhood, their frequency and recall can maintain the negative effects [10-12]. Unfortunately, the management of pain and anxiety in children in health centers is not always good, so this subject needs more research and knowledge [13].

The visual distraction would reduce suffering and, at the same time, allow venipuncture to be performed in an emergency. The distraction diverts the stressful stimulus, and centering the patient on a pleasant stimulus [6,14-18]. We compared anxiety and pain in two groups of children: an intervention group with visual distraction, and a control group (without visual distraction).

Methods

This was a prospective, randomized and controlled study of patients from 3 to 11 years old inclusive, who used the emergency department of a single Level I hospital in Madrid and needed venipuncture, either for blood analysis or to pass a catheter into a peripheral vein. The recruiting period was from July to December 2011 inclusive, on three fixed days per week.

The study was considered to involve a low risk for the patient, and it obtained the pertinent authorization of the Ethical Committee of Clinical Research (Area 1 of Madrid), considering that the study followed the legally-established requirements, and complied with the GCP standards (CPMP/IHC/135/95). Informed consent was obtained from the patient's parents or guardians.

The inclusion criteria were children from 3 to 11 who required venipuncture. Children with psychomotor retardation, chronic pathologies, any consciousness disorder, or who were classified as Priority 1 or Priority 2 (in a system of 5 levels of triage), or whose parents or guardians did not sign the informed consent, were excluded.

Recruited children were assigned by randomization to one of two groups of study: the study group was composed of children to whom the technique of video-distraction was applied, and the control group consisted of children to whom this technique was not applied.

The video-distraction technique consisted of showing short videos of the cartoons most frequently watched by Spanish children (using a portable DVD, LG®). The videos were chosen by each child (they were Doraemon®, Bob esponja® or Shreck®).

Venipuncture was performed in the same way in both groups, with four steps:

- Preparation of the necessary material for the venipuncture.
- Application of the tourniquet, looking for the appropriate vein and disinfection of the zone selected for puncture.
- Vein puncture (for extraction of blood or for catheterization).
- In the case of vein extraction, pressing the punctured area and sticking on a plaster; and in the case of catherization, fixing of the catheter.

Video-distraction was used from the first step of venipuncture, that is, preparation of the material. Children with inclusion criteria were chosen consecutively and assigned by randomization to one of the two groups, and considering three subgroups of age 3-5, 6-8 and 9-11 years old following randomed numbers from 1 to 140, generated by Research Randomizer (http://www.randomizer.org/form.htm).

Variables of the study taken for each patient were: sex, race/ethnic group, age, history of venipuncture (Yes or No; asking parents/guardian if the child has had a venipuncture in the last 2 months before being recruited for this study), technique of venipuncture (venipuncture for blood extraction or for catheterization), level of difficulty of the venipuncture (subjective assessment of the nurse who applied the technique), number of venipunctures up to success, experience of the nurse who performed the venipuncture (more or less than 6 months), level of anticipatory anxiety (from the moment the child knew he/she was going to be punctured to the moment the needle or angiocatheter touched the skin, that is, the anxiety which the child felt 1-5 minutes before the puncture), level of real anxiety (from the moment the needle touched the skin to the moment when it was extracted), level of anxiety of the parents/guardians (assessed from the moment parents were informed about the necessity of venipuncture up to the moment the nurse started the technique). The presence of parents/guardians was not allowed in the study group, because it was considered that their presence could be a non-pharmacological method to reduce anxiety in children, and it could be a bias). The level of pain was recorded (the child was asked about the level of pain that he/she felt during the puncture), and also the child's heart pulse (in beats per minute (bpm)).

The following methods were used to evaluate variables:

Level of child anxiety-Groninger Distress Scale [19]: This is a validated scale with five levels, from level 1, in which the patient has no anxiety or stress, to level 5, in which the child has extreme anxiety.

Level of anxiety of companions (parents/guardians)-we devised an observational assessment consisting of three steps:

- Basal state of anxiety
- Collaboration with the health staff
- Behavior with the child (whether they try to calm the child).

