Austin Hematology

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Editorial

The Potentially Useful Varicella Zoster Virus

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Received: October 24, 2019; **Accepted:** November 01, 2019; **Published:** November 08, 2019

Editorial

Varicella Zoster Virus (VZV), a double-stranded DNA virus that belongs to the alpha group of herpes viruses, is a highly contagious human neurotropic virus [1-4]. Primary infection or chickenpox occurs in childhood then the virus becomes latent in the nerve ganglia [4,5]. Immunosuppression predisposes to reactivation of VZV to cause herpes zoster decades later [4-8].

VZV behaves differently from other herpes viruses as it has the following characteristic features: having the smallest viral genome; losing almost all the genes that are not essential for its survival; being cell-associated and highly fusogenic; lacking inhibitors of autophagy; being an exclusively human pathogen; having a species-specific cytokine profile; and having an inverse relationship with glioma [1-4,8-14]. Additionally, it has recently being reported to have: association with Graft Versus Host Disease (GVHD) in recipients of Hematopoietic Stem Cell Transplantation (HSCT); having Bone Marrow (BM) stimulatory effects in patients with cytopenias and BM failure; and having antitumor actions in patients with Hematologic Malignancies (HMs) and solid tumors [2,15-22].

Recently, there is growing evidence suggesting several beneficial effects of the virus in immunocompromised hosts and these effects are translated into prolongation of survival [15,16]. The reported beneficial effects of VZV include: (1) stimulation of BM activity in patients with HMs and BM failure syndromes, (2) antitumor effects in various HMs and solid tumors, and (3) association with GVHD which has anticancer effects [2,14-23]. In addition, there are several reports on the safety of the live-attenuated VZV vaccine even in immune suppressed individuals and on the emerging role of the virus in cancer immunotherapy [24-33]. The reported beneficial effects may occur through several direct or indirect immunological mechanisms including: (1) alterations in BM microenvironment due to stress-induced hematopoiesis; (2) cells that are involved in the immunobiology and pathogenesis of the virus such as: Mesenchymal Stem Cells (MSCs), dendritic cells, Natural Killer (NK) cells, T-cells and mononuclear cells; (3) cellular proteins such as open reading frames, glycoproteins, promyelocytic leukemia protein, chaperons, and small ubiquitin-like modifier proteins; (4) extracellular vesicles, exosomes, and micro-RNAs; and (5) signaling pathways, cytokines, chemokines, and interferons [23,34-67].

The beneficial effects of VZV deserve further evaluation and should encourage scientists and researchers to give this potentially useful virus enough attention [2,23,67]. The antitumor effects as well as the stimulatory effect exerted by the virus on the 3 cell lines in the BM can be explained by one or more of the suggested mechanisms or may be due to a new mechanism that needs elucidation [2,15,23,67]. Ultimately, the virus itself; modified or engineered versions of the virus; or specific elements obtained from the serum of patients infected with VZV such as certain cytokines (e.g. interleukin-6 and tumor necrosis factor-α) and cells (e.g. MSCs and NK cells) may become novel therapeutic modalities in the management of patients with BM failure syndromes, HMs and solid tumors.

References

1. Kennedy PGE, Gershon AA. Clinical features of varicella-zoster virus infection. Viruses. 2018; 10: pii: E609.
2. Al-Anazi KA, Kanfar S, Aldayel A, Abduljalil O, Sayyed AH. Reversal of pure red cell aplasia by varicella zoster virus infection. J Hematol Clin Res. 2019; 3: 001-010.
3. Weber DJ. Prevention and control of varicella-zoster virus in hospitals. Edited by: Hirsch MS, Mitty JM. Up To Date. 2019.
4. Cohrs RJ, Gilden DH, Mahalingam R. Varicella zoster virus latency, neurological disease and experimental models: an update. Front Biosci. 2004; 9: 751-762.
5. Albrecht MA, Levin MJ. Epidemiology, clinical manifestations and diagnosis of herpes zoster. Edited by: Hirsch MS, Mitty J. Up To Date. 2019.
6. Onozawa M, Hashino S, Takahata M, Fujisawa F, Kawamura T, Nakagawa M, et al. Relationship between preexisting anti-Varicella-Zoster Virus (VZV) antibody and clinical VZV reactivation in hematopoietic stem cell transplantation recipients. J. Clin. Microbiol. 2006; 44: 4441-443.
7. Cvjetković D, Jovanović J, Hrnjaković-Cvjetković I, Brkić S, Bogdanović M. Reactivation of herpes zoster infection by varicella-zoster virus. Med Pregl. 1999; 52: 125-128.
8. Tombácz D, Prazsák I, Moldován N, Szűcs A, Boldogkői Z. Lytic transcriptome dataset of varicella zoster virus generated by long-read sequencing. Front Genet. 2018; 9: 460.
9. Sommer MH, Zagha E, Serrano OK, Ku CC, Zerboni L, Baiker A, et al. Mutational analysis of the repeated open reading frames, ORFs 63 and 70 and ORFs 64 and 69, of varicella-zoster virus. J Virol. 2001; 75: 8224-8239.
10. Grose C, Buckingham EM, Carpenter JE, Kunkel JP. Varicella-zoster virus infectious cycle: ER stress, autophagic flux, and amphisome-mediated trafficking. Pathogens. 2016; 5; pii: E67.
11. Lenac Roviš T, Bailer SM, Pothineni VR, Ouwendijk WJ, Šimić H, Babić M, et al. Comprehensive analysis of varicella-zoster virus proteins using a new monoclonal antibody collection. J Virol. 2013; 87: 6943-6954.
12. Grigoryan S, Yee MB, Glick Y, Gerber D, Kepten E, Garini Y, et al. Direct transfer of viral and cellular proteins from varicella-zoster virus-infected non-neuronal cells to human axons. PLoS One. 2015; 10: e0126081.
13. Münz C. The autophagic machinery in viral exocytosis. Front Microbiol. 2017; 8: 269.
14. Amirian ES, Scheurer ME, Zhou R, Wrensch MR, Armstrong GN, Lachance D, et al. History of chickenpox in glioma risk: a report from the glioma International Case-Control Study (GICC). Cancer Med. 2016; 5: 1352-1358.

