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Effect of Valsalva Maneuver Application Versus Virtual Reality on Children's Pain Intensity during Peripheral Cannulation

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Abstract: Background: Pediatric nurses spend a considerable time on IV cannulation procedures for children. It often requires the involvement of experienced nurses to perform this procedure **Purpose**: To examine the effect of Valsalva Maneuver application versus Virtual Reality use on children's pain intensity during peripheral cannulation. **Design:** A quasi-experimental research design was used. **Setting:** The study was conducted at the Emergency Department of Alexandria University Children's Hospital El Shatby. **Sampling:** 150 children who attended the previously mentioned settings were included in the study.**Instruments:** Three instruments were used (Children's Characteristics and their Medical Data Assessment Sheet, Faces, Legs, Activity, Cry, Consolability (FLACC) Pain Assessment Scale and Wong–Baker Faces Pain Rating Scale). **Methods:** All children in the three groups were received routine hospital care. While the study group I applied the Valsalva Maneuver and study group II used the Virtual Reality Goggles. **Results:** Although 80% of children in the control group had observable severe pain, only 16% of children who had VM and none of children who had VR had severe observable pain. Moreover, 80% of children in the control group perceived intense pain compared to 16% and none of children in the VM and VR groups respectively **Conclusions:** Both Valsalva Maneuver and Virtual Reality were effective in decreasing children's observable pain as well as pain intensity during peripheral cannulation. **Recommendations**: Pediatric nurses in the emergency department should be trained to use different non-pharmacological pain management modalities such as Valsalva maneuver and Virtual Reality to decrease children's suffering during peripheral cannulation.

Keywords: *Valsalva Maneuver, Virtual Reality, Children's Pain Intensity, Peripheral Cannulation.*

Introduction

Pediatric Intravenous (IV) cannulation is an essential part of current medicine and is practiced in almost all healthcare settings. Venous access allows blood sampling, administration of fluids, medications, parenteral nutrition, chemotherapy, and blood products. Intravenous cannulation is not without adverse events despite of its daily practice. It is one of the primary sources of procedure-related pain in pediatric hospitals. A fast and efficient venous cannulation is necessary for patient management, especially in emergency settings. However, IV cannulation is often a challenging experience for children, caregivers, and parents. Various studies on routine venous access procedures have demonstrated high levels of distress experience among adolescents, schoolers, preschoolers,

and toddlers. The primary cause of distress among pediatric patients is the pain associated with cannulation (Ohara et al., 2012, , Ben Abdelaziz et al., 2017 & Saju et al., 2019).

Pediatric nurses spend a considerable time on IV cannulation procedures for children. It often requires the involvement of experienced nurses to perform this procedure. The average time required for peripheral IV cannulation is reported as 2.5-16 minutes, with difficult IV access requiring approximately 30 minutes. Therefore, a delay in carrying out the treatment can occur (Rowley S. 2019 & Savino et al. 2013). In most cases, due to fear, restlessness among children, and small veins, it often requires multiple cannulations attempts to obtain patent intravenous access. These multiple cannulation attempts can further increase the experience of pain and discomfort in children (Negri et al. 2012, Ramalho et al. 2017 & Saju et al. 2019)

Distraction is one of the non-pharmacological techniques that aim to reduce pain intensity. It encourages a child to turn his or her attention to something aside from the agonizing experience. Furthermore, distraction methods not only lessen pain and anxiety during painful and invasive interventions, but also reduce the number of trials needed to get the vascular access in a shorter period. Distraction methods can be classified as active and passive types. The active distraction includes techniques like video games (VG), Virtual Reality (VR) glasses, managed respiration, and relaxation. The child will become concerned with some diversion throughout the medical procedure while using the active distraction. On the contrary, passive distraction includes strategies in which the child will just being attentive to something like listening to a song or watching television. Both approaches are usually used when a child needs to remain calm and quiet throughout the painful part of the procedure (Bukola and Paula 2017 ,Gonnade et al. 2017 & Soliman, Ouda, and Mahmoud 2019).