This scale was considered at four levels:

- Level 1, companion who looks calm, is co-operative with the staff, and tries to calm the child
- Level 2, companion who appears anxious, but tries to calm the child
- Level 3, companion who appears anxious and does not calm the child
- Level 4, companion who appears very anxious, is not very or not at all co-operative with the staff, and does not calm the child.

Level of pain: To measure the pain perceived by the child during the venipuncture, we used validated and adapted scales for each age group. All children could say how much pain they felt. In children 3 to 7 years old the Wong-Baker scale (Copyright 1983, Wong-Baker FACES ™ Foundation, www.WongBakerFACES.org. Used with permission) was used: it is a visual analog scale with drawings of faces expressing different degrees of pain; there are 6 faces, and each face has a score (0, 2, 4, 6, 8 and 10; where 0 is no pain, 2 is mild pain, 4 and 6 are moderate pain, and 8 and 10 are severe pain). In children older than 7 we used the verbally administered numerical rating scale [20] (numerical scale with regular intervals of one unit from 1 to 10, 0 being no pain and 10 the maximum pain possible).

Level of venipuncture difficulty: To assess the difficulty we devised a graduated numerical scale from 1 to 5 (1 for very easy, 2 for easy, 3 for normal, 4 for difficult, and 5 for very difficult to carry out). The nurse assessed the level of difficulty after venipuncture.

The primary outcome was to study the efficacy of the use of a video-distraction system to reduce anxiety and pain in children (3 to 11 years old) on whom venipuncture was performed in an emergency department.

The second outcomes were:

- To determine whether there is a correlation between the stress or anxiety of children before the procedure (anticipatory anxiety) and during the procedure (real anxiety), and the level of perceived pain.
- To determine whether the level of anxiety of the relatives who accompany children is correlated with the anticipatory stress, real stress and pain of children due to venipuncture.
- To determine the correlation between anticipatory and perceived anxiety during the procedure in children who had had venipuncture in the two previous months.
- To analyze the risk factors of moderate/severe pain related to venipuncture.

Descriptive statistics were assessed using means (SD). Pearson's chi-square test and Fisher's test were used to analyze the association of qualitative variables. Pearson's linear correlation coefficient (r) was used to analyze linear association between two variables. Data were also analyzed with nonparametric methods when the sample was small or distribution of the population data was free (Kruskal-Wallis H test, Mann-Whitney U test and Spearman's correlation coefficient [rho]). Logistic regression analysis was also used to analyze the relationship between some categorical dependent variables and one or more independent variables. Computer analysis was performed with SPSS (version 16.0; IBM Corporation, Armonk, NY).

Results

For six months, 27,831 children were attended to in the emergency department of one hospital. Of these, 2,480 (8.9%) received venipuncture, and 868 were aged between 3 and 11 years old, of whom 375 received venipuncture during the three recruiting days. Out of these, 160 children had inclusion criteria. A total of 140 of these were included in the study (17 were not included because of overload in the department and 3 because parents did not consent), 70 in the video-distraction group and 70 in the control group. Children in both groups were divided into subgroups: a) Video-distraction group: 26 children 3-5 years old, 19 children 6-8 years old and 24 children 9-11 years old; b) Control group: 27 children 3-5 years old, 21 children 6-8 years old and 23 children 9-11 years old. This distribution was homogeneous, so groups were comparable.

Demographic data and characteristics related to venipuncture are shown in **Table 1**. There were no significant differences in the characteristics of the two groups of study, except in the experience of nurses (p=0.005), with more experienced nurses in the control group (90.0% with more than 6 months of experience) than in the video-distraction group (71.4% with more than 6 months of experience). This last difference was not considered a reason to regard the sample as not comparable.

Table 1 Demographic and venipuncture characteristics of the 140 children recruited.

