

Effects of Distraction Using Virtual Reality Glasses During Lumbar Punctures in Adolescents With Cancer

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Purpose/Objectives: To determine the effects of virtual reality (VR) glasses on adolescents with cancer undergoing lumbar punctures (LPs).

Design: Pilot study using an experimental, control group design.

Setting: In-hospital oncology clinic.

Sample: 30 adolescents with cancer (17 in the VR and 13 in the control group) undergoing frequent LPs.

Methods: Subjects were randomly assigned to groups. Both groups received standard intervention during the LP, but the experimental group also wore VR glasses and watched a video. Following the LP, both groups rated their pain using a visual analog scale (VAS) and were interviewed to evaluate their experience.

Main Research Variables: Pain, subjective evaluation of experience.

Findings: Although VAS pain scores were not statistically different between the two groups ($p = 0.77$), VAS scores tended to be lower in the VR group (median VAS of 7.0, range 0–48) than in the control group (median VAS of 9.0, range 0–59). 77% of subjects in the experimental group said the VR glasses helped to distract them from the LP.

Conclusions: VR glasses are a feasible, age-appropriate, nonpharmacologic adjunct to conventional care in managing the pain associated with LPs in adolescents.

Implications for Practice: The clinical application of various age-appropriate distracters to reduce pain in adolescents undergoing painful procedures should be explored.

Key Points . . .

- ▶ Virtual reality (VR) glasses are a feasible, age-appropriate, nonpharmacologic adjunct to conventional care in managing pain associated with lumbar punctures (LPs) in adolescents with cancer.
- ▶ Visual analogue scale pain scores tended to be lower in the VR group.
- ▶ The majority of adolescents who received the VR glasses felt the glasses distracted them from the LP and wanted to use them again.
- ▶ More research is needed to explore novel distraction techniques for managing pediatric pain associated with procedures.

the bedside, nurse clinicians at a pediatric cancer center have observed that adolescents who frequently undergo this procedure during their cancer treatment continue to experience pain and anxiety.

An individual approach is recommended for managing procedural pain using behavioral and pharmacologic

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Adolescents diagnosed with cancer must undergo frequent painful procedures, such as lumbar punctures (LPs), during their therapy, and many describe such procedures as the most distressing aspect of their disease (U.S. Department of Health and Human Services, 1992). Unfortunately, LPs must be performed frequently throughout the course of treatment. Despite the use of standard therapy that includes conscious sedation, eutectic mixture of local anesthetics (EMLA®, [AstraZeneca Pharmaceuticals, LP, Wilmington, DE]) applied at the LP site, and one parent at

interventions for children with cancer (Zeltzer et al., 1990). Distraction is thought to be an effective strategy for coping with pain-produced distress (McCaul & Malott, 1984). When used in the management of pain, distraction has been referred to as cognitive refocusing, which directs attention away from the pain (McCaffrey & Pasero, 1999) to a non-noxious event or stimulus in the immediate environment (Fernandez, 1986). Many researchers who used distracters, such as blowing bubbles (French, Painter, & Coury, 1994), viewing kaleidoscopes (Carlson, Broome, & Vessey, 2000; Vessey, Carlson, & McGill, 1994), using relaxation/guided imagery (Broome, Lillis, McGahee, & Bates, 1992), and using party blowers (Manne, Bakeman, Jacobsen, Gorfinkle, & Redd, 1994) have demonstrated the effectiveness of distraction. These studies have shown an overall reduction in pain and anxiety but have been evaluated primarily in nonadolescent patients. Instead of using such simple distracters, virtual reality (VR) glasses, a more novel distracter, could be an excellent diversional strategy and an effective nonpharmacologic intervention for reducing LP pain in adolescents.

McCaul and Malott (1984) postulated that the effectiveness of distraction in relieving the distress associated with painful procedures depends on the interpretation of the pain experience and the attentional capacity of the distracter. For distraction to be effective, one must assume that the perception of painful stimuli is not completely autonomic but can be (at least partially) controlled cognitively (McCaul & Malott). If the attentional capacity of a distracter is high, thus consuming most of one's cognitive energies, less cognitive capacity for processing painful stimuli exists (Vessey et al., 1994). Because the pain experience has both a sensory component (what the pain feels like) and an affective component (how distressing it is), authors have hypothesized that the use of distraction could be an effective strategy for reducing sensory and affective components of pain and for decreasing the attentional capacity left to process the pain, thereby reducing the adolescent's pain and distress (Vessey et al.).