Vagal nerve stimulation (VNS) effectively reduces human pain and is stimulated by the Valsalva Maneuver (VM). This method is a simple pain-alleviating physiological technique with fast onset with no pharmacological side effects. It attenuates venipuncture pain by both somatic and distraction mechanisms. It reduces the child's fear, anxiety and enhances the coping ability for procedural pain. Applying the VM during peripherally inserted venous catheter PIVC decreases the severity and frequency of pain by raising the pressure in the chest cavity, which causes the vagal nerve to respond. (Mohammadi et al. 2011, Akdas et al., 2014, Kumar et al., 2018 & Tapar et al., 2018).

Virtual reality (VR) simulation is a computer-based technology that creates an artificial three-dimensional (3D) environment. It uses a combination of tactile, auditory and visual stimuli to create the illusive experience. It consists of a head-mounted display and a thick pair of goggles that are connected to either a computer or a mobile phone. The headset has sensors that follow users' head movements, creating the illusion of moving around in the virtual space. The idea behind VR's role in reducing pain is related to the limited attentional capacity in which the child will have a slower response to incoming pain signals. Virtual reality does not interrupt the pain signals but acts directly and indirectly on pain perception and signaling through attention, emotion, concentration,

memory, and other senses (Arane, Behboudi, and Goldman 2017,Bukola and Paula 2017& Finianos and Elisabet, 2021).

Pediatric nurses play a crucial role during peripheral cannulation. Most of the interventions and prevention strategies such as insertion, monitoring and assessing peripheral venous cannula (PVC) sites are part of routine nursing care. Nurses should have accurate knowledge and practice of the preparation and insertion of the IV cannula. In addition, they should also maintain safety and comfort of the child all over the cannulation procedure. Numerous distractive and non-pharmacological modalities can be applied by pediatric nurses to decrease pain during this invasive procedure (Rn et al. 2012, Soliman et al. 2019 & Mohamed, Ahmed, and Tawfic 2020).

Significance of the study

Peripheral cannulation is a daily procedure in the pediatric emergency department. Despite of its live-saving purposes, it induces pain and discomfort for children. Consequently, pain assessment and management using the non-pharmacological modalities such as Valsalva Maneuver and Virtual Reality are required. Above all, limited studies are done to examine the effect of their utilization on pain during peripheral cannulation in Egypt. For this reason, this study will be conducted.

Purpose:

To examine the effect of Valsalva maneuver application versus Virtual Reality use on children's pain intensity during peripheral cannulation.

Research Hypotheses

1. Children who apply Valsalva Maneuver during peripheral cannulation will exhibit less pain intensity than those who do not.
2. Children who use Virtual Reality during peripheral cannulation will exhibit less pain intensity than those who do not.
3. Children who use Virtual Reality during peripheral cannulation will exhibit less pain intensity than those who apply Valsalva Maneuver.

Operational Definition

In the current study:

- Virtual Reality: It is a non-pharmacological pain management technique in which a 3D goggles is placed on the child's head and animated cartoon is exhibited for five minutes before, during and after 5 minutes of peripheral cannulation.
- Valsalva Maneuver: It is a non-pharmacological pain management technique in which the child forcefully attempts to exhale against a closed balloon before, during and after 5 minutes of peripheral cannulation.

Methods

Research Design

An independent treatments group design (parallel group design) was used to accomplish this study.

Setting

The study was conducted at the Emergency Department of Alexandria University Children's Hospital (AUCH) - at El Shatby, Alexandria, Egypt.

Sampling

A convenient sample of 150 children who attended the previously mentioned setting was included according to the following inclusion criteria:

1) Age from 3-6 years old.
2) Fully conscious.
3) Free from diseases associated with hypertension such as Nephrotic Syndrome and Glomerulonephritis

because Valsalva Maneuver may induce hypertension (Kumar et al., 2018).

4) Free from any mental disability in order to be able to understand and follow the instructions during the application of Valsalva Maneuver as well as Virtual Reality.

Instruments:

Three instruments were used to collect the necessary data.

Instrument One: Children's Characteristics and their Medical Data Assessment Sheet:

This instrument was developed by the researchers after comprehensive review of recent and relevant literature (Mohamed et al. 2020). It was used to assess the children's characteristics and their medical data. It included the following: age, gender, diagnosis, history of previous cannulation and cannula size.

