Herpes Zoster Patient Education: A Coloring Book Approach

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Abstract

Shingles, the disease caused by the herpes zoster virus, is a widespread and widely misunderstood illness in the United States. It is preventable, but many at-risk patients do not know what measures they may take to prevent it. Clear communication from physician to patient is crucial for patient understanding of diseases. Many patient education materials on herpes zoster currently available are often unused. It is therefore beneficial to public health to disseminate new mediums of medical communication, and one way of accomplishing this is through adult coloring books. The pathophysiology of herpes zoster virus is here explored and the idea of using an adult coloring book to educate patients on the subject in a comprehensible way is presented.

Keywords: Herpes zoster, shingles, vaccines, coloring book, patient health literacy
Herpes Zoster Patient Education: A Coloring Book Approach

Herpes zoster (HZ), more commonly called shingles, results from the reactivation of varicella zoster virus (VZV), which initially causes chicken pox. Shingles affects sensory nerve ganglia and peripheral nerves and their branches and produces intense pain in patients having a shingles outbreak. Annually, 1.1 million cases of HZ occur in the U.S., and despite the availability of an HZ vaccine, a low vaccination rate is a public health concern. Many unvaccinated participants in a clinical study were unaware that the vaccine is available and recommended (Teeter et al, 2014). Despite HZ being common, many patients have misconceptions about the pathophysiology of the disease and treatment options, which include oral antiviral medications (Reeves & Beuscher, 2015).

According to Simberkoff, The herpes zoster vaccine is both safe and well tolerated in older, immunocompetent adults. Recipients may receive some localized side effects, but no risk has been found for infection of HZ occurring from the inoculation. Furthermore, it appears not to lead to any more serious health complications. Since evidence supports the benefits of routine vaccinations for the at-risk population, new and more effective strategies for spreading public awareness about shingles and its prevention are needed (Simberkoff et al., 2010).

According to Williams, Davis, Parker, and Weiss, Public awareness of medical issues such as HZ is vitally dependent upon the concept of patient health literacy. Patient health literacy is a critical aspect of physician-to-patient communication, especially among the elderly. Poor health literacy is common, and is correlated with worsening health conditions. A major source of miscommunication is physician usage of medical
terminology. This may be remedied by use of language at a lower reading level. One study showed that handouts given at a fifth-grade reading level increased vaccination rates (Williams, Davis, Parker, & Weiss, 2002). Another study of education programs for people with chronic health problems requiring medications included three groups: one-to-one counseling, group education, and one or both of these strategies in combination with audiovisual materials. For all three groups, positive changes were observed in all education programs (Mullen, Green, & Persinger, 1985).

Many patients, regardless of education level, have trouble understanding their discharge instructions (Hill et al., 2016). Patients remember more information if given a handout as opposed to just being told, and even more if it involves visual aids (Reeves & Buescher, 2015). One study, in which standard patient discharge instructions were compared to those that were pictograph-enhanced, found that pictographic-enhancement improved patient recall and satisfaction with the instructions, by using measures of immediate and delayed recall. Furthermore, patients’ understanding of their instructions were likely increased by the addition of illustrations (Hill et al., 2016). Use of colors and large, easy to read font in such handouts is helpful, and especially if it is in a form that the patient can take home (Reeves & Buescher, 2015). Comics are an efficient and effective way to communicate complex information. They have been used in science education, as well as to promote public awareness and patient health literacy of various ailments, including HIV. Even though comics have often been aimed only at children, they have been successful in disseminating ideas to adults who want to learn about
complicated ideas in fun ways. It is also helpful if the scientist is involved in both writing and illustrating the comic (Park, Kim, & Chung, 2011).

Multiple studies (Bloch-Elkon, 2007; Catalan-Matamoros, 2011) suggest that the mass media does indeed influence public health decisions (Adekunle & Adlan, n.d.). The media’s power to design, package, and distribute effective messages plays an important contributing role in combating health challenges before they become uncontrollable. Aside from the use of comics in spreading knowledge of HIV, Adekunle and Adlan reported that media methods were also employed in the 2014 Ebola outbreak. This was especially noticeable in Nigeria. Stories, editorials, and images including comics and cartoons about Ebola pervaded the Nigerian media, leading to later studies on media framing of public health hazards. More than one third of news stories on Ebola focused on treatment and control of the disease. This angle focused on containment of the outbreak, as opposed to other angles that focused more on fear of death, or finding aid after contracting the disease (Adekunle & Adland, n.d.).