Purpose

Although the benefits of distraction have been documented for managing pain and distress in younger children, these authors are unaware of any studies that described the effectiveness of simple distraction with adolescents undergoing major painful procedures. To achieve a broader understanding of distraction in this group of patients, a pilot study was conducted to determine the effects of using VR glasses as a developmentally appropriate distraction technique on pain perception and subjective evaluations of effectiveness in adolescents with cancer undergoing frequent LPs. This study explored whether differences exist in the level of self-reported pain between adolescents with cancer who wear VR glasses for distraction when undergoing frequent LPs and adolescents who receive standard nursing interventions, the experiences of adolescents with cancer during LP, and subjective evaluations of the VR glasses.

Methods

Design, Sample, Setting

This study used an experimental control group design, as well as a qualitative evaluation of the experience, to deter-

mine the effectiveness of distraction on pain perception and the subjective evaluations of the experience in adolescents with cancer undergoing frequent LPs. A convenience sample of 30 subjects undergoing LPs was studied; subjects were randomly assigned to the experimental VR distraction group or the standard care comparison group. Subjects were between the ages of 10–19 years, male and female, being treated for cancer, receiving LPs as part of therapy, undergoing at least a second LP, of any ethnic origin, able to understand and communicate in English, and able to hear and see. Informed written consent was obtained from each parent, and assent was obtained from the adolescent before the start of the study. The study, conducted in a private, in-hospital clinic treatment room within a 322-bed pediatric teaching hospital in the southwest United States, was approved by the hospital's institutional review board.

Intervention

Six certified oncology nurses performing the LPs received standardized instruction on (a) how to use and teach subjects about the VR glasses, (b) methods for obtaining informed consent, and (c) collecting demographic data. The adolescents in the comparison group received standard nursing care for an LP, including (a) weight-based conscious sedation using fentanyl and midazolam, (b) 2.5 grams of EMLA cream applied at the spinal injection site, (c) a full explanation of the LP given to the patient and parent, and (d) parental presence at the patient's side for support. Although subjects received sedation, they were cognitively aware of the environment and able to respond, move, and verbalize discomfort and anxiety during the LP.

Members of the experimental group wore VR glasses (manufactured by i-O Display Systems LLC, Menlo Park, CA) during their LPs, in addition to receiving standard nursing care. The glasses were similar to oversized sunglasses with earphones attached. They were secured on the patient with a hook and loop strap around the crown of the head. Each patient adjusted the earphones and volume prior to the start of the LP. Subjects were placed in the standard side-lying position for their LPs with a videocassette recorder/television placed at eye level. They all watched the same video through the glasses, which provided three-dimensional (3-D) viewing, and listened to music in stereo sound. The VR video, which was 32 minutes long, was recorded in succession to provide a total of 64 minutes of footage. The video was titled "Escape" and was distributed by VIRTUAL i-O (Portland, OR) (Atkins, 1996). It contained experiences of skiing down the Swiss Alps, explosive drag racing, a stroll down Paris sidewalks, and visions of quiet mountain streams. According to the distributor, the video is a multidimensional sight and sound experience that allows subjects to see and hear images "up close, all around, and in their face" (Atkins). Because of the 3-D glasses, some of the video events appeared to jump out of the screen to bring a new sense of reality to the video. Prior to conscious sedation, nurses used a standardized script to explain the purpose of the VR glasses to subjects and the need to focus their attention on what they were hearing and seeing instead of on the discomfort of the procedure (see Figure 1). The subjects started watching the video when placed on the procedure table at the beginning of the LP and finished when the sedation recovery criteria were met.

