



"VIRAL DIVERSITY AND ORGAN-SPECIFIC MANIFESTATIONS: A REVIEW ON VIRAL INFECTIONS ACROSS MULTIPLE ORGANS"

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ABSTRACT

There are various types of viruses present which triggers the different-different organs of the body. *HERPES VIRUS*, *EPSTEIN-BARR VIRUS*, *HUMAN IMMUNODEFICIENCY VIRUS*, *VARICELLA ZOSTER VIRUS*, *HSV*, *VZV*, *CMV*, *MOLLUSUM CONTAGIOSUM*, *EBV*, *RUBEOLA*, *INFLUENZA A,B VIRUS*, *RESPIRATORY SYNCYTIAL VIRUS*, *RHINOVIRUS*, *ENTEROVIRUS*, *HUMAN METAPNEUMOVIRUS*, *HANTAVIRUS*, *PARAINFLUENZA VIRUSES TYPES 1,2,3, AND 4*, *HUMAN BOCAVIRUS*, *CORONAVIRUS*, *PARACHOVIRUSES*, *HUMAN HERPES VIRUS 6 AND 7*, *HERPES SIMPLEX VIRUS*, *MIMIVIRUS*, *HUMAN IMMUNODEFICIENCY VIRUS (HIV)*, *HEPATITIS B VIRUS (HBV)*, *HANTA VIRUS*, *ADENOVIRUS*, *POLYOMAVIRUS*, *CYTOMEGALOVIRUS*, *HEPATITIS C VIRUS (HCV)*, *SMALL POX VIRUS*, *VARICELLA VIRUS*, *HEPATITIS A*, *HEPATITIS B*, *INFLUENZA VIRUS*, *MEASLES*, *MUMPS*, *HUMAN PARVOVIRUS B19*, *RABIES*, *ROTAVIRUS*, *RUBELLA*, these viruses shows affects the different organs of the body such as eyes, brain, lungs, heart, kidney, liver, etc. They cause various types of diseases and shows symptoms. As a treatment, antiviral drugs are generally prescribing such as Acyclovir, Povidone-iodine & dexamethasone, trifluridine, vidarabine, sulfonamide, fluoromide, prednisolone, peramivir, oseltamivir, zanamivir, ribavirin, pleconaril, aciclovir, entecavir, adefovir, dipivoxil, amantadine, Isoprinosine, etc.