Citation: Al-Anazi KA and Al-Jasser AM. The Potentially Useful Varicella Zoster Virus. Austin Hematol. 2019; 4(1): 1025.

15. Al-Anazi KA, Al-Jasser AM, Evans DA. Effect of varicella zoster virus infection on bone marrow function. Eur J Haematol. 2005; 75: 234-240.

16. Kamber C, Zimmerli S, Suter-Riniker F, Mueller BU, Taleghani BM, Betticher D, et al. Varicella zoster virus reactivation after autologous SCT is a frequent event and associated with favorable outcome in myeloma patients. Bone Marrow Transplant. 2015; 50: 573-578.

17. Canniff J, Donson AM, Foreman NK, Weinberg A. Cytotoxicity of glioblastoma cells mediated ex vivo by varicella-zoster virus-specific T cells. J Neurovirol. 2011; 17: 448-454.

18. Pundole X, Amirian ES, Scheurer ME. Role of varicella zoster virus in glioma risk: Current knowledge and future directions. OA Epidemiology. 2014; 2: 6.

19. Leske H, Haase R, Restle F, Schichor C, Albrecht V, Vizoso-Pinto MG, et al. Varicella zoster virus infection of malignant glioma cell cultures: a new candidate for oncolytic virotherapy? Anticancer Res. 2012; 32: 1137-1144.

20. Kawano N, Gondo H, Kamimura T, Aoki K, Iino T, Ishikawa F, et al. Chronic graft-versus-host disease following varicella-zoster virus infection in allogeneic stem cell transplant recipients. Int J Hematol. 2003; 78: 370-373.

21. Raymond AK, Singletary HL, Nelson KC, Sidhu-Malik NK. Dermatomal sclerodermoid graft-vs-host disease following varicella-zoster virus infection. Arch Dermatol. 2011; 147: 1121-1122.

22. Baselga E, Drolet BA, Segura AD, Leonardi CL, Esterly NB. Dermatomal lichenoid chronic graft-vs-host disease following varicella-zoster infection despite absence of viral genome. J Cutan Pathol. 1996; 23: 576-581.

23. Al-Anazi KA, Al-Anazi WK, Al-Jasser AM. The beneficial effects of varicella zoster virus. J Hematol Clin Res. 2019; 3: 016-049.

24. Willis ED, Woodward M, Brown E, Popmihajlov Z, Saddier P, Annunziato PW, et al. Herpes zoster vaccine live: a 10 year review of post-marketing safety experience. Vaccine. 2017; 35: 7231-7239.

25. Wang L, Verschuuren EAM, van Leer-Buter CC, Bakker SJL, de Joode AAE, Westra J, et al. Herpes zoster and immunogenicity and safety of zoster vaccines in transplant patients: a narrative review of the literature. Front Immunol. 2018; 9: 1632.

26. Aoki T, Koh K, Kawano Y, Mori M, Arakawa Y, Kato R, et al. Safety of live attenuated high-titer varicella-zoster virus vaccine in pediatric allogeneic hematopoietic stem cell transplantation recipients. Biol Blood Marrow Transplant. 2016; 22: 771-775.

27. Chou JF, Kernan NA, Prockop S, Heller G, Scaradavou A, Kobos R, et al. Safety and immunogenicity of the live attenuated varicella vaccine following T replete or T cell-depleted related and unrelated allogeneic hematopoietic cell transplantation (alloHCT). Biol Blood Marrow Transplant. 2011; 17: 1708-1713.