Children's characteristics	N (%)
Sex	
- Male	81 (57.9)
- Female	59 (42.1)
Age	
- 3-5 years old	53 (37.9)
- 6-8 years old	40 (28.6)
- 9-11 years old	47 (33.6)
Race/Ethnic group	
- Asian	1 (0.7)
- Spanish	104 (74.3)
- Gypsy	11 (7.9)
- Hispanic American	11 (7.9)
- Black	4 (2.9)
- East European	9 (6.4)
History of venipuncture (last 2 months)	
- Yes	23 (16.4)
- No	117 (83.6)
Heart pulse (beats per minute)	**Mean ± SD**
- Before venipuncture	102.86 ± 19.24
- During venipuncture	115.76 ± 20.09
- After venipuncture	103.94 ± 20.11
Technical characteristics	**N (%)**
Type of technique	
- For blood extraction	87 (62.1)
- For peripheral vein catheterization	53 (37.9)
Number of attempts	
- 1	114 (81.4)
- 2	26 (18.6)
Nurse's experience with venipuncture	
- <6 months	27 (19.3)
- >6 months	113 (80.7)
Level of difficulty	
- 1 (very easy)	34 (24.3)
- 2 (easy)	63 (45.0)
- 3 (normal)	39 (27.9)
- 4 (difficult)	4 (2.9)
- 5 (very difficult)	0 (0.0)

The mean age of the all patients included in the study was 6.82 years old, 76 males (58.5%) and 54 females (41.5%). The mean age was 4.03 (SD=0.75) in the subgroup 3-5 years old, 7.0 (SD=0.75) in the 6-8 subgroup and 9.85 (SD=0.85) in the 9-11 subgroup. A total of 23 (16.4%) children had had venipuncture in the two previous months.

There were no differences in anticipatory anxiety depending on the sex (p=0.61). Children 3-5 years old had more significant anxiety than the other two age subgroups (p=0.006). Children with history of venipuncture in the last two months had more significant anxiety (p<0.001).

There were significant differences in the level of pain depending on the age: a higher level of pain in children 3-5 years old than in the other two age groups (p=0.007), and in children with more than one attempt to puncture (p<0.001). There were no

significant differences in the level of pain related to sex, history of venipuncture in the two previous months, venipuncture technique or the experience of the nurse.

In the analysis of anxiety level between intervention groups (video-distraction v. control) we found: 1) In the total group of children, significantly lower levels of anticipatory anxiety were detected in the video-distraction group (p<0.001) **(Table 2)**; and significantly lower levels of real anxiety were observed in the video-distraction group (p<0.001). The level of real anxiety was non-existent or mild in 97.1% and moderate in 2.9% of children in the video-distraction group, and there was no case of severe anxiety. The control group showed non-existent or mild real anxiety in 52%, moderate anxiety in 35.7% and severe anxiety in 11.4% **(Table 2)**. 2) In anticipatory anxiety in subgroups of age, significant differences were observed in two subgroups of age, there being a lower level of anticipatory anxiety in children 3-5 years old (p<0.001) and 6-8 years old (p=0.043) in the video-distraction group. In children 9-11 years old it was not significant (p=0.06). 3) In real anxiety in age subgroups, significant differences were observed in all subgroups of age (p<0.05), there being a lower level of real anxiety in the video-distraction group.

Results (mean ± SD) comparing anticipatory and real anxiety in video-distraction and control groups, in all children and in subgroups of age, are shown in **Table 3**.

In the analysis of pain-level perception between intervention groups (video-distraction v. control) we found:

- The mean level of pain was 4.45 (SD 2.49) in all children, 3.18 (SD 1.72) in the video-distraction group and 5.74 (SD 2.48) in the control group. There was a significant difference (p<0.001; CI 95%: 1.87-3.30; SEM: 0.31) between the video-distraction and the control group. Moderate/severe pain was more frequent in the control group (78% of children) than in the video-distraction group (40% of children).
- In age subgroups, significant differences in pain levels between video-distraction and no video-distraction were found in each age subgroup (Table 3). Moderate/severe pain was significantly more frequent in patients without video-distraction in the three age groups (p<0.001 for 3-5 years old group, p<0.001 for 6-8 years old group and p<0.006 for 9-11 years old group) **(Figure 1)**.

In the analysis of heart pulse between intervention groups (video-distraction v. control) we found a significantly higher heart pulse in the control group than in the video-distraction group (p=0.01),

Table 2 Level of anticipatory and real anxiety in video-distraction and control groups.