You get to wear virtual reality glasses during your spinal tap today. These glasses have worked for some people by distracting them and may help you to concentrate on something other than the discomfort of the procedure. If you are really distracted, it is nearly impossible for you to think of something else like the spinal tap. You can help the glasses work even better by focusing all of your attention on the video and listening to the music. If you find yourself feeling discomfort or being nervous about the procedure, try to refocus your attention to the video. Concentrate all of your attention on what you are seeing—the sights, colors, and action. Listen to the sounds, noises, and music. Try to completely focus all of your attention on what you see and what you hear. Again, if you find yourself thinking about the spinal tap, just let go of those thoughts and return your attention to the video.

Figure 1. Script for Teaching Subjects About Virtual Reality Glasses

Instrumentation and Procedure

To evaluate pain in adolescents undergoing LPs, a **visual analog scale (VAS)** was used. The VAS used a 100-mm vertical line with end points anchored as “no pain” at the bottom of the scale and “pain as bad as it could possibly be” at the top. The VAS pain scores range from 0 to 100. The VAS is a widely used pain measurement with well-established validity and reliability for adults and children 9–15 years old (Abu-Saad & Holzemer, 1981; Downie et al., 1978; Price, McGrath, Raffi, & Buckingham, 1983; Reading, 1980; Vessey et al., 1994). Among the numerous tools available for assessing pain, direct scaling procedures, such as VAS, are popular because of their simplicity, versatility, relative insensitivity to bias effects, and the assumption that the procedures yield numerical values that are valid, reliable, and on a ratio scale (Price et al.). These researchers also demonstrated that the VAS can be used as a valid and reliable measure for both the intensity and the unpleasantness of human pain.

The nurse performing the LP assessed the subject’s sedation level following the LP using the **Sedation Assessment Scale**, an institutional scale used to monitor the safety of sedated patients. The scale ranged from 0, indicating the highest level of sedation, to 11, indicating complete recovery from sedation. Before rating their pain after the procedure, subjects had to score a minimum of eight on the Sedation Assessment Scale, which usually occurred in about 30 minutes following the LP. This score indicated the minimum level of recovery from sedation. At this time, subjects in both groups were asked to draw a line on the VAS that best described the level of pain experienced during the LP.

In addition to measuring the level of pain, an investigator-developed questionnaire was used to determine the experiences during the LP of both groups and the subjective evaluations of the VR glasses by those in the experimental group (see Figure 2). The 10-item VR questionnaire consisted of a combination of open-ended questions (e.g., What were you thinking about during the spinal tap (LP)?) and response set questions (e.g., Compared to your last spinal tap, was this spinal tap extremely difficult, difficult, less difficult, or much less difficult). After rating their pain, all subjects were interviewed using the VR questionnaire and their responses were audiotaped. Subjects in both groups verbally responded to the first five questions related to their experience and

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1. Tell me what your spinal tap (lumbar puncture [LP]) was like today?
 2. What were you thinking about during the spinal tap (LP)?
 3. What do you remember during your spinal tap (LP)?
 4. Did anything help make the spinal tap (LP) better for you?
 - a. If so, what made it better for you?
 - b. If no, could anything have made this spinal tap (LP) better? What?
 5. Compared to your last spinal tap (LP), was this spinal tap (*please circle*)
Extremely difficult
Difficult
Less difficult
Much less difficult
– If patient wore VR glasses, continue questionnaire. –
 6. What was it like wearing the VR glasses?
 7. Was there anything you liked about the VR glasses?
Yes
No
If yes, what?
 8. Was there anything you didn’t like about the VR glasses?
Yes
No
If yes, please describe.
 9. Would you like to use the VR glasses during your next spinal tap (LP)?
 10. Did the VR glasses take your mind off the spinal tap (LP)?
Very much
Somewhat
Not much
Not at all
-

Figure 2. Virtual Reality Questionnaire

thoughts during the LP. In addition, experimental subjects were asked five additional questions dealing with the evaluation and effectiveness of the VR glasses as a distracter.

To establish content validity of the VR questionnaire, a four-member content expert panel was asked to judge the relevance of each question in measuring the patient’s perceived experience during a LP and their evaluation of the VR glasses. In addition, content experts were asked to determine the readability and clarity of the questionnaire and to recommend any additions, changes, or deletions of questions. Based on their recommendations, the questionnaire was revised accordingly.