28. Winston DJ, Mullane KM, Cornely OA, Boeckh MJ, Brown JW, Pergam SA, et al. V212 Protocol 001 Trial Team. Inactivated varicella zoster vaccine in autologous haemopoietic stem-cell transplant recipients: An international, multicentre, randomised, double-blind, placebo-controlled trial. Lancet. 2018; 391: 2116-2127.

29. Stadtmauer EA, Sullivan K, Marty F, Dadwal SS, Papanicolaou GA, Shea TC, et al. One-year safety and immunogenicity of two formulations of an adjuvanted varicella-zoster virus (VZV) subunit candidate vaccine in adult autologous hematopoietic cell transplant (HCT) recipients. Biol Blood Marrow Transplant. 2013; 19: S168-S169.

30. Issa NC, Marty FM, Leblebjian H, Galar A, Shea MM, Antin JH, et al. Live attenuated varicella-zoster vaccine in hematopoietic stem cell transplantation recipients. Biol Blood Marrow Transplant. 2014; 20: 285-287.

31. Sasadeusz J, Prince HM, Schwarer A, Szer J, Stork A, Bock HL, et al. Immunogenicity and safety of a two-dose live attenuated varicella vaccine given to adults following autologous hematopoietic stem cell transplantation. Transpl Infect Dis. 2014; 16: 1024-1031.

32. Parrino J, McNeil, SA, Lawrence SJ, Kimby E, Pagnoni MF, Stek JE, et al. Safety and immunogenicity of inactivated varicella-zoster virus vaccine in adults with hematologic malignancies receiving treatment with anti-CD20 monoclonal antibodies. Vaccine. 2017; 35: 1764-1769.

33. Leung TF, Li CK, Hung EC, Chan PK, Mo CW, Wong RP, et al. Immunogenicity of a two-dose regime of varicella vaccine in children with cancers. Eur J Haematol. 2004; 72: 353-357.

34. Boiko JR, Borghesi L. Hematopoiesis sculpted by pathogens: Toll-like receptors and inflammatory mediators directly activate stem cells. Cytokine. 2012; 57: 1-8.

35. Zhao JL, Baltimore D. Regulation of stress-induced hematopoiesis. Curr Opin Hematol. 2015; 22 (4): 286-292.

36. Pascutti MF, Erkelens MN, Nolte MA. Impact of viral infections on hematopoiesis: from beneficial to detrimental effects on bone marrow output. Front Immunol. 2016; 7: 364.

37. Pleyer L, Valent P, Greil R. Mesenchymal stem and progenitor cells in normal and dysplastic hematopoiesis-masters of survival and clonality? Int J Mol Sci. 2016; 17. pii: E1009.

38. Thanunchai M, Hongeng S, Thitithanyanont A. Mesenchymal stromal cells and viral infection. Stem Cells Int. 2015; 2015: 860950.

39. Auletta JJ, Deans RJ, Bartholomew AM. Emerging roles for multipotent, bone marrow-derived stromal cells in host defense. Blood. 2012; 119: 1801-1809.

40. Nowakowski A, Drela K, Rozycka J, Janowski M, Lukomska B. Engineered mesenchymal stem cells as an anti-cancer Trojan horse. Stem Cells Dev. 2016; 25: 1513-1531.

41. Abendroth A, Morrow G, Cunningham AL, Slobedman B. Varicella-zoster virus infection of human dendritic cells and transmission to T cells: implications for virus dissemination in the host. J Virol. 2001; 75: 6183-6192.

42. Morrow G, Slobedman B, Cunningham AL, Abendroth A. Varicella-zoster virus productively infects mature dendritic cells and alters their immune function. J Virol. 2003; 77: 4950-4959.

43. van Erp EA, van Kampen MR, van Kasteren PB, de Wit J. Viral infection of human natural killer cells. Viruses. 2019; 11; pii: E243.

44. Campbell TM, McSharry BP, Steain M, Ashhurst TM, Slobedman B, Abendroth A, et al. Varicella zoster virus productively infects human natural killer cells and manipulates phenotype. PLoS Pathog. 2018; 14: e1006999.

45. Diaz PS, Smith S, Hunter E, Arvin AM. T lymphocyte cytotoxicity with natural varicella-zoster virus infection and after immunization with live attenuated varicella vaccine. J Immunol. 1989; 142: 636-641.

46. Laing KJ, Russell RM, Dong L, Schmid DS, Stern M, Magaret A, et al. Zoster vaccination increases the breadth of $CD4^+$ T cells responsive to varicella zoster virus. J Infect Dis. 2015; 212: 1022-1031.

