Use of immersive virtual reality to reduce anxiety during complex paediatric dressing changes

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SUMMARY

In recent years, there has been an increasing interest in the practical applications of virtual reality (VR) in healthcare. One discussed application of this technology is to reduce anxiety during procedures for paediatric patients. Following skin loss in paediatric patients, careful management of the wound with appropriate dressings and frequent dressing changes is a key part of the treatment process. In children, continued dressing changes are often a source of anxiety, which complicates procedures causing distress to the child, their parents and staff members. VR systems have the potential to not only reduce anxiety but also pain in children requiring frequent dressing changes. Although our knowledge of this technology is improving, further research is needed to evaluate its full potential in this population and to establish guidelines to take advantage of the full potential of VR technology.

BACKGROUND

Virtual reality (VR) is a term used to describe computer-simulated three-dimensional environments, immersing the users' senses to create an illusion of reality.[1] It has been of growing popularity over the past 25 years, as its potential applications in healthcare have continued to increase. Of huge interest is its application in the paediatric population. In an extensive study by the 'Children and Virtual Reality' collaboration, VR was shown to be well accepted and a source of excitement in children aged 2–15.[2] As a result, its applications in paediatric healthcare warrant careful discussion and consideration, particularly as a distraction during procedures to reduce pain and anxiety.[3] The population of interest in this case report is children requiring frequent complex dressing changes.

Necrotising Fasciitis is a recognised complication of varicella-zoster infection (chicken-pox), it is a serious complication requiring careful management and monitoring, including frequent dressing changes.[4] Repeated procedures, such as dressing changes, are a source of anxiety and pain in children, which can complicate procedures and lead to delays in treatment.[5] One method of reducing such anxiety is using VR systems as a distraction.[3]

The following case report discusses the benefits of the DR.VR Junior system to reduce anxiety during a complex paediatric change of dressings.

CASE PRESENTATION

A patient in their early childhood attended the emergency department of his local hospital following a worsening chickenpox infection. He was systemically unwell and following examination was diagnosed with necrotising fasciitis of the anterior neck postchicken pox infection. On the day of admission (day 0) and the two subsequent days (day 1 and 2), he underwent emergency debridement of the neck. This resulted in 1.5% total body surface area skin loss (figure 1), he was managed postoperatively by the intensive care team.

Following initial management and step-down from intensive care, he was transferred to the regional burns centre for management of the neck wound (day 5). Immediately following his transfer, he underwent a change of dressing under general anaesthetic, and the wound was dressed with a plan to repeat the change of dressing in 3–4 days without general anaesthetic.

During his time in the hospital, the child had become fearful of staff, refusing to talk when members of the clinical team were in the room and hiding behind his mother and father. His increasing anxiety complicated necessary procedures and he was on most occasions difficult to distract or console unless the healthcare staff left the room. Due to his increasing anxieties, it was suggested that the DR.VR headset could be used at the next change of dressing to help calm and distract the child.

TREATMENT

The immersive VR system used was the DR.VR Junior, which comprises a Pico VR headset and optional noise-cancelling headphones controlled by a Samsung tablet (designed and provided by Rescape Innovation). The headset provides a 360° environment, with an accompanying audio description. On this occasion, the safari and the underwater environments were used, which comprises a series of high-quality videos lasting a total of 7 min and 25 s.

To help orientate the child to the device before his change of dressing, it was trialled on the ward with the support of his consultant and the patient's mother. Using the VR headset, which displayed the underwater environment, the child was given time to get used to the device. According to his parents, he was excited and engaged with the VR environment. They said he seemed comfortable using the device and he verbalised what he could see while a member of the clinical team was present with him.

Prior to the change of dressing, the patient's consultant had previous experience with the technology, no other staff members had received training on the use of the device.

The VR headset was then used for his next change of dressing. This was the first change of dressing performed without a general anaesthetic. As per local protocol for paediatric dressing changes, he received midazolam and oral morphine predressing change.

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Figure 1 Photograph demonstrating skin loss of 1.5% TBSA, to the anterior neck following debridement of necrotising fasciitis. TBSA, total body surface area.

During the change of dressing, he was given the VR device showing first the safari environment, then the underwater environment. The child's father was present and helped engage the child with the technology.

OUTCOME AND FOLLOW-UP

The VR device did not completely distract the patient from the dressing change; however, the clinical team was able to remove the old dressing, clean the wound and place a new dressing while he used the headset. Completing this dressing change would have been almost impossible without the VR headset. During the change of dressing, there were some technical delays connecting the equipment and sizing it correctly to his head. Despite these challenges, he engaged with the software and seemed distracted by the content appearing on screen.

Discussing the use of the headset with the family afterwards, they agreed that the VR headset was of benefit in reducing his anxiety throughout the procedure. They believed that the times when he disengaged and became upset were due to the device slipping off his face. Furthermore, they believed that the device would be beneficial for future dressing changes. Please refer to the parent perspective section for further detail.