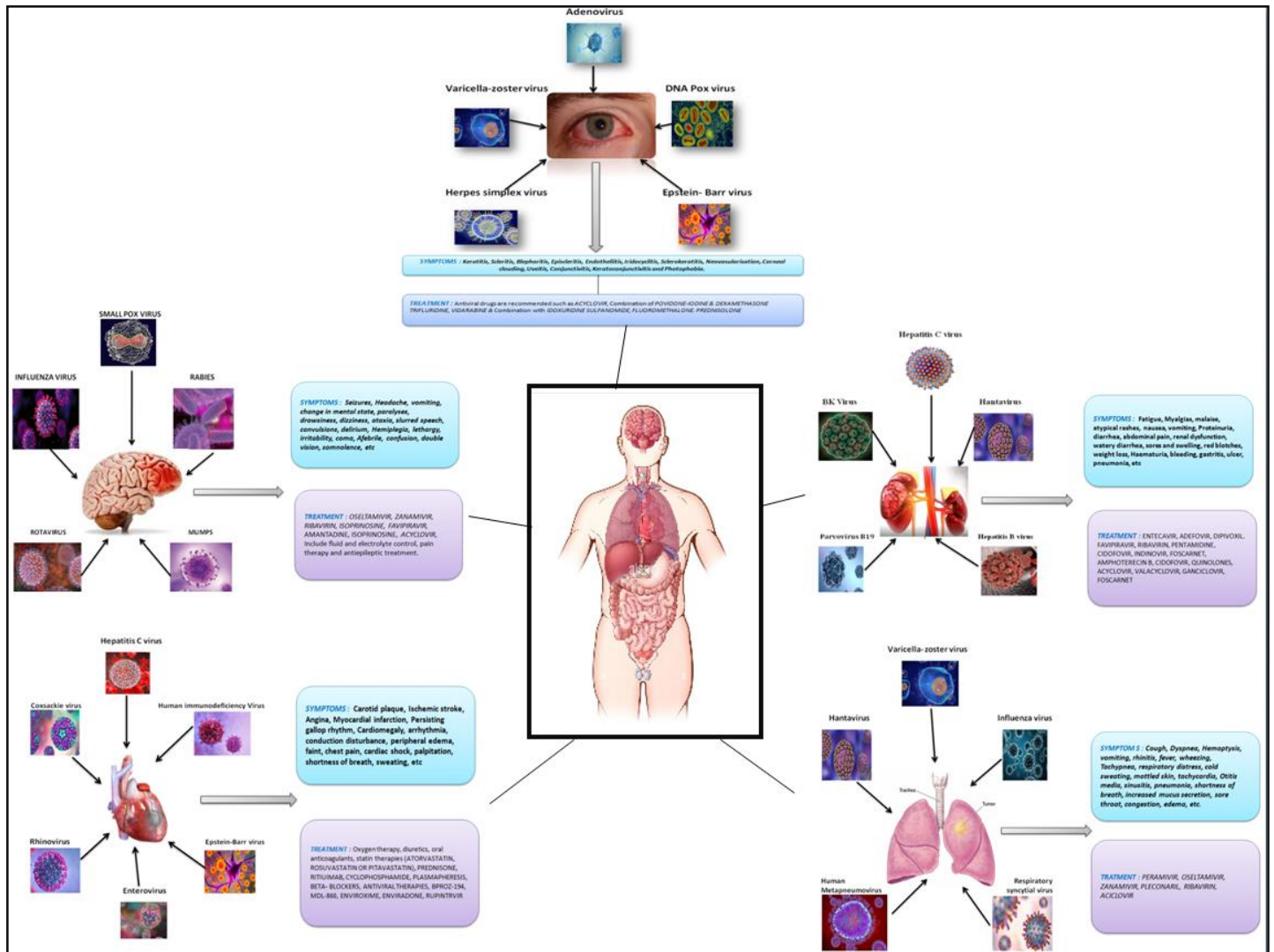


figure 1: - graphical abstract (various types of viruses present which trigger the different-different organs of the body)

1 INTRODUCTION

Viruses are the smallest obligate intracellular infective agent that contains only one type of nucleic acid, either DNA or RNA, in their genome. General properties of viruses such as they are resistance to antibiotics & sensitive to interferon, they have no metabolic activity outside the living cell, they do not possess a cellular organization (like ribosome, endoplasmic reticulum, mitochondria), they lack the enzymes necessary for protein & nucleic acid synthesis, they are dependent for replication on the synthetic machinery of host cell so they cannot grow in cell free culture, their viral genome (nucleic acid) divert the host metabolism to synthesis a number of virus specific macromolecule require for the production of virus progeny, they multiply by a complex process & not by binary fission, with few exceptions viruses are heat labile. The extracellular infectious virus particles are called virions.

The range of viruses is 20–300 nm. The smallest virus or smallest DNA virus is Parvovirus, and the largest virus or largest DNA virus is Poxvirus. The smallest RNA virus is PICORNA VIRUS, and the largest RNA virus is PARAMYXO VIRUS. There are three ways in which we measure the size of viruses: (1) Collodion membrane filter; (2) rate of sedimentation; (3) electron microscope. The virion consists of a nucleic acid core (genome), capsid (protein coating), and envelop. Nucleic acid core based on DNA and RNA viruses. DNA viruses are known as Hepadna, herpes, adeno, parvo, pox, and papova. RNA viruses are the following: arena virus, bunya virus, corona virus, delta virus, picorna virus, paramyxovirus, hepe virus, calici virus, reo virus, retro virus, flavi virus, filo virus, orthomyxo virus, and toga virus.

All the DNA viruses have double stranded DNA except parvo virus which has single stranded DNA & all the RNA viruses have single stranded RNA except reo virus which has double stranded RNA. Capsid is composed of a large number of protein subunit (polypeptides) which are known as capsomers. Capsid forming an impenetrable shell around the nucleic acid core, so protects it & provides structural symmetry to the virus. All the DNA viruses have double-stranded DNA except Parvo virus, which has single-stranded DNA, and all the RNA viruses have single-stranded RNA except Reo virus, which has double-stranded RNA. Capsid is composed of a large number of protein subunits (polypeptides), which are known as capsomers. Capsid forms an impenetrable shell around the nucleic acid core, which protects it and provides structural symmetry to the virus particle. The envelope is lipoprotein in nature, lipid (largely of host cell origin), and protein (virus-coded). Enveloped viruses are susceptible to the action of lipid solvents like chloroform. Non-enveloped DNA viruses are the papova virus, adenovirus, and parvovirus. Non-enveloped RNA viruses are the Picorna virus, the Calici virus, and the Reo virus. Rest assured, all DNA and RNA viruses are enveloped. Some viruses have segmented nucleic acids (genomes): Bunya viridae (3 segments of ssrna), Orthomyxo viridae (8 segments of ssrna), Reo viridae (10–12 segments of dsrna), and Arena viridae (2 segments of ssrna). Particle. Envelop is lipoprotein in nature, lipid (largely of host cell origin) and protein (virus coded). Enveloped viruses are susceptible to the action of lipid solvents like either and chloroform. Non – enveloped DNA virus is papova virus, adeno virus and parvo virus. Non-enveloped RNA virus is Picorna virus, calici virus and reo virus. Rest all DNA and RNA virus is enveloped. Some viruses have segmented nucleic acid (genome) – Bunya viridae (3 segmented of ssrna), Orthomyxo viridae (8 segments of ssrna), reo viridae (10-12 segments of dsrna) & arena viridae (2 segments of ssrna).