Instrument Two: Faces, Legs, Activity, Cry, Consolability (FLACC) Pain Assessment Scale)

FLACC Pain Assessment Scale was adopted from Bokola & Paula (2017) and translated by Shabana & Ibrahim (2018) . It relied on behavioral indicators to assess children's pain. This instrument is a checklist that aimed to examine the child's behavior in response to pain. It was developed for children aged two to seven years. It included face, legs, activity, cry and consolability criteria. Scoring system for each criteria was zero (no pain), one (some pain) and two (pain). Total scoring system was zero for relaxed and comfortable. Mild discomfort ranged from 1-3 degrees. Scores indicating moderate pain ranged between 4 – 6. Higher scores which ranged between 7 – 10 indicated severe pain, severe discomfort or both. (r = 0.93).

Instrument three: The Wong–Baker Faces Pain Rating Scale

This instrument was adopted from Finianos & Elisabet, 2021 and Gupta et al., 2016. The Wong–Baker Faces Pain Rating Scale is a pain scale that was initially developed by Donna Wong and Connie Baker (Finianos & Elisabet, 2021 and Gupta et al., 2016). It is a self-report scale used by the child to express his/her perception of pain intensity. It was developed for children aged from 3-18 years of age. There are 6 faces in the Wong-Baker Pain Scale. The first face represented a pain score of 0 indicating "no hurt". The second face represented a pain score of 2, and indicated "hurts a little bit." The third face represented a pain score of 4 which indicated "hurts a little more". The fourth face represented a pain score of 6 and indicating "hurts even more". The fifth face represented a pain score of 8 and indicated "hurts a whole lot". Finally, the sixth face represented a pain score of 10 indicating "hurts worst." (r = 0.87)

Fig.1. Wong-Baker Faces Pain Rating Scale

Source: Finianos, Jessica, and S. Elisabet. 2021

Pilot Study:

A pilot study was carried out on 10% of the study (15) child to ensure the clarity, estimate the time required to fulfill the questions and assess their appropriateness. No modifications were needed. Pilot study sample was excluded from the total studied sample.

Ethical Considerations

Approval from the Research Ethics Committee of the Faculty of Nursing at Alexandria University was obtained before conducting the study. Written informed consent was obtained from the children's caregivers after explaining the purpose and methods of the study. Caregivers had the right to voluntary enroll their children in the study. Caregivers had the right to withdraw their children from the study at any time during the implementation of the study. Privacy of children and confidentiality of the collected data were maintained throughout the study period. Anonymity of children was considered throughout the implementation of the study.

Procedure:

A written approval was obtained from the directors of the previously mentioned setting after an official letter was submitted from the Dean of the Faculty of Nursing explaining the purpose and methods of data collection.

The total study sample was randomly assigned to three equal groups:

- **Group I** (control group) consisted of 50 children. They only received routine hospital care during peripheral cannulation.
- **Group II** (study group I) consisted of 50 children. They were subjected to Valsalva Maneuver application.
- **Group III** (study group II) consisted of 50 children. They were subjected to Virtual Reality use.

General characteristics and medical data for all children were obtained using **instrument one.** Data collection started with control group, followed by study group I then study group II . For children in the control group, objective pain intensity assessment was performed by the researcher for all children using **FLACC Scale (instrument II)** during the cannulation procedure to meticulously assess child's behaviors towards pain. Subjective pain intensity assessment was performed by every child using **Wong–Baker Faces Pain Rating Scale (instrument III).** This was done immediately after the cannulation procedure. Every child was asked to choose the face that best describes his/her feeling of pain. The number parallel to each face was recorded down by the researcher.

The researchers performed a role play about the Valsalva technique in front of every child in study group I. It was done for 3-5 times and lasted about 5-7 minutes. This role play was performed while the assigned nurse was preparing the peripheral cannulation equipment. Every child was permitted to choose the favorite color and shape of the used balloon. Then, children were instructed to, sit or lie down, inhale deeply and hold breath, bear down as though straining to initiate a bowel movement, hold on in this position for 10 -15 seconds, blow-up the balloon and finally resume normal breathing.

Objective pain intensity assessment was performed by the researcher for all children using FLACC Scale (instrument two) during the cannulation procedure and subjective pain intensity assessment was performed by every child using Wong–Baker Faces Pain Rating Scale (instrument three) immediately after the cannulation procedure

of the Masha and Bear Cartoon movie was freely downloaded to the researcher mobile phone, VR goggles headset was opened, the researcher turned on the cartoon movie. Then, the researcher placed the smartphone as shown in the picture below, the headphones of the goggle's headset were connected to the researcher mobile phone, VR headset was closed.