Data Analysis

Data were entered into Microsoft® Access and analyzed using SPSS®, version 10. Two-tailed p values of less than 0.05 were considered to be significant. Comparisons between subjects in the experimental and control groups based on demographic characteristics, as well as clinical and procedural variables (e.g., whether EMLA cream was applied to the LP site, whether a parent was present during the LP, ease of the LP, level of sedation, mix of nurses performing the LP) and the categorical responses from the VR questionnaire, were performed by using the Fisher’s exact test. Because the continuous variables were not found to be normally distributed, the nonparametric Mann-Whitney U test was used to compare age, medication dosages, and the VAS pain scores between the experimental and control groups.

Taped interviews following the LP using the VR questionnaire were transcribed verbatim. Responses to each of the

questions were analyzed individually to present summary findings. Each of the responses then was analyzed for content by identifying the frequency, order, or intensity of the occurrence of words, phrases, or sentences to understand the LP experience for the total group and to determine the experimental group's evaluation of the effectiveness of the intervention as a distraction technique. Reliability of the content analysis was established through consensus (verbal agreement after discussion) between three of the researchers after independent analysis of the data.

Findings

A total of 30 subjects was admitted to the study with 13 (43%) in the control and 17 (57%) in the experimental group. All subjects had at least one LP prior to enrollment in the study. The subjects ranged in age from 10–19 with a median

age of 13.6 years. Just over half (53%) of the subjects were male, and the majority of subjects (80%) were either Caucasian or Hispanic. Overall, 67% of the subjects had a diagnosis of acute lymphoblastic leukemia (ALL) (see Table 1).

In most instances, EMLA cream was applied to the site of the needlestick prior to the LP (77%) and a parent was present with the patient during the procedure (80%). Subjects in both groups received a median of 77.5 mcg (range 0–140) of fentanyl and 3.0 mg (range 0–15) of midazolam during the LP. Nearly all of the LPs were rated by the nurses as easy to perform (90%). All subjects reached a minimum sedation level of eight prior to rating their pain and being interviewed following the LP, with the majority (90%) reaching a sedation level of 11. A total of six certified oncology nurses performed all 30 of the LPs.

No significant differences were found between the experimental and control groups based on age, gender, or ethnicity.

Table 1. Demographic, Clinical, and Procedural Characteristics

Characteristic	Control Group (n = 13)		Experimental Group (n = 17)		Total (n = 30)	
Age in years						
Median	14.30		13.10		13.60	
Range	10.71–19.10		9.90–18.70		9.90–19.10	
Characteristic	n	%	n	%	n	%
Gender						
Males	7	54	9	53	16	53
Females	6	46	8	47	14	47
Race						
White	6	46	8	47	14	47
Black	2	15	3	18	5	17
Hispanic	5	39	5	29	10	33
Other	0	0	1	6	1	3
Diagnosis*						
Acute lymphoblastic leukemia (ALL)	12	92	8	47	20	67
B-cell lymphoma	0	0	1	6	1	3
Lymphoma	1	8	0	0	1	3
T-cell	0	0	2	12	2	7
T-cell ALL	0	0	4	24	4	13
T-cell lymphoma	0	0	2	12	2	7
EMLA®						
Yes	9	69	14	82	23	77
No	4	31	3	18	7	23
Parent at bedside						
Yes	10	77	14	82	24	80
No	3	23	3	18	6	20
Ease of lumbar puncture						
Easy	12	92	15	88	27	90
Moderate	1	8	1	6	2	7
Difficult	0	0	1	6	1	3
Sedation assessment score						
8	1	8	0	0	1	3
10	0	0	2	12	2	7
11	12	92	15	88	27	90
Fentanyl dose in mcg						
Median	60.0		80.0		77.5	
Range	0–140		0–130		0–140	
Midazolam dose in mg						
Median	3.0		2.0		3.0	
Range	0–15		0–15		0–15	

* p < 0.05

Significantly more subjects in the control group than in the experimental group had a diagnosis of ALL ($p = 0.02$). Subjects in both groups were statistically comparable based on clinical and procedural characteristics including use of EMLA, whether a parent was present during the LP, amount of fentanyl and midazolam administered, ease of performing the LP, sedation assessment score prior to interviewing the patient, and the mix of nurses performing the LP.