There are three types of symmetry determined by the arrangement of capsids around the nucleic acid core: icosahedral symmetry, helical symmetry, and complex symmetry. An icosahedron is a polygon with 12 vertices or corners and 20 facets in the shape of equilateral triangular faces. It has a rigid structure. All the DNA viruses except pox viruses have icosahedral symmetry; there are also involved non-encased RNA viruses such as Picorna, Calici, and Reo viruses. Helical symmetry forms when nucleic acid and the capsomers are wound tighter. All enveloped RNA viruses have helical symmetry.

Some viruses do not show either icosahedral or helical symmetry due to the complexity of their structure. The pox virus has complex symmetry. Viruses have different shapes: the pox virus (brick-shaped), the rabies virus (bullet-shaped), and the tobacco mosaic virus (rod-shaped). There are various methods by which viruses can be identified: by serological method, by lesion on the chorioallantoic membrane, by cytopathogenic effects in tissue culture, by plaque in agar-covered tissue culture, by heameagglutination, and by virus interference. As viruses are obligate intracellular parasites, they cannot be grown on any culture medium; they are multiplying only in living cells. There are three methods by which we grow the viruses: animal inoculation, embryonated egg inoculation, and tissue culture. The viruses reproduce or replicate in living cells by following six steps:

- a. Attachment (the phages attach to the surface of the host).
- b. Penetration (the viral DNA enters the host cell).
- c. Uncoating (the genome uncoated from capsid).
- d. Biosynthesis (phage DNA replicates and phage proteins are made).
- e. Maturation (new phage particles are assembled), and
- f. Lysis (the cell lysis releasing the newly made phage).

2 EFFECT OF VIRUS ON EYES: -

Ocular viral infections are caused by HERPES VIRUS, EPSTEIN-BARR VIRUS, HUMAN IMMUNODEFICIENCY VIRUS, VARICELLA ZOSTER VIRUS, HSV, VZV, CMV, MOLLUSUM CONTAGIOSUM, EBV, ADENO VIRUS, and RUBEOLA.



2.1 HERPES SIMPLEX VIRUS

Herpes Simplex Virus have two types are Type 1 (HSV-1) and Type 2 (HSV-2). Both types of herpes simplex virus cause without symptoms and active disease (Ritterband & Friedberg, 1998). Type 1 (HSV-1) mostly spread by oral contact and causes infections in or around the mouth. It can also cause genital herpes. Most adults are infected with HSV-1. Common oral herpes symptoms include Painful blisters or lesions, Conjunctivitis, Photophobia, Excessive tearing, Pain, Blurred vision, Redness, Irritation, Blepharitis. Type 2 (HSV-2) spreads by sexual contact and causes genital herpes. Common genital herpes symptoms include bumps, blisters or ulcers around the genitals or anus. In eyes, there are symptoms observed such as eyes redness, tearing and vision loss. Antiviral medicines commonly given in Herpes Simplex Virus such as *Acyclovir* (Harris, 2019).

2.2 ADENOVIRUS

Adenovirus engenders an epidemic conjunctivitis and epidemic keratoconjunctivitis which are rigorous and prodigiously contagious conjunctiva infections. Adenovirus caused Adenoviral Conjunctivitis which affects the eyes. Symptoms are observed such as Body sensation, Photophobia, Glare, Reduced vision, etc. Keratoconjunctivitis is pink eye that affects both your conjunctiva and your cornea. Keratoconjunctivitis caused by an adenovirus is called epidemic keratoconjunctivitis (EKC). Pink eye from adenovirus can lead to red, painful and watery eyes. When your cornea is involved due to EKC, you may experience blurry vision and swelling. Adenovirus is treated by antiviral drugs such as Combination of *POVIDONE-IODINE & DEXAMETHASONE* (Jonas et al., 2020)

2.3 VARICELLA- ZOSTER VIRUS

Herpes zoster ophthalmicus, resulting from VZV infection of the first branch of the trigeminal nerve, engenders a characteristic rash and might develop to keratitis and Uveitis cause morbidity. The eye is affected in approximately 1/2 of cases of V1 varicella-zoster virus reactivation. During acute disease, in addition to the painful forehead rash, symptoms and signs may have Fever, Malaise, Headache, Anorexia, Lassitude, Mood changes, Antisocial behaviour, Depression, Insomnia etc (Liesegang, 2008). Antiviral drugs are used such as *Acyclovir* (Niederer et al., 2021).

2.4 DNA POX VIRUS

Molluscum contagiosum is a mildly contagious viral skin infection. The infective agent is a large DNA poxvirus which causes multiple grouped umbilicated papules, lesions are found on the conjunctiva. In *Molluscum contagiosum* there are Hyperemia, Edema, Lesions, Fever & Lymphadenopathy are visible. This virus can spread by using skin to skin contact or by having unprotected vaginal, anal or oral intercourse. Treatment used in *Molluscum contagiosum* is antiviral drugs such as *TRIFLURIDINE, VIDARABINE & combination with IDOXURIDINE* (Pepose et al., 2003).