Anticipatory anxiety	Video-distraction group N (%)	Control group N (%)	Significance level (p)
None	24 (34.3)	10 (14.3)	<0.001
Mild	46 (65.7)	36 (51.4)	
Moderate	0 (0.0)	20 (28.6)	
Severe	0 (0.0)	4 (5.7)	
Real anxiety	**Video-distraction group (%)**	**Control group N (%)**	**p**
None	0 (0.0)	1 (1.4)	<0.001
Mild	68 (97.1)	36 (51.4)	
Moderate	2 (2.9)	25 (35.7)	
Severe	0 (0.0)	8 (11.4)	

Table 3 Anticipatory anxiety, real anxiety and perceived pain in video-distraction and control groups.

	Video-distraction group (mean ± SD)	Control group (mean ± SD)	Significance level (p)
Anticipatory anxiety			
Total	1.76 ± 0.62	2.80 ± 1.17	<0.001
Age (years) subgroups:			
3-5	1.92 ± 0.69	3.41 ± 1.01	<0.001
6-8	1.76 ± 0.62	2.63 ± 1.21	=0.043
9-11	1.57 ± 0.51	2.25 ± 1.03	=0.06
Real anxiety			
Total	2.33 ± 0.53	3.34 ± 0.99	<0.001
Age (years) subgroups:			
3-5	2.58 ± 0.64	3.74 ± 0.76	<0.001
6-8	2.29 ± 0.46	3.47 ± 0.90	<0.001
9-11	2.09 ± 0.29	2.47 ± 1.09	=0.003
Perceived pain			
Total	3.18 ± 1.72	5.74 ± 2.48	<0.001
Age (years) subgroups:			
3-5	3.38 ± 2.01	6.52 ± 2.69	<0.001
6-8	2.86 ± 1.62	5.89 ± 1.85	<0.001
9-11	2.61 ± 1.12	4.75 ± 2.46	<0.001

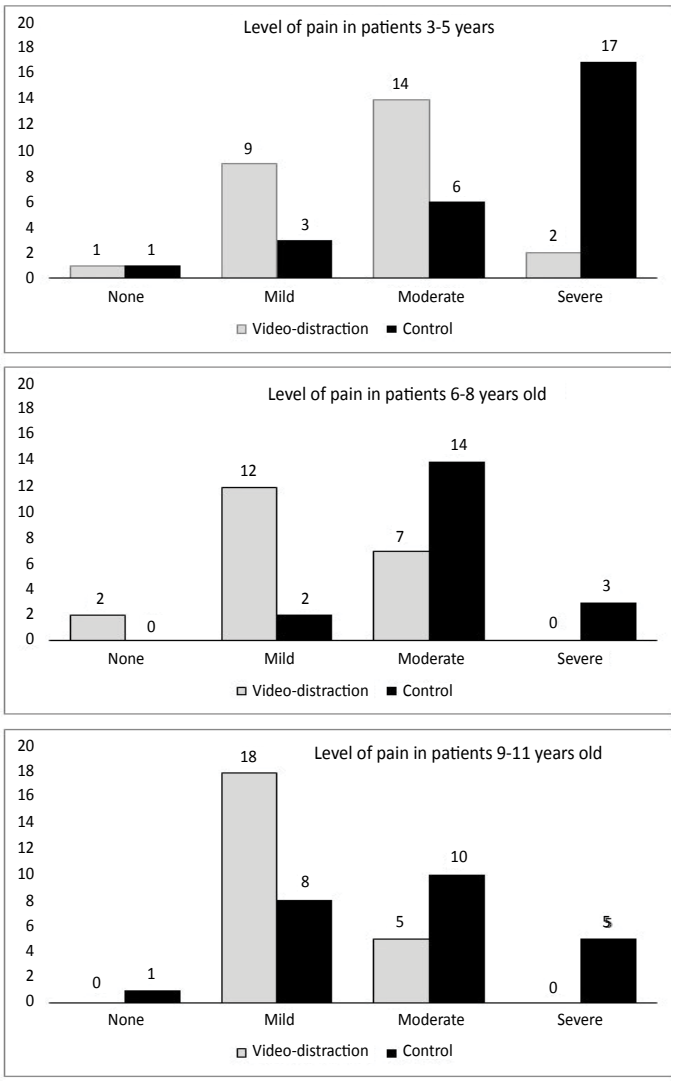

Figure 1 Pain level in subgroups of age in patients subjected to venipuncture with or without video distraction (figures represent absolute number of children).

in the three moments of the intervention: before, during and after venipuncture.