In order to apply visual patient health literacy to shingles, the virus and disease process must first be understood, beginning with the immune response to VZV. This is an airborne virus, transmitted by cell-free virus particles (the virus floats around by itself, unlike viruses that are contained inside cells) (Stein, Slobedman, & Abendroth, 2012). The first cells to respond to the infection are likely dendritic cells (DCs) (Abendroth, Morrow, Cunningham, & Slobedman, 2001). These are irregularly shaped cells that capture antigens, which are usually proteins, at sites of contact with the external environment, and carry the antigen until they come into contact with a T-cell specific for
that antigen (Nairn & Helbert, 2007, p. 63). T-cells are a part of the adaptive immune response, in which “self” is distinguished from “non-self” by recognizing foreign substances, also called antigens (Nairn & Helbert, 2007). The two main defense cells that recognize antigens are B cells, which secrete antibodies, and T-cells, which find antigens presented by dendritic cells. There are two main types of T-cells: CD4+ helper cells, which produce cytokines, and CD8+ cytotoxic cells, which kill infected cells (Nairn & Helbert, 2007). Dendritic cells initiate responses from CD4+ and CD8+ cells, which are a special type of T-cell that monitor the environments outside of and inside of the cell for pathogens, respectively (Nairn & Helbert, 2007).

In VZV, dendritic cells provide a mechanism of transport of the antigens to lymph nodes, and then to the T-cells that can become infected with the virus (although the virus invades T-cells it does not kill them, allowing the virus to be disseminated) (Abendroth et al., 2001). T-cells then traffic the virus to the skin (Stein et al., 2012). At the skin, cytotoxic CD4+ and CD8+ T-cells play an important role in VZV immunity, as they infiltrate the dermis of VZV lesions, as well as infected sensory ganglia. In response, the immune system will deploy interferons to limit the spread of the virus and activate natural killer cells (NKs) (Stein et al., 2012) a type of lymphocyte that kill virally-infected cells and help activate the adaptive immune response (Nairn & Helbert, 2007). NK cells play an important role in early VZV infection control by killing virally infected cells before the T-cells have had a chance to clonally expand (Stein et al., 2012). Herpes viruses such as VZV have several ways of combatting the immune response, including preventing the infected cells from signaling that they are infected, thus inhibiting NKs
from doing their job of killing cells. Therefore, while type 1 interferons suppress the
growth of the VZV infection, VZV in turn limits the potency of interferons (Stein et al.,
2012).

Reactivation of chickenpox virus is the primary cause of shingles. The virus stays
within the sensory ganglia for the life of the host (Stein et al., 2012). Primary infection
with VZV causes chickenpox, and subsequent reanimation of the latent virus can result in
shingles (Larkin, Heckles, & Ogilive, 1985). This was revealed by use of restriction
enzymes (which recognize specific base pair sequences of DNA and cleave the DNA
there), creating a unique restriction fragment pattern (Nairn & Helbert, 2007). Restriction
enzymes were used to compare six VZV DNA isolates, revealing that identical VZV
strains are present in the latent and reactivated states (Stein et al., 2012). For any given
restriction enzyme, VZV DNA does not show any significant variance of restriction
fragment patterns for different samples, suggesting that HZ represents the re-activation of
an original, infecting VZV strain (Picini, Ecker, Grose, & Hyman, 1983).