2.5 EPSTEIN- BARR VIRUS

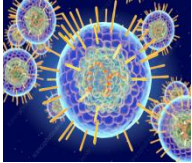
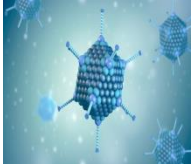
Epstein- Barr virus (EBV) is a DNA virus of the herpes virus genus (Matoba et al., 1986). EBV Infection may cause lesions in the central nervous system that affect vision includes optic neuritis, pupil neuritis papill-edema and so on (Wong et al., n.d.). Diseases are caused by Epstein- Barr virus which are Follicular conjunctivitis, Stromal keratitis, etc. There are symptoms observed such as corneal lesions, Iridocyclitis, Glaucoma, Chorioretinitis, Optic nerve lesions, etc. (Zoster et al., n.d.) We can treat Epstein- Barr virus by *SULFONAMIDE, FLUOROMETHALONE & PREDNISOLONE* drug that may help prevent EBV from reactivating in your body (Matoba et al., 1986).


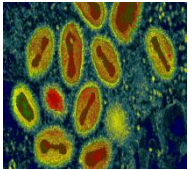
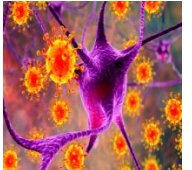
Symptoms are observed in ocular viral infection such as Keratitis, Scleritis, Blepharitis, Episcleritis, Endotheliitis, Iridocyclitis, Sclerokeratitis, Neovascularisation, Corneal clouding, Uveitis, Conjunctivitis, Keratoconjunctivitis and Photophobia.

TERMS USED-

Keratitis (Inflammation of the cornea)
 Scleritis (Inflammation of the sclera)
 Blepharitis (Inflammation of the eyelid)
 Episcleritis (Inflammation of the episclera)
 Endotheliitis (Inflammation of the innermost layer of the cornea)
 Iridocyclitis (Inflammation of both the iris and the ciliary body)
 Sclerokeratitis (Inflammation of both the sclera and cornea)
 Uveitis (Inflammation of the middle layer of the eyes)
 Conjunctivitis (Irritation or Inflammation of the conjunctiva)
 Keratoconjunctivitis (Inflammation of both the cornea and conjunctiva at the same time)

TABLE 1: EFFECT OF VIRUS ON OCULAR

<u>S.NO</u> :	<u>VIRUS INVOLVED</u>	<u>DISEASE</u>	<u>ORGAN EFFECTED</u>	<u>SYMPTOMS OBSERVED</u>	<u>TREATMENT</u>	<u>REFERENCE</u>
1.	Herpes simplex virus (HSV 1 HSV 2) 	Herpes Keratitis	EYES	<ul style="list-style-type: none"> • Painful blisters or lesions • Conjunctivitis • Photophobia • Excessive tearing • Pain • Blurred vision • Redness • Irritation • Blepharitis 	Antiviral drugs are recommended such as <i>Acyclovir</i> .	(Harris, 2019) (Ritterband & Friedberg, 1998)
2.	Adenovirus 	Adenoviral Conjunctivitis		<ul style="list-style-type: none"> • Body sensation • Photophobia • Glare • Reduced vision 	Combination of <i>POVIDONE- IODINE</i> & <i>DEXAMETHAS ONE</i>	(Jonas et al., 2020)

3.	Varicella-zoster virus 	Herpes zoster ophthalmicus	EYES	<ul style="list-style-type: none"> • Fever • Malaise • Headache • Oresia • Lassitude • Mood changes • Antisocial behaviour • Depression • Insomnia 	Antiviral drugs are recommended such as <i>Acyclovir</i>	(Liesegang, 2008) (Niederer et al., 2021)
4.	DNA Pox virus 	Molluscum contagiosum		<ul style="list-style-type: none"> • Hyperemia • Edema • Lesions • Fever • Lymphadenopathy 	Antiviral drugs are recommended such as <i>TRIFLURIDINE, VIDARABINE</i> & combination with <i>IDOXURIDINE</i>	(Pepose et al., 2003)
5.	Epstein- Barr virus 	Follicular conjunctivitis, Stromal keratitis		<ul style="list-style-type: none"> • Corneal lesions • Iridocyclitis • Glaucoma • Chorioretinitis • Optic nerve lesions 	<i>SULFANOMIDE, FLUOROMETHALONE & PREDNISOLONE</i> is a drug that may help prevent EBV	(Zoster et al., n.d.) (Matoba et al., 1986)

3. EFFECT OF VIRUS ON LUNGS

Viral respiratory infection is caused by influenza a, b virus, respiratory syncytial virus, rhinovirus, enterovirus, human metapneumovirus, hantavirus, varicella-zoster virus, parainfluenza viruses types 1,2,3, and 4, human bocavirus, coronavirus, adenovirus, parechoviruses, epstein-barr virus, human herpes virus 6 and 7, herpes simplex virus, mimivirus and cytomegalovirus.