In the correlation analysis by Spearman's test (rho) we found that:

- There is a strong correlation (rho=0.658) between anticipatory and real anxiety level, meaning that the higher the child's anticipatory anxiety level, the higher that child's real anxiety. There was also correlation between anticipatory anxiety and level of perceived pain (rho=0.540), the level of pain being higher when the anticipatory anxiety was higher.
- There was a strong correlation (rho=0.799) between the real level of anxiety just before the procedure and the perceived pain, the pain level being higher when the real anxiety was higher.
- Considering age groups, a strong correlation was observed between real anxiety level and level of pain in all age groups: rho=0.757 for 3-5 years old group, rho=0.846 for 6-8 years old group, and rho=0.748 for 9-11 years old group.
- There was a poor correlation between parents' anxiety and anticipatory anxiety of children (rho=0.24).

Risk factors for moderate/severe pain in venipuncture were researched by logistic regression analysis. The result was that younger age, venipuncture without video-distraction and a higher number of attempts at venipuncture predispose to moderate/severe pain.

Discussion

In this study 75% of patients who received venipuncture without video-distraction showed anxiety before the procedure, and 40% showed moderate/severe anxiety; 98% of patients without distraction showed anxiety during the procedure, and 49% a moderate/severe level. Similar results have been published before. In a study of 171 children, in which the level of stress was analyzed before and during venipuncture, it was found that 34-64% of children from 3 to 6 years old had moderate/severe stress [21]. In another study, 63% of children from 7 to 18 remembered having an unpleasant and painful venipuncture, and 46% afterwards described their fear as "very" or "extremely" high [22].

There are several studies showing the efficacy of visual distraction to control anxiety and pain in children who experience painful procedures, for example, venipuncture. Reinoso Barbero studied the prevalence of pain in pediatric patients in hospital, and found that 80.3% of children recognized that pain had been reduced by the use of different distraction techniques [2].

Timing is also an important factor in the efficacy of distraction. In order to minimize anticipatory anxiety and to accelerate emotional recovery after the event, distraction should begin as soon as the child goes into the treatment room and should continue for several minutes after the procedure [23]. In our study, video-distraction started when the decision to perform venipuncture was taken, and just before the preparation of material commenced.

Several distraction systems have been studied, and if it is to be efficient, distraction has to be adapted to and attractive for the child [24]. The efficacy of visual distraction by showing cartoons has been demonstrated in the majority of children, and it is an easy and sure system [5,18,25-29]. Children feel anxiety both before and during the procedure [30], and any intervention to prevent or reduce anxiety has to begin as soon as possible, including waiting time, preparation, procedure and end. This is supported by a prospective randomized study carried out for Capilli et al. in 2007 with interactive music [31].

Our study demonstrates, like other studies [32-34], that children who received visual distraction from cartoons had lower anxiety levels, both before and during the procedure. The anxiety in the video-distraction group can be lower than in the control group, because the stress due to the future painful procedure is mitigated by watching cartoons and the child is not conscious of the preparation of the material, and does not pay attention to any elements which produce fear [35]. Children without video-distraction, as they did not have any compensatory stimulus, are more conscious of the technique and its preparation.

We found that video-distraction had a higher benefit in younger children (groups of 3-5 and 6-8) by reducing anticipatory anxiety. But during the venipuncture all age groups showed much lower anxiety levels in the video-distraction group than in the control group, as other studies with different techniques to reduce anxiety have shown [36].

As in our study, Vassey et al. demonstrated that distraction using a kaleidoscope reduced the pain and anxiety in children caused by venipuncture [37]. Studies carried out by Cohen et al. suggest that means of distraction adapted to age (appropriate films depending on age, use of rattle or stuffed animals) plus a training for adults result in behavior expressing less pain in babies and infants [23]. Other studies confirm that using distraction is efficient to reduce perceived pain caused by minor painful procedures [5,14,33,37,38].