To determine the effects of the VR glasses, VAS pain scores were measured in both groups. The median pain score on the VAS for the total group was 8.0 with a range of 0–59, indicating a large degree of variability in patient responses. Although no statistical difference was found ($p = 0.77$) on the VAS pain scores between the control and experimental groups, those in the VR group reported a trend toward lower pain scores (median VAS of 7.0, range of 0–48) than did subjects in the control group (median VAS of 9.0, range of 0–59) (see Figure 3). For those subjects who reached an 11 on the sedation assessment scale (indicating complete recovery from conscious sedation), the VAS pain scores tended to be lower in the VR group than in the control group (see Figure 4). Moreover, for each of the procedural strategies used by both groups of subjects to reduce psychophysiologic pain and distress during the LP, including EMLA being used at the LP site and parents being present for the procedure, subjects in the VR group consistently reported lower VAS scores than did subjects in the control group although the differences were not statistically significant (see Figures 5 and 6). Despite the lack of statistical significance, the consistent pattern across all the variables indicates that a nonrandom process was occurring.

Subjects in both groups were interviewed to gain an understanding of their experiences during the LP using the first five questions on the questionnaire. Their responses to each of these questions were summarized. When asked, “Tell me what your spinal tap was like today,” almost all (29; 97%) of the patient responses in both the experimental and control groups were indicative of a favorable experience. Only one patient in the VR group reported a less favorable experience, stating “I think the EMLA cream was in the wrong place so I was poked twice.” The remaining 29 responses included short, concise answers with very little elaboration or detail

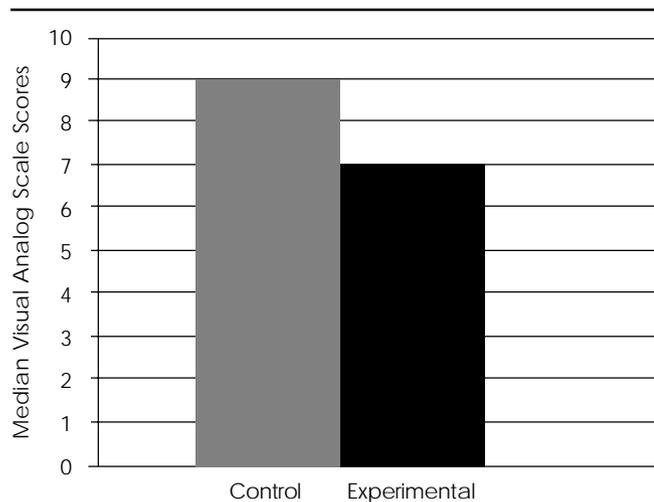


Figure 3. Median Pain Scores

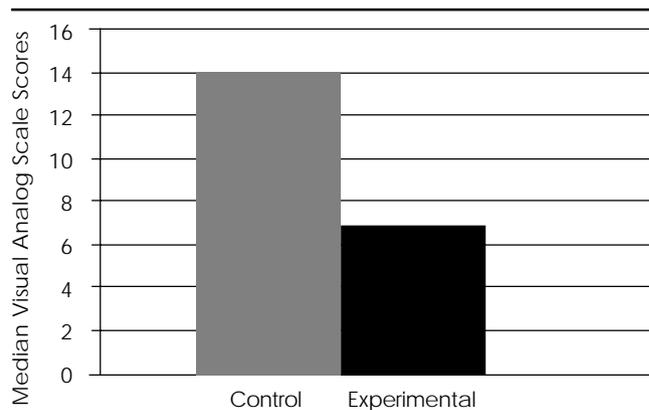


Figure 4. Median Pain Scores of Subjects Who Reached a Score of 11 on the Sedation Assessment Scale

despite probing by the interviewer. For example, “I didn’t have a lot of pain;” “Everything was good today;” “I didn’t feel nothin’ ” (sic); “It was okay. My mom said I didn’t know it was happening;” “I hardly felt it at all;” “It was okay;” “It was fast and easy;” and “Normal.”