3.1 Influenza A and B virus

Influenza viruses have some of the most important human pathogens, causing substantial seasonal & pandemic morbidity and mortality (Herold et al., 2015). Diseases caused by influenza virus Pneumonia, Chronic respiratory diseases. Symptoms may occur when disease are caused such as Hyperemia, Edema, Increased mucus secretion, Shortness of breath, Dyspnea, Wheezing, Abnormal breath sounds or auscultation, Cough and Sore throat (Dai et al.,

2020). Antibiotics can treat many forms of pneumonia. Some forms of pneumonia can be prevented by vaccine i.e. *PERAMIVIR*, *OSELTAMIVIR*, *ZANAMIVIR*(Ruuskanen et al., 2011).

3.2 Respiratory syncytial virus

RSV is a single-stranded RNA virus of the paramyxoviridae family. Diseases caused by respiratory syncytial virus are Bronchiolitis and Pneumonia. Symptoms may occur congestion, cough, Rhinorrhea, wheeze, increased work of breathing, cyanosis(Wright & Piedimonte, 2011). Drug recommended such as RIBAVIRIN (inhalation, intravenous)(Peltola et al., 2008).

3.3 Rhinovirus

Rhinovirus (HRVs) generally caused the upper respiratory diseases(Malmström et al., 2006). Diseases caused by rhinovirus are chronic obstructive pulmonary disease (COPD), asthma, pneumonia. The symptoms observed in rhinovirus are Common cold, Wheezing illness, Pneumonia, Sinusitis, Otitis media, etc. As a treatment PLECONARIL drug is recommended(Peltola et al., 2008).

3.4 Enterovirus

The entero viruses are the genus of the family Picorna viridae and show similar morphological, structural, molecular properties and replication strategies(Cooper et al., n.d.). Enterovirus caused the disease such as Pneumonia, Upper respiratory tract infection, chronic obstructive pulmonary disease, Cystic fibrosis, Asthma. There are symptoms seen like Cold sweating, Mottled skin, Tachycardia, Tachypnea, Hypertension, Respiratory distress, etc.(Wang et al., 2005) Treatment available regarding these diseases are antiviral drugs i.e. PLECONARIL(Peltola et al., 2008).

3.5 Human metapneumovirus

Human metapneumovirus is a single- stranded, negative sense and non-segmented RNA virus, HMPV is a member of paramyxo viridae family. Diseases caused by the human metapneumovirus like Lower and upper respiratory diseases. There are symptoms observed such as cough, rhinitis, fever, wheezing, etc (Kroll & Weinberg, 2011). RIBAVIRIN drug is recommended as a treatment.(Ruuskanen et al., 2011)


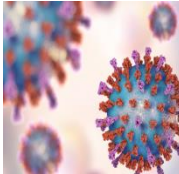
3.6 Hantavirus

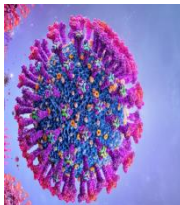
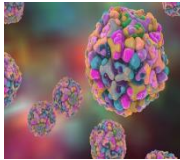
Hantaviruses are trisegmented RNA viruses, and a member of Hantaviridae family, Orthohantavirus genus. Hanta pulmonary syndrome disease caused by the Hantavirus. Symptoms seen in Hanta pulmonary syndrome are Cough, Dyspnea, Tachypnea, Shock, etc(Alonso et al., 2019). RIBAVIRIN drug is recommended as a treatment. (Peltola et al., 2008)


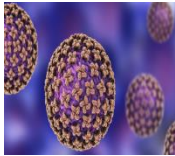
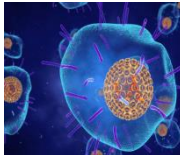
3.7 Varicella- zoster virus

Varicella pneumonia disease caused by the Varicella- zoster virus. Patient may be showing symptoms like Vomiting, Cough, Dyspnea, Hemoptysis, etc.(Gnann, 2002). Varicella pneumonia disease may be cured with antiviral drug like *ACICLOVIR*(Peltola et al., 2008).

TABLE 2: EFFECT OF VIRUS ON LUNGS

<u>S.NO.</u>	<u>VIRUSES EFFECTED</u>	<u>DISEASES</u>	<u>ORGAN EFFECTED</u>	<u>SIGN AND SYMPTOMS</u>	<u>TREATMENT</u>	<u>REFERENCE</u>
1.	Influenza A and B virus 	Pneumonia, Chronic respiratory diseases	LUNGS	<ul style="list-style-type: none"> • Hyperemia • Edema • Increased mucus secretion • Shortness of breath • Dyspnea • Wheezing • Abnormal breath sounds or auscultation • Cough • Sore throat • Headache 	Pneumonia can be prevented by vaccine i.e. <i>PERAMIVIR</i> , <i>OSELTAMIVIR</i> , <i>ZANAMIVIR</i>	(Ruuskanen et al., 2011) (Dai et al., 2020)
2.	Respiratory syncytial virus 	Bronchiolitis and Pneumonia		<ul style="list-style-type: none"> • Congestion • Rhinorrhea • Cough • Wheeze • Increased work of breathing 	Drug recommended such as <i>RIBAVIRIN</i> (inhalation, intravenous)	(Ruuskanen & Ogra, n.d.)