Herpes zoster generally develops when the previously infected individual’s
restraining immunity falls below the minimum restraining level (Thomas & Robertson,
1971). Antibodies are immunoglobulin proteins produced by B cells in response to
specific foreign antigens (such as the glycoproteins on the surface of VZV) that initially
stimulated their production (Nairn & Helbert, 2007). These glycoproteins on the surface
of the virus’ envelope are essential for viral replication and infectivity, therefore,
abnormal antibody binding to the surface proteins of VZV plays an important role in recovery from
the infection, by inhibiting cell-to-cell spread of the infection, cell killing via lymphoid
cells, and neutralization (Larkin, Heckles & Olgive, 1985). Antibodies, then, are more likely to prevent or limit VZV reinfection, as opposed to fighting against the virus once the infection occurs (Stein et al., 2012). During HZ, immune cells are prone to infiltrate the ganglia. The virus is able to penetrate abraded skin and spread up a peripheral nerve into spinal ganglia (Thomas & Robertson, 1971). Therefore, unlike the skin infection of chickenpox by VZV, HZ targets the peripheral nervous system (although it is already in the nerve cells from the time of VZV infection). The reactivated virus travels to the skin through the nerves and produces a rash very similar to that of VZV (Stein et al., 2012). However, HZ rashes differ in that the rash is of dermatomal distribution – meaning that it only affects one side of the body in the area of skin that is supplied by sensory neurons originating in spinal ganglia (Centers for Disease Control, 2013). The rash mainly affects the chest, neck, and eye areas (Centers for Disease Control, 2013). If left untreated, 50 to 70% of HZ patients develop complications of the ocular region, and in extreme cases, blindness may occur (Centers for Disease Control, 2013).

Upon reactivation, T cells target the infected nerves. The infiltration of cells in the spinal ganglia is composed of more CD4+ than CD8+ T-cells, but CD8+ are generally in closer proximity to the neurons (Stein et al., 2014). CD8+ T-cells are typically responsible for inducing the death of infected cells (Stein et al., 2012). MHC-I and MHC-II (major histocompatibility complexes) are upregulated in human ganglia during herpes zoster (Stein et al., 2014). This is important as herpes viruses are known to downregulate MHC expression (Nairn & Helbert, 2007). NK cells recognize and target cells with unusual MHC expression, so in HZ low MHC expression serves to signal NK cells to take action
(Nairn & Helbert, 2007). Even decades after the illness, VZV-specific T-cells persist, but over time, a decline in these T-cells - either because of time or immunosuppression - leads to an increased incidence of HZ (Stein et al., 2012).

Immunity can be periodically boosted by exposure to wild-type (standard) VZV in the community. Cell-mediated immunity (CMI), which refers to cytotoxic T-cells, or CD8+ T-cells, decreases over time. One study found that VZV specific CMI decreased by 2.7-3.9% each year (Levin et al., 2008). The zoster vaccine induces a significant increase in VZV-CMI (Levin et al., 2008). The vaccine is injected into the deltoid region (Centers for Disease Control, 2013). According to the CDC, it decreased incidence of shingles outbreaks by 51%. Unfortunately, response to the vaccine decreases with age (by 3-4% each year) (Stein et al., 2012, Levin et al., 2008). This efficacy drops to 36.7% after age 70 (Lal, et al, 2015). However, a new version of the vaccine that was developed recently that contains a subunit of HZ (as opposed to live, attenuated VZV) has been demonstrated to have 97.2% efficacy (Lal, et. al, 2015). The new vaccine does not appear to decrease in efficacy in older adults, nor has it been recorded to induce immune-mediated diseases. Another advantage of an HZ subunit vaccine is that it is less likely to result in replication of the disease that it is supposed to prevent. This makes it a good alternative for patients with compromised immune systems (Lal, et al, 2015).

It is imperative that aging adults are informed of the opportunity for vaccination to help prevent shingles outbreaks before too much time has passed, and key to accomplishing this is finding a way to disseminate HZ information effectively.
Addressing this problem should involve asking how patients learn best, as well as how physicians prefer to provide information.

**Methods**

An adult coloring book illustrating the pathophysiology of shingles was produced for the benefit of promoting health literacy among the susceptible community. It is intended to be an easily understood, visual reference that is designed in a take-home form for patients. Accompanying print instructions for patient care could be available alongside, similar to supplemental material. This could include warnings about side affects of the vaccine, what to expect and when, and which possible side effects would warrant a second visit to the doctor.