Responses to the question “What were you thinking about during the spinal tap (LP)?” clearly showed that the majority of the subjects in the VR group (13 of 17; 77%) were distracted by the intervention. For example, the VR subjects reported they were “watching the video most of the time” and made references to the 3-D glasses. One noted “The movie was nice.” In contrast, the responses in the control group were vague and without reference to any distracter. Eleven out of 13 subjects (85%) reported they were thinking about “nothing” or “sleeping” or they offered no response. One focused on the previous spinal tap and worried about current pain and the other said she thought about food.

In response to the question “What do you remember during your spinal tap?”, 13 (77%) subjects in the experimental group clearly identified scenes from the VR video. For example, they reported “3-D effects,” “skiing,” “motorcycles,” “robots,” “the Eiffel Tower,” “skating,” and “a bunch of dif-

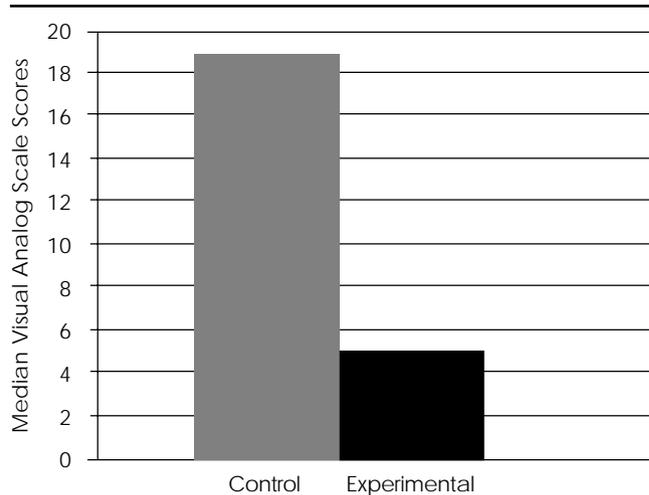


Figure 5. Median Pain Scores of Subjects Who Received EMLA at the Lumbar Puncture Site

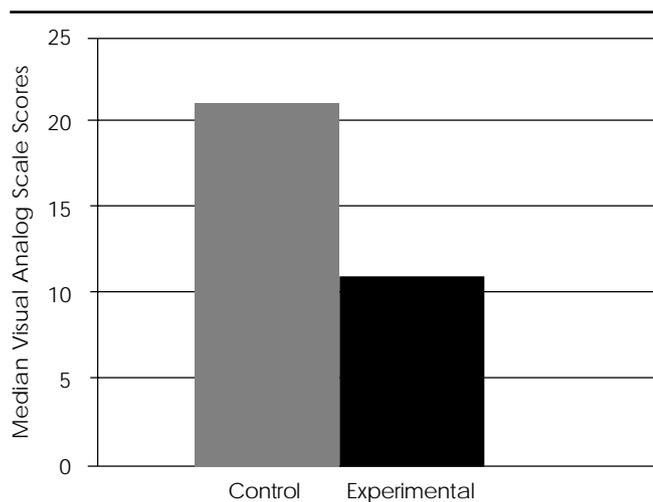


Figure 6. Median Pain Scores of Subjects Who Had Parents Present During the Lumbar Puncture

ferent things in the movie.” Subjects in the control group reported remembering either “nothing,” made reference to conversation in the room, or offered no response.

When asked the question, “Did anything help make the spinal tap better for you?,” overwhelmingly, 15 (88%) subjects in the VR group indicated that the “video” or “the glasses” helped their LP experience. One in the VR group mentioned “the medicine” in response to this question, in contrast to the control group respondents who stated that sedation helped (5), nothing helped (5), or did not respond (3). More subjects in the VR group (69%) than in the control group (42%) said that the current LP was much less difficult than their last LP, although this difference was not statistically significant ($p = 0.42$).