				<ul style="list-style-type: none"> • Cyanosis 		(Wright & Piedimonte, 2011)
3.	<p>Rhinovirus</p> 	<p>Chronic obstructive pulmonary disease (COPD), Asthma, Pneumonia</p>		<ul style="list-style-type: none"> • Common cold • Wheezing illness • Pneumonia • Sinusitis • Otitis media 	<p>Drug recommended such as <i>PLECONARIL</i></p>	(Peltola et al., 2008)
4.	<p>Enterovirus</p> 	<p>Pneumonia, Upper respiratory tract infection, Chronic obstructive pulmonary disease, Cystic fibrosis, Asthma</p>	LUNGS	<ul style="list-style-type: none"> • Cold sweating • Mottled skin • Tachycardia • Tachypnea • Hypertension • Respiratory distress 	<p>Drug recommended such as <i>PLECONARIL</i></p>	(Ruuskanen et al., 2011) (Wang et al., 2005)

5.	<p>Human metapneumovirus</p> 	<p>Lower and upper respiratory diseases</p>		<ul style="list-style-type: none"> • Cough • Rhinitis • Fever • Wheezing 	<p>Antiviral drug used i.e. RIBAVIRIN</p>	<p>(Ruuskanen & Ogra, n.d.)</p> <p>(Kroll & Weinberg, 2011)</p>
6.	<p>Hantavirus</p> 	<p>Hanta pulmonary syndrome</p>		<ul style="list-style-type: none"> • Cough • Dyspnea • Tachypnea • Shock 	<p>Antiviral drugs such as RIBAVIRIN</p>	<p>(Ruuskanen & Ogra, n.d.)</p> <p>(Alonso et al., 2019)</p>
7.	<p>Varicella-zoster virus</p> 	<p>Varicella pneumonia</p>		<ul style="list-style-type: none"> • Cough • Dyspnea • Hemoptysis • Vomiting 	<p>Antiviral drugs such as ACICLOVIR</p>	<p>(Gnann, 2002)</p>
			LUNGS			

4. EFFECT OF VIRUS ON KIDNEY

Renal viral infections are caused by Human Immunodeficiency Virus (HIV), hepatitis b virus (HBV), hanta virus, epstein-barr virus, adenovirus, polyomavirus, cytomegalovirus and hepatitis c virus (HCV).

Typically, characteristic histological pattern caused by each virus.

HEPATITIS B VIRUS CAUSE
MEMBRANOUS
GLOMERULONEPHROPATHY

HEPATITIS C VIRUS CAUSE
MEMBRANOPROLIFERATIVE
GLOMERULONEPHRITIS

4.1 Hepatitis C virus (HCV)

HCV affected the kidney and cause diseases such as Mesangiocapillary Glomerulonephritis (MPGN), Mixed Cryoglobulinemia and Membranous Glomerulopathy (Singh & Nickleit, 2004). Patients may suffer with symptoms like Pain in abdomen area, Bleeding, bloating in the nausea and abdomen, Loss of appetite, Fatigue, Swollen blood vessels in the skin or yellow skin or eyes, Weight loss. Antiviral drugs are used in treatment i.e. Ribavirin (Fabrizi et al., 2020).

4.2 Hepatitis B Virus (HBV)

HBV affected the kidney and cause diseases such as Membranous Glomerulopathy, Mesangiocapillary Glomerulonephritis (MPGN) and IgA Nephropathy (IgAN) (Singh & Nickleit, 2004). Patients may suffer with symptoms like Fatigue, Malaise, Swollen blood vessels in the skin or yellow skin and eyes and Fluid in the abdomen. Drugs are usually used such as ENTECAVIR (*ETV*), ADEFOVIR and DIPIVOXIL (Kotton & Fishman, 2005).

4.3 Hantavirus

Hantavirus affected the kidney and cause diseases such as Haemorrhagic fever with renal syndrome (HFRS) & Hantavirus Cardiopulmonary syndrome (HCPS). (Singh & Nickleit, 2004) Patients may suffer with symptoms like Fever, Malaise, Nausea, vomiting, Haematuria, Proteinuria, Headache, Body aches, Diarrhea, Abdominal pain, Renal dysfunction, etc. (BRIAN HJELLE) Antiviral drugs are used such as FAVIPIRAVIR & RIBAVIRIN (Prasad et al., 2019).