The target audience for the educational coloring book is the at-risk population, although anyone could benefit from increased awareness of shingles. The coloring book could be distributed to physicians, and made available in the waiting rooms of the office or given directly to patients by their doctor. Patients are more likely to be vaccinated if a healthcare provider recommends it (Teeter et al, 2014). Furthermore, it is unrealistic to expect a nurse practitioner to cover all information related to the disease and vaccine in a 10-15 minute session (Reeves & Beuscher, 2015). The book focuses on presenting how the virus functions in the human body and how the vaccine prevents shingles from occurring. The design should bring to light the most important points about the disease in such a way that a patient with little or no health literacy could grasp.
Some images that were used in inspiration for the creative style are depicted below:


Figure 1. The image above is an example of the relatively simple line work that makes an effective coloring book. The lines are not completely uniform, so as not to create visual redundancy, but the design is also not overly complex, making it easier to understand.

Figure 2. The above image is an example of the kind of anthropomorphism used in the HZ coloring book. Anthropomorphisms make potentially frightening diseases seem less intimidating.

Figure 3. Images such as the one above were inspirations for cross-sectional, anatomical level parts of the design that are inserted to help orient the viewer to a larger view of what is happening in the picture.

Results

Based on the above inspirations, among others, the following HZ coloring book was produced:
Herpes Zoster: The Reason Behind the Rash

An illustrated guide to understanding the illness
This is the Varicella Zoster virus, a herpes virus. It is the virus that causes chickenpox. It floats around freely in the air, because it was released by an infected person, looking for a new host to attack.
Once VZV infects a host, dendritic cells (DCs) are most likely to notice first and begin the immune response.

DCs activate T-cells, which are immune warriors that distinguish “self” from “non-self.”
DCs take the virus to lymph nodes, where they bring antigens (which are "non-self" particles) to special T-cells (called CD4+ and CD8+) to activate them.
VZV combats the immune system by infecting T-cells, and using them as a way to get to the host’s skin.
In response to this, the immune system deploys interferons (IFs). Interferons limit the spread and replication of VZV.
Meanwhile, other interferons activate natural killer cells (NK), which kill infected cells.
VZV tries to stop NKs by getting in the way of important pathways that interferons use to communicate with NKs.
**VZV** gets inside the spinal nerve sensory ganglia and stays dormant there as long as its victim is alive.

**T-cells** keep it trapped inside, so the victim does not know VZV is still present.
Eventually, the T-cells that are restraining VZV get worn out by causes such as stress or immune suppression therapy...

...When that happens, shingles, also known as herpes zoster (HZ) is free to emerge
Now the immune system realizes what is going on, and T-cells invade the peripheral nerves.

These are satellite cells. They normally guard the nerve against invasion.
Once HZ breaks out, it is free to move from the spine to the periphereral nerves.
HZ is unilateral - meaning it only affects one side of the body. The rash mainly appears in the chest, neck, and eye regions.
The HZ vaccine, which is injected into the shoulder, is composed of live, weakened VZV.

This keeps the T-cells alert and ready to fight off danger.
HZ can be conquered! Find out from your doctor if you are a candidate for the HZ vaccine and be protected from shingles outbreaks today.
I predict the outcome of this project will be threefold: (1) it will raise the vaccination rate, thus lowering the incidence of shingles, (2) increase understanding of the mechanisms of the virus and disease process, and (3) involve patients more thoroughly in their own health-related decisions (as in, getting vaccines that are most beneficial to them personally).

**Discussion**

An adult coloring book would provide a competitive edge over previously existing patient education materials for several reasons. For one, adult coloring books have recently become tremendously popular. Flett et. al. (2017) found that in 2015, they composed 6.6% of adult nonfiction books sold for the year. Secondly, coloring has been demonstrated as an effective stress reducer (Flett et al., 2017). A 2017 study concluded that a weeklong coloring intervention might improve short-term depressive and anxious symptoms (Flett et al., 2017). Dealing with illness can cause anxiety, and such a stressor could serve to weaken the patient’s immune system at a time when it is needed most. If coloring could reduce stress, it could be an added benefit to retention of medical information.

The HZ vaccine is low-risk and effective. Since HZ is both common and, unfortunately, widely misunderstood, finding new ways of spreading awareness is a highly relevant issue to current clinical research. A coloring book would combine visual learning with simple language in a way that would be engaging to people who might not otherwise find interest in the topic.


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This message was sent to ocharuhas@liberty.edu in reference to Case #: 295696
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Andrew Sliwoski <asliwoski@doverpublications.com>
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