The clinical team present was also satisfied with the use of the device as it assisted them in carrying out the change of dressing as planned. They believed it to not only be of benefit as a method of distraction but also to improve neck movements because to fully visualise the entire VR environment, the wearer is required to turn their head in all directions to appreciate the 360' virtual environment. The clinical team was able to instruct the patient to look in specific directions improving access to the opposite side of the dressing. Instructions were given orally to the child by the clinical staff and their parent. We were fortunate to have highly skilled team members, who thought on their feet during the procedure to take advantage and prompt the change of direction. In the future, a more structured approach, perhaps decided in a briefing prior to the VR-assisted dressing change, would ensure maximum benefit. On some occasions, the child changed direction on his own accord, which could have impeded the work of the clinical team; however, the dressing change was a careful procedure, free of time constraints, so this was not the case.

DISCUSSION

The application of VR to reduce pain and anxiety during procedures is of growing interest to the medical community, and its potential benefits have been widely discussed in the literature. In the context of chronic wound dressing changes, the use of VR as a distraction was shown to reduce the time taken to change dressing. There was also a reduction in pain and anxiety scores recorded by the patients.[6] It is, however, important to note that the pain and anxiety scores were self-reported by the participants, which have been noted to be unreliable in children.[7]

In a comparison of distraction techniques for daily burn dressing changes, van Twillert *et al*[8] observed the effects of VR, TV and other self-chosen distraction methods to reduce pain. Thirteen of the 19 participants reported a reduction in their pain when using VR. Additionally, VR was shown to be more effective as a method of distraction when compared with TV. Further praise for the technology has been provided by Furness *et al*[9] in their qualitative study of VR effectiveness, which discussed in detail the usability and acceptability in adult burns patients requiring dressing changes.

In a paediatric population, a systematic review and meta-analysis published in 2019 identified 17 citations, which discussed the effect of VR on pain and anxiety in children and adolescents.[3] Although limited data were available for the effects on anxiety, the effect on pain was well described with 14 of the identified studies showing a significant reduction in pain when compared with usual care. Due to the continually increasing pool of literature discussing the use of VR, an up-to-date systematic review would be of benefit to current research.

Considering the specific technology (DR.VR) described in this case report, Lynch *et al* showed it to be feasible, safe and well accepted in an adult population of intensive care patients, relatives and staff members.[10] The focus of this study was to explore the benefit of VR for stress, anxiety and pain management in the intensive care unit.

In a paediatric population, the interventional study by Shepherd *et al*[11] recruited 33 children, aged 2–15 years old. The participants were allowed to use the DR.VR Junior headset during venepuncture or cast production, recording preprocedure and postprocedure anxiety scores. Statistical analysis demonstrated a significant difference between preprocedure and postprocedure scores. The research group also reported that the headset was well received by the patients, parents and healthcare professionals. It is important to note that this was an interventional study which had no control group for statistical comparison. Furthermore, it seems understandable that the postprocedure scores would be lower since the patient is not expecting or anticipating further pain or intervention. However, it was reported all 32 patients included in the trial stated they would like to use the device in the future. A more robust methodology would improve understanding of the full effect of this technology.

In addition, in this case, the VR headset encouraged the child to mobilise their neck to observe the entirety of the virtual environment; unfortunately there is a paucity of literature discussing the potential benefits of immersive VR for improving neck mobility in a paediatric population. There has been some discussion on the use of VR to reduce neck pain through VR exercises; however, this was reported as a case series analysis, which does not aid our hypothesis.[12]

There is a wealth of literature supporting the various clinical applications of VR headsets, which is continually growing. In the context of complex paediatric dressing changes, further quality interventional studies are needed to prove its efficacy. The case report above has provided a foundation on which to base further research, describing the potential benefits of the DR.VR Junior system as well as raising important considerations for researchers, including technical training for staff members and contingency strategies if technological difficulties were encountered during the trial. Further research discussing the benefits of technical training for the entire team, involved in the dressing changes and possible

advantages of a preprocedure briefing, would further enhance the evidence base for this technology. It is also important to give careful consideration to the measure used to assess anxiety; readers should refer to the comprehensive review by Louw *et al*,[13] even though this review focused on a specific population of South African children, it provides useful commentary and discussion of easy-to-use measures of pain and anxiety in children. On this occasion, we did not gather qualitative feedback from the child, due to their age and time constraints; however, this would be beneficial in more extensive studies.

Parent's perspective

(He) first tried the virtual reality (VR) on the ward a few days before his dressing change. The doctor came in and explained all about it. At this point, (he) would not communicate with any healthcare professionals due to his fears of being in hospital and the trauma he went through. I had to show (him) the VR first and once he put the device on it was amazing to see him smiling and pointing at the different fish as that was the first time (in hospital) that he began to interact with staff.

During this first dressing change, (he) was very nervous. Once the VR set was on, he seemed to relax a little. He again started communicating with staff, pointing at what he could see. I feel that the VR is definitely a good distraction when children are going through something uncomfortable or distressing. I would definitely like (him) to use the VR for future dressing changes.

Learning points

- Virtual reality (VR) has the potential to reduce pain and anxiety during complex paediatric dressing changes.
- The DR.VR Junior system can aid healthcare staff in completing frequent dressing changes in children.
- 360° virtual environments should be explored as a method of improving neck mobility in children following injury.
- Further quality research is needed to fully evaluate the benefits of VR in this population as well as the best method of delivering and evaluating the interventions in paediatric patients.

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Case reports provide a valuable learning resource for the scientific community and can indicate areas of interest for future research. They should not be used in isolation to guide treatment choices or public health policy.

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