4.4 Human immunodeficiency virus (HIV)

HIV affected the kidney and cause diseases such as Focal segmental glomerulosclerosis, Collapsing glomerulopathy, Membranous glomerulopathy, Hepatitis B co-infection, Syphilis co-infection, Mixed Cryoglobulinaemia, Thrombotic Microangiopathy, Immunotactoid glomerulopathy, Post-infectious Glomerulonephritis (Singh & Nickleit, 2004). Patients may suffer with symptoms like Persistent diarrhea, Watery diarrhea, Sores or swelling, Difficult in swallowing or soreness, red blotches, Pneumonia, Severe unintentional, weight loss, Swollen lymph nodes, Skin rash, Opportunistic infection. Drugs are recommended which are *nephrotoxic* (i.e. pentamidine, cidofovir, indinavir, foscarnet, amphoterecin b)

4.5 BK Virus Nephropathy (Polymavirus)

BK Virus affected the kidney and cause diseases such as Hemorrhagic and NON-hemorrhagic cystitis, asymptomatic hematuria, Ureteral stenosis & interstitial nephritis. (Singh & Nickleit, 2004) Patients may suffer with symptoms like Fever, Dysuria, Hematuria, Ureteral stenosis, Pneumonitis, Hematuria (Yooprasert & Rotjanapan, 2018). Drug usually used LEFLUNOMIDE, CIDOFOVIR, QUINOLONES & INTRAVENOUS Ig (Bohl & Brennan, 2007).

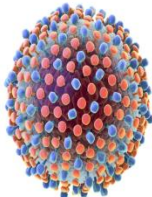
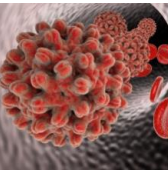
4.6 Cytomegalovirus

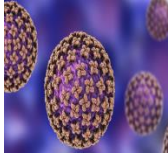
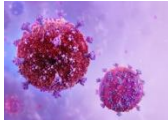
Cytomegalovirus affected the kidney and cause diseases such as Chronic glomerulonephritis, DM nephropathy, Hypertensive nephrosclerosis, Chronic tubulointerstitial nephritis, Polycystic kidney disease(Cordero et al., 2012). Patients may suffer with symptoms like Fever, Leucopenia, Myalgia, Fatigue, Thrombocytopenia, Myelosuppression, Colitis, Gastritis, Ulcer, Bleeding, & Pneumonia. *ACYCLOVIR*, *VALACYCLOVIR*, *FAMCICLOVIR*, *GANCICLOVIR*, *FOSCARNET* are used in the treatment of cytomegalovirus(Kotton & Fishman, 2005).

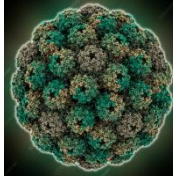
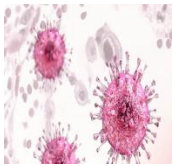
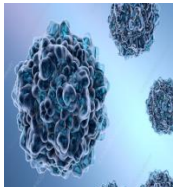
4.7 Parvovirus B19

Parvovirus B19 affected the kidney and cause diseases such as Erythropoietin-resistant anemia, Myocarditis, Pneumonitis, Pancytopenia(Kotton & Fishman, 2005). Patients may suffer with symptoms like Fever, Myalgias, Malaise, Atypical rashes & Fatigue. therapies are not recommended but can treat with IVIG, PRCA, etc.

TABLE 3: EFFECT OF VIRUS ON KIDNEY

S.N O.	VIRUSES INVOLVED	DISEASES	ORGAN AFFECTED	SIGN AND SYMPTOMS	TREATMENT	REFERENCE
1.	Hepatitis C virus (HCV) 	Mesangiocapillary Glomerulonephritis (MPGN), Mixed Cryoglobulinemia, Membranous Glomerulopathy	KIDNEY	<ul style="list-style-type: none"> • Pain in abdomen area • Bleeding, bloating in the nausea and abdomen • Loss of appetite • Fatigue • Swollen blood vessels in the skin or yellow skin or eyes • Weight loss 	Ribavirin drug used.	(Kakkar et al., 2023) (Fabrizi et al., 2020)
2.	Hepatitis B Virus(HBV) 	Membranous Glomerulopathy, Mesangiocapillary Glomerulonephritis (MPGN), IgA Nephropathy(IgAN)		<ul style="list-style-type: none"> • Fatigue • Malaise • Swollen blood vessels in the skin or yellow skin and eyes • Fluid in the abdomen 	Drugs are usually used such as <i>ENTECAVIR (ETV)</i> , <i>ADEFOVIR and DIPIVOXIL</i> .	(Kotton & Fishman, 2005)