Subjects in the VR group also were interviewed using five additional qualitative questions from the questionnaire to determine their evaluation of the VR glasses and its effectiveness as a distraction technique during the LP. Their responses to these last five questions supported the answers they provided to the first five questions on the VR questionnaire. Seventy-seven percent of the subjects in the experimental group said that the VR glasses took their mind off the LP. They reported that the video helped them to focus their thoughts and distract them from the procedure. Subjects continued to vividly describe their recollections of the sights and sounds on the video during the LP. They depicted the music, scenes, movement, and action experience in the video as “neat,” “cool,” “fun,” and “interesting.” Several subjects recounted the real-life sensations they felt during the session: “I thought I was in there.” “It’s like you move with [the video].” “It’s like you’re there.”

One patient, who had previously visited the Eiffel Tower and who was uncomfortable with heights, commented that he did not like the Eiffel Tower scene on the video. Nearly all of the subjects (94%) said they wanted to use the VR glasses again during their next LP.

Discussion

The results of this study demonstrate that the level of pain reported by both groups of subjects undergoing LPs was low,

indicating that the multimodal pharmacologic and nonpharmacologic approach of using conscious sedation, EMLA at the LP site, and having parents at the bedside during the procedure was successful in managing the subjects’ procedural pain. Although no significant difference existed in the VAS scores between the two groups, VAS scores tended to be lower in the experimental than the control group. For subjects who reached the highest level of recovery or a score of 11 on the sedation scale prior to rating their pain, those in the VR group tended to report less pain than control group subjects. Even for subjects in both groups who had EMLA applied to the LP site and who had a parent present during the procedure, the VAS pain scores in the VR group were lower than in the controls. Although these differences did not reach statistical significance, likely because of the small sample size, any multimodal approach to procedural pain management that consistently lowers the perception of pain can be considered clinically meaningful.

In the past, the major focus on pediatric pain research has centered on pharmacologic strategies for pain management. In contrast, Lambert (1999) suggested that the literature published between 1988–1997, which examined nonpharmacologic pain management interventions or studied the use of these intervention by nurses, demonstrated that all of the interventions provided some degree of pain relief. The present study supports the growing body of nursing and psychological literature that identifies distraction techniques as a promising nonpharmacologic approach to pain management for pediatric patients.

Most studies suggest that simple distraction techniques, such as kaleidoscopes (Carlson et al., 2000; Vessey et al., 1994), party blowers (Blount et al., 1992; Manne et al., 1990), distracting toys (Smith, Barabasz, & Barabasz, 1996), blowing out air (French et al., 1994; Manne et al., 1994), music via earphones (Fowler-Kerry & Lander, 1987), cartoon watching (Cohen, Blount, & Panopoulos, 1997), or nonprocedural talk (Gonzales, Routh, & Armstrong, 1993) are effective or trend toward effectiveness in decreasing self-reported pain in younger children for procedures such as venipuncture or immunization. However, one recent study of children and adolescents undergoing venipuncture or IV insertion reported no differences in pain, fear, or distress between the distraction-kaleidoscope group and the control group (Carlson et al.). Little data exists that evaluates other kinds of distraction for pain reduction during more painful procedures, such as LPs in the older child or adolescent. Our study is the first to suggest that a more novel distracter (VR glasses) may be effective in reducing perceived procedural pain. The VR glasses are easy-to-use in older children and adolescents and require little training for nurses. In addition, these study results support the work of Kazak et al. (1996) who successfully demonstrated the benefits of combining nonpharmacologic and pharmacologic approaches of pain management in pediatric subjects. The current study results also support the descriptive findings from Schneider and Workman (2000) who found that VR glasses were beneficial in helping adolescents cope with their chemotherapy.

The results of the qualitative data demonstrate that the majority of adolescents in the VR group perceived the benefits of using VR glasses to help divert their thoughts from the LP experience and refocus their attention on another event. Subjective evaluations of the VR glasses support the

theoretic postulation that the perception of painful stimuli can be, to some degree, cognitively controlled. Although the mechanism that enables distraction to be an effective strategy for managing pain is not known, some hypothesize that the perception of pain can be controlled because individuals possess a limited capacity for processing of information (Johnson & Petrie, 1997). If one's attention is predominately engaged in a specific task, then the attention available for another task is limited (Kahneman, 1973). When a distracter is capable of capturing a subject's attention, the individual has less cognitive ability to process painful stimuli. In applying these postulates to the current study, the cognitive energies of the subjects in the VR group appear to have been successfully occupied by the sights, movement, and sounds of the VR video, leaving less energy to interpret the sensory and affective components of pain.