We found higher levels of anxiety among younger children - in children aged 3-5 the level was higher than in 6-8 and 9-11 year-olds (p=0.006), and the same was observed by other researchers [39,40]. Some studies indicate that men and women differ in the way they feel emotional events, and the studies observed, in painful and unpleasant events, a higher level of anticipatory anxiety in women than in men [41,42]. Results in our study do not confirm this, because we did not find differences in anticipatory anxiety between the sexes, as in the study of Sikorova et al. in children 5-10 years old [40]. In addition, like other authors, we did not find any difference between the sexes in the perception of pain [43-45]. Goodenough et al., in a study about the effect of age and sex on the feeling of pain caused by needle, observed that girls showed a higher level of pain from 8 years old, but boys and girls younger than 8 had the same score for pain [46]. And other researchers have reported differences in pain expression between boys and girls during invasive procedures [23].

Wong and Baker [47] and Duff [22] indicate that repetitive venipunctures are a stressful and painful experience for children. Prior experience of venipuncture can increase the anticipatory anxiety level in children, especially in those for whom the previous procedure was inappropriate or bloody. Our results coincide with previous discoveries in other studies [36,39,40,48], because we detected differences ($p<0.001$) in anticipatory anxiety dependent on whether there was a history of venipuncture in the two previous months; but some studies did not find a relationship between anxiety and recent venipuncture [45]. But, unlike the case with anxiety, we did not find any difference in the pain level between children with or without a recent history of venipuncture.

The threshold of pain is different with age, and it is known that younger children have a lower threshold [49-51]. In general, younger children (e.g., 4-6 years old) report more pain than older children (7 or older) with the same stimulus [52], and more fear and phobia [53]. Our results are similar to those of previous studies, observing a higher pain level in younger children, from 3 to 5 (p=0.007). Nevertheless, Cummings et al. did not find any relationship between age and pain level [3].

Patients who suffer painful procedures feel more anxiety when the painful event is unpredictable [54]. We found differences in the pain level depending on the number of attempts at venipuncture, the level being higher in patients for whom more punctures were necessary. Some studies have researched into whether the parents' behavior can have an influence on the child's anxiety. Broome et al. observed that parents' anxiety can affect the child's anxiety and pain, and training of parents had positive results on the children's behavior during the procedure [55]. In their study, James et al. found that pain perception in children was lower when the child's companion during the procedure was the father than when the companion was the mother or a grandparent, and this could be caused by the higher stress in the latter, which affected the child [56]. But, in our study, we did not find any correlation between the anxiety of the parents and that of the child during venipuncture. This could be due to the fact that the parents did not stay with the child during the procedure; and this could be a research bias (mentioned in 'Limitations'), but another possibility, not investigated, is that the anxiety was alleviated as much by the staff who carried out the procedure in the control group as by the calming effect of the video in the video-distraction group.

In conclusion, video-distraction is an efficient, safe, easy and cheap method to use in a pediatric emergency department to reduce anxiety and pain in children who are subjected to a very common procedure such as venipuncture.

Limitations

This study has several limitations. On the one hand it is a study in a single center and with a limited number of patients, in the other hand is not a blind study due to the characteristics of the intervention. The visual distraction that we used was short of cartoons selected previously by the researchers. Perhaps if the cartoons were selected by the children, the distraction level could be higher.

Conclusions

Video-distraction in pediatric emergency can be a useful method to reduce anxiety and pain in children subjected to venipuncture.

Acknowledgements

The authors would like to thank Dr. Ana Moreno Cerro, who provided medical writing assistance, and José María Bellón who provided statistics; and nurses from the Emergency Department of the Gregorio Marañón Hospital (Madrid) without whom this research would have been impossible.

Compliance with Ethical Standards

The authors declare that they have no conflicts of interest. The study was considered to involve a low risk for the patient, and it obtained the pertinent authorization of the Ethical Committee of Clinical Research (Area 1 of Madrid), considering that the study followed the legally-established requirements, and complied with the GCP standards (CPMP/IHC/135/95). Informed consent was obtained from the patient's parents or guardians.

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