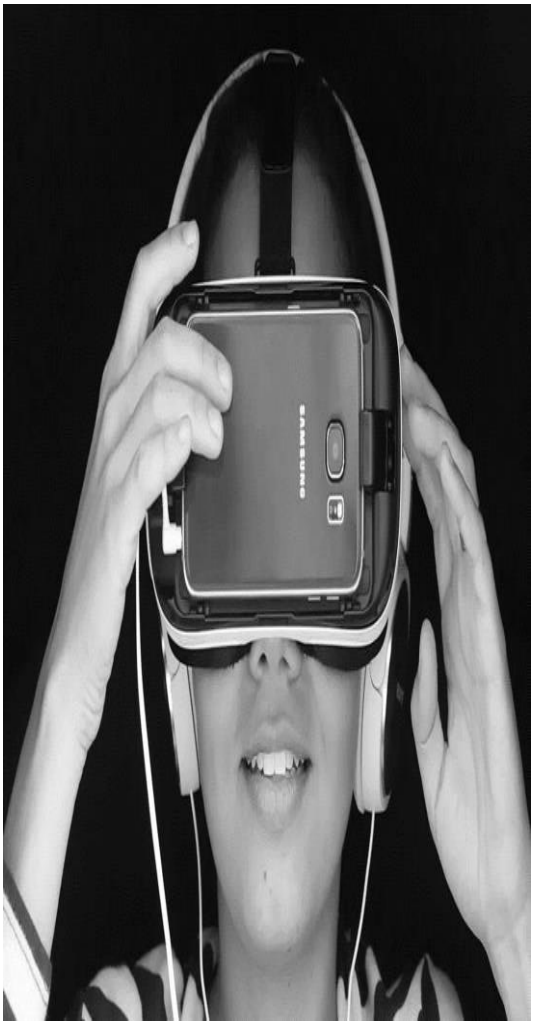

Fig.2. Virtual Reality Goggles Attached with Smart Phone and Headset with Headphones
Source: Bollys, 2022.

Children in the study group II were assisted by the researchers to place the VR headset on child's head, adjust the spacing of lenses as well as focus, watch the 3D movie and connect the sound system via the headphones. Objective and subjective pain intensity were performed as previously described.

A comparison was done between the three groups to evaluate the effect of Valsalva Maneuver application versus Virtual Reality use on children's pain intensity during peripheral cannulation. The total time elapsed with every child in the three groups takes from 20-30 minutes. Data collection continued for a period of two months extending from May-June 2022.

Statistical Analysis

The raw data were coded and transformed into coding sheets. The results were revised. The data was then entered into SPSS (version 20) using a personal computer. Output drafts were checked against the revised coded data for typing and spelling mistakes. Finally, analysis and interpretation of data were conducted. The following statistical measures were used: Descriptive statistical measures included numbers, percentages, minimum, maximum, arithmetic mean and standard deviation, statistical analyses: Paired ttest, Chi square ($\chi 2$), Fisher exact and Pearson's Correlation Coefficient (r) .The significance of the results was set to the level of 5%.

Results

Table 1 shows the characteristics of children in the study groups (Valsalva Maneuver (VM), Virtual Reality (VR) and control group). The children's mean age was 4.2400, 4.8400 and 3.9800 years in the VM, VR, and control groups respectively. As for gender, 66 % of children in the VM and 64 % in the control groups were boys. On the other hand, 62% of children in the VR group were girls. Children with surgical problems accounted for 34 %, 30 % & 46% of children in VM, VR and control groups respectively. As for the history of

previous cannulation, 76 % of children in the VM and 92 % of the control groups had no previous cannulation before. While Data collection covered a period of two months from May-June 2022.

Table 2 shows distribution of children in the study groups (VM and VR) and control group according to observed pain behaviors of FLACC scale. For face observed pain behaviors, 16% of children in the VM and none in the VR groups showed constant frowning, clenched jaw, and quivering chin during peripheral canulation. Whereas, 60% of children in the control group showed the previous behaviors. As regards legs observed pain behaviors, 12% of children in the VM and 10% in the VR groups showed legs kicking or drawing up during peripheral canulation. Regarding observed pain activity, 10% of children in the VM and 0% in the VR groups were arched, rigid, or jerking during peripheral canulation. But 42% of children in the control group showed the earlier behaviors. Concerning crying, 24% of children in the VM and none in the VR groups were crying steadily, screaming or sobbing with frequent complaints during peripheral canulation. As for Consolability, none of children in the VM or VR groups were difficult to console or comfort during peripheral canulation. It was clear that children in the control group had more severe behavioral responses to pain than children in the study groups. There were statistically significant differences between three groups regarding their observed pain behaviors.