The evaluations of the experimental group also indicated that VR glasses were successful as a novel distracter. The glasses were practical to use in the side-lying position necessary for the LP. Despite conscious sedation, subjects were able to experience the sights and sounds of the VR video and vividly recall specific details associated with the experience. McCaffery and Pasero (1999) postulated that such distraction furnishes patients with a sensory shield that protects them from painful stimuli because of the increased sensory stimulation that the distracter provides. A distracter that furnishes the most effective level of sensory shielding, therefore, is probably one that includes as much sensory input as possible (i.e., auditory, visual, tactile, kinesthetic, and olfactory) (Bush, 1987; McCaffery & Pasero). In contrast, the sensory shielding provided by a distracter probably subsides as the strategy and stimuli become boring to the patient. Although the VR glasses provided only auditory and visual input, the scenes, events, and action on the video were so diverse and changed so quickly that subjects had little time to process and recognize an event before the next input appeared. The multidimensional sight and sound experience included in the VR video, combined with the sense of "being there," furnished by the 3-D glasses, created constantly changing experiences that sustained novelty and required a high attentional capacity to process the incoming stimuli.

This study has limitations. The applicability of these findings to other populations is limited because of the small sample size. Recommendations include that this study be replicated and expanded to include a larger sample, focusing on outcomes with different adolescent populations undergoing a variety of procedures in various settings. Also, the six nurses who performed the LPs were all experts who were highly skilled in performing this procedure. Their proficiency likely played a role in the resultant low pain levels experienced in general by both groups of subjects. In addition, most of the subjects in both groups had little to say about negative experiences during the procedure, although they had multiple opportunities during the interview to voice their concerns, fears, and discomfort. In general, we found that the adolescents were reluctant to talk during the interview despite extensive probing from the interviewer. Many of their responses were "thin" (minimal) and did not yield the more developed perceptions about the experience that was anticipated. Future researchers should explore other strategies to

elicit the lived experience during procedures from adolescent subjects.

Implications for Nursing Practice

Distracters, such as VR glasses, appear to be indicated for patients who are undergoing painful procedures that are mild to moderate in intensity and are time limited (a few minutes to an hour). The start-up costs for the equipment is minimal and includes VR glasses (about \$500 a pair), television (variable), videocassette recorder (variable), cart for equipment mounting (variable), and videotapes (about \$25 each).

For adolescents undergoing LP, the VR glasses were practical to use in a side-lying LP position and provided an age-appropriate, socially acceptable, diversional strategy in dealing with a painful procedure. Candidates for this type of distraction technique include adolescents who are interested in using distraction, can understand that distraction is used to alter their perception of pain, have the mental ability to re-focus their attention from the LP to the sights and sound on the VR video, and have the physical energy to concentrate. Patients should know what is involved with the LP, what will be done, the length of time involved, and the sensations that will occur (McCaffery & Pasero, 1999). Based on the researchers' experience with the subject who was uncomfortable with the Eiffel Tower scene on the video, patients also should be instructed to simply close their eyes for a few moments if any image on the video becomes unpleasant for them.

In conclusion, the pain scores in both the VR and the control groups were low, indicating the success of a multimodal approach to procedural pain. Less pain was reported by those in the VR group than in the control group and although this difference was not found to be statistically significant, it may represent a clinically important trend. The majority of the subjects in the VR group said that they believed that the VR glasses helped to distract them from the LP, and almost all wanted to use them again.

Multimodal approaches that combine pharmacologic and nonpharmacologic interventions have been recommended for managing procedural pain in infants, children, and adolescents (US Department of Health and Human Services, 1992). The results of this study demonstrate that VR glasses have the potential to be a feasible, age-appropriate, easy to use, nonpharmacologic adjunct to conventional standards of care in managing the pain associated with painful procedures of adolescents with cancer. Based on the findings demonstrated in this study and the need to establish research-based practices for managing procedural pain, future research investigating the clinical application of distraction is warranted.

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