47. Gilden DH, Devlin M, Wellish M, Mahalingham R, Huff C, Hayward A, et al. Persistence of varicella-zoster virus DNA in blood mononuclear cells of patients with varicella or zoster. Virus Genes. 1989; 2: 299-305.

48. Jones D, Como CN, Jing L, Blackmon A, Neff CP, Krueger O, et al. Varicella zoster virus productively infects human peripheral blood mononuclear cells to modulate expression of immunoinhibitory proteins and blocking PD-L1 enhances virus-specific $CD8^+$ T cell effector function. PLoS Pathog. 2019; 15: e1007650.

49. Wang JP, Kurt-Jones EA, Shin OS, Manchak MD, Levin MJ, Finberg RW, et al. Varicella-zoster virus activates inflammatory cytokines in human monocytes and macrophages via Toll-like receptor 2. J Virol. 2005; 79: 12658-12666.

50. Cohen JI, Cox E, Pesnicak L, Srinivas S, Krogmann T. The varicella-zoster virus open reading frame 63 latency-associated protein is critical for establishment of latency. J Virol. 2004; 78: 11833-11840.

51. Gary L, Gilden DH, Cohrs RJ. Epigenetic regulation of varicella-zoster virus open reading frames 62 and 63 in latently infected human trigeminal ganglia. J Virol. 2006; 80: 4921-2926.

52. Lebrun M, Lambert J, Riva L, Thelen N, Rambout X, Blondeau C, et al. Varicella-zoster virus ORF9p binding to cellular adaptor protein complex 1 is important for viral infectivity. J Virol. 2018; 92; pii: e00295-18.

53. Oliver SL, Yang E, Arvin AM. Varicella-zoster virus glycoproteins: entry, replication, and pathogenesis. Curr Clin Microbiol Rep. 2016; 3: 204-215.

54. Lallemand-Breitenbach V, de Thé H. PML nuclear bodies. Cold Spring Harb Perspect Biol. 2010; 2: a000661.

55. Li Q, Buranathai C, Grose C, Hutt-Fletcher LM. Chaperone functions common to nonhomologous Epstein-Barr virus gL and varicella-zoster virus gL proteins. J Virol. 1997; 71: 1667-1670.

56. Wimmer P, Schreiner S. Viral mimicry to usurp ubiquitin and SUMO host pathways. Viruses. 2015; 7: 4854-4872.

57. Liu L, Zhou Q, Xie Y, Zuo L, Zhu F, Lu J. Extracellular vesicles: novel vehicles in herpesvirus infection. Virol Sin. 2017; 32: 349-356.

58. Anderson MR, Kashanchi F, Jacobson S. Exosomes in viral disease. Neurotherapeutics. 2016; 13: 535-546.

59. Li X, Huang Y, Zhang Y, He N. Evaluation of microRNA expression in patients with herpes zoster. Viruses. 2016; 8: pii: E326.

60. Zajkowska A, Garkowski A, Świerzbińska R, Kułakowska A, Król ME, Plaszyńska-Sarosiek I, et al. Evaluation of chosen cytokine levels among patients with herpes zoster as ability to provide immune response. PLoS One. 2016; 11: e0150301.

61. Jenkins DE, Redman RL, Lam EM, Liu C, Lin I, Arvin AM. Interleukin (IL)-10, IL-12, and interferon-gamma production in primary and memory immune responses to varicella-zoster virus. J Infect Dis. 1998; 178: 940-948.

62. Zak-Prelich M, McKenzie RC, Sysa-Jedrzejowska A, Norval M. Local immune responses and systemic cytokine responses in zoster: relationship to the development of postherpetic neuralgia. Clin Exp Immunol. 2003; 131: 318-323.

63. Chi P-I, Liu H-J. Molecular signaling and cellular pathways for virus entry. ISRN Virol. 2013; 306595: 8.

64. Kurapati S, Sadaoka T, Rajbhandari L, Jagdish B, Shukla P, Ali MA, et al. Role of the JNK pathway in varicella-zoster virus lytic infection and reactivation. J Virol. 2017; 91; pii: e00640-17.

65. Rahaus M, Desloges N, Wolff MH. Varicella-zoster virus requires a functional PI3K/Akt/GSK-3alpha/beta signaling cascade for efficient replication. Cell Signal. 2007; 19: 312-320.

66. Verweij MC, Wellish M, Whitmer T, Malouli D, Lapel M, Jonjić S, et al. Varicella viruses inhibit interferon-stimulated JAK-STAT signaling through multiple mechanisms. PLoS Pathog. 2015; 11: e1004901.

67. Al-Anazi KA, Al-Jasser AM. Varicella zoster virus: The potentially useful virus. J Hematol Clin Res. 2019; 3: 011-015.

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Citation: Al-Anazi KA and Al-Jasser AM. The Potentially Useful Varicella Zoster Virus. Austin Hematol. 2019; 4(1): 1025.