Table 3 shows distribution of children having different levels of observed pain behaviors in the Valsalva maneuver, Virtual Reality and Control Groups. Regarding the severity of observed pain behaviors, 16% of children in VM , 0% in VR and 80% in the control groups showed severe pain or discomfort during peripheral cannulation. There was a strong negative correlation with statistically significant difference between the three groups with (rs) = - 0.716- & P= 0.000.

Table 4 shows distribution of children having different levels of perceived pain behaviors in the Valsalva Maneuver, Virtual Reality and Control Groups .Regarding the perceived pain intensity, none of children in VM and VR groups felt that it hurts worst compared to about one third (32 %) of children in the control during peripheral cannulation. While 6% of children in VM, 22% in VR and none of children in the control groups expressed that they felt no hurt during peripheral cannulation. There was a moderate negative correlation with statistically significant difference between the three groups with (rs) = - 0.641 & P=0. 000.

Table (1): Characteristics of Children in the Study Groups (Valsalva maneuver and Virtual Reality) and the Control Group (n=150)

Characteristics	Valsalva Maneuver (VM)Group		Virtual Reality (VR) Group		Control Group		Total (150)		Test of Significance
	No (50)	%	No (50)	%	No (50)	%	No (150)	%	
Age/year:									
3-	15	30.0	10	20.0	18	**36.0**	43	28.6	**χ2= 59.066 P= .000 ***
4-	8	16.0	10	20.0	15	30.0	33	22.0	
5-	27	**54.0**	8	16.0	17	34.0	52	34.7	
6	0	0.0	22	**44.0**	0	0.0	22	14.7	
Minimum	3.00		3.00		3.00		3.00		
Maximum	5.00		6.00		5.00		6.00		
Mean /SD	4.2400/ .89351		4.8400/ 1.20136		3.9800/ .84491		4.3533/ 1.05000		
Gender:									
Boy	33	**66.0**	19	38.0	32	**64.0**	84	56.0	**χ2= 9.903 P= .007 ***
Girl	17	34.0	31	**62.0**	18	36.0	66	44.0	
Diagnosis:									
Surgical problems	17	**34.0**	15	**30.0**	23	**46.0**	55	36.7	**χ2=24.304 P=.002 ***
Respiratory problems	7	14.0	11	22.0	5	10.0	23	15.3	
Gastrointestinal problems	13	26.0	15	30.0	20	40.0	48	32.0	
Urinary problems	6	12.0	9	18.0	2	4.0	17	11.3	
Endocrinal problem	7	14.0	0	0.0	0	0.0	7	4.7	
History of previous Cannulation:									
Yes	12	24.0	27	**54.0**	4	8.0	43	28.7	**χ2=26.668 P=.000 ***
No	38	**76.0**	23	46.0	46	**92.0**	107	71.3	
Cannula Size (FR):									
22	0	0.0	0	0.0	9	18.0	9	6.0	**χ2=32.826 P=.000 ***
24	3	6.0	0	0.0	9	18.0	12	8.0	
26	47	**94.0**	50	**100.0**	32	**64.0**	129	86.0	

Table (2): Distribution of Children in the Study Groups (Valsalva Maneuver and Virtual Reality) Versus Control Group Regarding Observed Pain Behaviors of FLACC Scale (n=150)

Items of observational behavior		Valsalva Maneuver (VM)Group		Virtual Reality (VR) Group		Control Group		Test of Significance
		No (50)	%	No (50)	%	No (50)	%	
Face	No particular expression or smile	12	24.0	32	**64.0**	7	14.0	**χ2= 66.202 P= .000**
	Occasional grimace or frown, withdrawn, disinterested	30	**60.0**	18	36.0	13	26.0	
	Frequent to constant frown, clenched jaw, quivering chin	8	16.0	0	0.0	30	**60.0**	
Leg	Normal position or relaxed	18	36.0	28	**56.0**	6	12.0	**χ2= 54.742 P= .000**
	Uneasy, restless, tense	26	**52.0**	17	34.0	11	22.0	
	Kicking or legs drawn up	6	12.0	5	10.0	33	**66.0**	
Activity	Lying quietly, normal position, moves easily	24	**48.0**	38	**76.0**	5	10.0	**χ2= 56.442 P= .000**
	Squirming, shifting back/forth, tense	21	42.0	12	24.0	24	**48.0**	
	Arched, rigid, or jerking	5	10.0	0	0.0	21	42.0	
Cry	No cry, awake or asleep	9	18.0	30	**60.0**	5	10.0	**χ2= 61.881 P= .000**
	Moans or whimpers, occasional complaint	29	**58.0**	20	40.0	15	30.0	
	Crying steadily, screams or sobs, frequent complaints	12	24.0	0	0.0	30	**60.0**	
Consolability	Content, relaxed	9	18.0	33	**66.0**	0	0.0	**χ2= 107.127 P= .000**
	Reassured by occasional touching, hugging, or "talking to," distractible	41	**82.0**	17	34.0	23	46.0	
	Difficult to console or comfort	0	0.0	0	0.0	27	**54.0**	

Table (3): Distribution of Children Having Different Levels of Observed Pain Behaviors in the Valsalva Maneuver, Virtual Reality and Control Groups

Total Score of Observed Pain Behaviors of FLACC Scale	Valsalva Maneuver (VM) Group		Virtual Reality (VR) Group		Control Group		Total		Test of Significance
	No (50)	%	No (50)	%	No (50)	%	No (150)	%	
Comfortable	6	12.0	25	50.0	0	0.0	31	20.6	**χ2=104.644 P=.000 Spearman Correlation coefficient (r_s) = - 0.716- P= 0.000**
Mild discomfort	12	24.0	11	22.0	5	10.0	28	18.6	
Moderate discomfort	24	48.0	14	28.0	5	10.0	43	28.6	
Severe discomfort or pain	8	16.0	0	0.0	40	80.0	48	32.0	

Pearson chi square (χ2) *P significant at < 0.05
Spearman correlations **. Correlation is significant at P = 0.01 level
Strong Negative Correlation with statistical significant difference

Table (4): Distribution of children having different Levels of Perceived Pain Behaviors in the Valsalva maneuver, Virtual Reality and Control Groups

Children's perception of pain	Valsalva Group		Virtual Group		Control Group		Total (150)		Test of Significance
	No (50)	%	No (50)	%	No (50)	%	No (50)	%	
No hurt	3	6.0	11	22.0	0	0.0	14	9.3	**$\chi 2$=95.369 P=.000**
Hurts little bit	9	18.0	17	34.0	3	6.0	29	19.3	
Hurts little more	24	48.0	11	22.0	2	4.0	37	24.7	**Spearman Correlation coefficient (r_s) = -0.641 P=0.000**
Hurts even more	11	22.0	7	14.0	10	20.0	28	18.7	
Hurts whole lot	3	6.0	4	8.0	19	38.0	26	17.3	
Hurts worst	0	0.0	0	0.0	16	32.0	16	10.7	

Pearson chi square ($\chi 2$) *P significant at < 0.05
Spearman correlations
**. Correlation is significant at P = 0.01 level
Moderate Negative Correlation with statistical significant difference

Discussion

Pain is the most frequently encountered complaint presented in the pediatric emergency department. Peripheral cannulation is one of the commonest invasive procedures that induce pain to children. Thus, health care providers must follow a child-centered approach in assessing and managing their feeling of pain during these procedures. Distraction as a non-pharmacological modality is the most frequently used intervention in the emergency department to divert children's attention away from painful stimuli. This way reduce pain intensity among children undergoing peripheral cannulation (Srouji, Ratnapalan, and Schneeweiss 2010)

Valsalva maneuver is a unique method as it does not require any equipment. It can be easily learned and utilized by the children and reduces the pain intensity related to peripheral cannulation (Meenu and Balakrishnan 2019). In the present study, nearly half of children in the Valsalva group compared to about only one fifth of the control group felt comfortable during peripheral cannulation, as assessed by researchers using FLACC scale. Moreover, none of children in Valsalva group compared to about one third in the control group expressed the worst hurts during cannula insertion, as assessed by Wong Baker scale. The decreased pain level in Valsalva group may be justified by children's preoccupation with trying to blow-up the colorful balloons as they were given the opportunity to choose their favorite color and shape. Moreover, children in the Valsalva group were concerned with applying the steps of the Valsalva maneuver in the way that divert their attention away from the painful stimuli. Congruently, Mahmoud, Mosaad, and Elghareeb (2021) found that about forty percent in the Valsalva group felt mild pain during peripheral cannulation. While forty percent in the control group felt severe pain during peripheral cannulation, with a statistically significant difference between the two groups. Additionally, Alan and Khorshid (2022) concluded that the cases in the intervention Valsalva group had less severe pain during the peripheral intravenous catheter insertion than the patients in the

control group with a statistically significant difference between the two groups.

Virtual reality (VR) is rapidly evolving technology that is used as a novel distraction tool for children undergoing different invasive procedures (Ali et al. 2022). As for the current study, half of children in the VR group compared to none of the control group felt comfortable during peripheral cannulation, as assessed by researchers using FLACC scale. Furthermore, none of children in VR group compared to about one third in the control group expressed the worst hurts during cannula insertion, as assessed by Wong Baker scale. The increased comfort in the study group may be justified by the deep involvement of studied children in the virtual reality experience. VR grasped their attention away from the peripheral cannulation procedure and decreased their perception of pain. Likewise, Wong & Cho Lee, (2020) results revealed that children in the intervention VR group demonstrated a significantly greater reduction in pain intensity during peripheral cannulation than the control group. Similarly, Chan et al. (2019) found that children who used the VR during peripheral cannulation in the emergency department had more significant reduction in pain than the control group.

Heading off pain, sorrow, and struggling of children in healthcare delivery is a crucial expert obligation of pediatric nurses. The American Pain Society (APS) recommended the use of multimodality non-pharmacological interventions for the management of pain in children (Aydin, S, and C 2016). In the current study, Valsalva Maneuver and Virtual Reality Goggles were used comparably to assess their effect on children's pain intensity during peripheral cannulation. It was found that about one tenth of children in Valsalva group compared to half in the VR group felt comfortable during peripheral cannulation as assessed by researchers using FLACC scale. Additionally, about one twentieth of children in Valsalva group compared to about one quarter in the VR group expressed no hurts during cannula insertion, as assessed by Wong Baker scale. The difference of pain feeling among children in the two groups may be justified by the technology fascination that was created by the VR environment which may attract children's attention more than the Valsalva Maneuver. As well, Özsoy and Ulus, (2022) compared using a VR versus watching cartoon from tablets on children's pain perception during dressing change and they used Wong Baker Scale to assess pain. They founded that VR was more effective in decreasing pain perception than just watching cartoon from tablets. On the other hand, Shivashankar, Nalini, and Rath, (2018) were not in the same line with the findings of the current study. They found that distraction by pressing ball was more effective than Valsalva Maneuver in decreasing pain intensity during peripheral cannulation as assessed by Visual Analogue Scale.

Finally, the current study had been able to shed down light on the various non-pharmacological pain management modality as Valsalva Maneuver and Virtual Reality. In this respect, pediatric nurses can distract the attention of children away from pain by active participation in such techniques during peripheral cannulation.

Conclusion

Based on the results of the current study, it can be concluded that both Valsalva Maneuver and Virtual Reality were effective in decreasing children's pain intensity during peripheral

cannulation. Children's feeling of comfort during peripheral cannulation and their expression of no hurt during the procedure were higher in the Virtual Reality than the Valsalva Maneuver.

Recommendations

1. Pediatric nurses in the emergency department should be trained on different non-pharmacological pain management modalities such as Valsalva Maneuver and Virtual Reality to decrease children's suffering during peripheral cannulation.
2. Valsalva Maneuver supplies must be available in the emergency department as it is cost effective and can be easily used by children. Colorful balloons used in the maneuver can be used as an incentive for children.
3. The availability of at least one Virtual Reality Goggles in the pediatric emergency department becomes a must. It can be very helpful in relaxing the difficulty easing and frightened children.
4. Dissemination of illustrative booklets about Valsalva maneuver and Virtual Reality application steps must be done between nurses in the emergency department.

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