<p>3.</p>	<p>Hantavirus</p> 	<p>Haemorrhagic fever with renal syndrome (HFRS), Hantavirus Cardiopulmonary syndrome (HCPS)</p>		<ul style="list-style-type: none"> • Fever • Malaise • Nausea, vomiting • Haematuria • Proteinuria • Headache, Body aches • Diarrhea • Abdominal pain • Renal dysfunction 	<p>Antiviral drugs are used such as FAVIPIRAVIR & RIBAVIRIN.</p>	<p>(Hjelle et al., 1995)</p>
<p>4.</p>	<p>Human immunodeficiency virus (HIV)</p> 	<p>Focal segmental glomerulosclerosis, Collapsing glomerulopathy, Membranous glomerulopathy, Hepatitis B co-infection, Syphilis co-infection, Mixed Cryoglobulinemia, Thrombotic Microangiopathy, Immunotactoid glomerulopathy, Post-infectious Glomerulonephritis</p>	<p>KIDNEY</p>	<ul style="list-style-type: none"> • Persistent diarrhea • Watery diarrhea • Sores or swelling • Difficult in swallowing or soreness • Red blotches • Pneumonia • Severe unintentional weight loss • Swollen lymph nodes • Skin rash • Opportunistic infection 	<p>Drugs are recommended which are NEPHROTOXIC (i.e. PENTAMIDINE, CIDOFOVIR, INDINAVIR, FOSCARNET, AMPHOTERICIN B)</p>	<p>(Hjelle et al., 1995)</p>

5.	BK Virus Nephropathy (Polymaviruses) 	Hemorrhagic and NON-hemorrhagic cystitis, Asymptomatic hematuria, Ureteral stenosis Interstitial nephritis		<ul style="list-style-type: none"> • Fever • Dysuria • Hematuria • Ureteral stenosis • Pneumonitis • Hematuria 	Drug usually used LEFLUNOMIDE, CIDOFOVIR, QUINOLONES & INTRAVENOUS Ig.	(Singh & Nickeleit, 2004) (Bohl & Brennan, 2007) (Yooprasert & Rotjanapan, 2018)
6.	Cytomegalovirus 	Chronic glomerulonephritis, DM nephropathy, Hypertensive nephrosclerosis, Chronic tubulointerstitial nephritis, Polycystic kidney disease	KIDNEY	<ul style="list-style-type: none"> • Fever • Leucopenia • Myalgia • Fatigue • Thrombocytopenia • Myelosuppression • Colitis • Gastritis • Ulcer • Bleeding • Pneumonia 	ACYCLOVIR, VALACYCLOVIR, FAMCICLOVIR, GANCICLOVIR, FOSCARNET are used in the treatment.	(Kotton & Fishman, 2005) (Cordero et al., 2012)
7.	Parvovirus B19 	Erythropoietin-resistant anemia, Myocarditis, Pneumonitis, Pancytopenia		<ul style="list-style-type: none"> • Fever • Myalgias • Malaise • Atypical rashes • Fatigue 	Antiviral therapies are not recommended but can treat with IVIG, PRCA, etc.	(Kotton & Fishman, 2005)

5. EFFECT OF VIRUS ON BRAIN

Neurological infection caused by *small pox virus, varicella virus, hepatitis a, hepatitis b, influenza virus, measles, mumps, human parvovirus b19, rabies, rotavirus, rubella, epstein-barr virus*

5.1 SMALL POX VIRUS

Small pox virus is the only non-zoonotic member of the Orthopox virus Genus. Small pox virus may cause diseases in the Cerebrum such as Cranial neuropathies, Aseptic meningitis, post-Vaccinial encephalitis, acute disseminated encephalitis, Transverse myelitis, Guillain- barre syndrome (Miravalle et al., 2010). Symptom may occur when the

small virus effected on the cerebrum such as *headache, vomiting, change in mental state, signs of meningeal irritation and paralysis*(Dolgopol et al., n.d.).

5.2 VARICELLA- ZOSTER VIRUS

Varicella and herpes zoster both are caused by varicella- zoster virus. VZV contains DNA and consist of four major components(Kennedy, 1987). Varicella virus may cause diseases such as aseptic meningitis, encephalitis, cerebellar ataxia, gait disorder, neuropathy(Miravalle et al., 2010). There are symptoms seen when virus cause diseases are drowsiness, headache, dizziness, ataxia, slurred speech, convulsions, delirium, Dysarthria, coma, etc. ACYCLOVIR is a drug used in the treatment of varicella virus(Kennedy, 1987).

5.3 HEPATITIS A VIRUS

Hepatitis A is an RNA virus which causes disease encephalitis, strokes, Transient ischemic attacks, polyneuropathy, etc(Miravalle et al., 2010). There are signs & symptoms caused by hepatitis virus are Albuminocytologic dissociation, slowing of nerve conduction velocity, Slowing of nerve conduction velocity. (CHINDO MALLUM) Hepatitis A virus is cured by IVIG, Plasma exchange, Steroids, Supportive care, Antibiotics, Corticosteroids, Anticonvulsants, Intravenous methylprednisolone CHINDO MALLUM.

5.4 HEPATITIS B VIRUS

HBV affect the cerebrum and cause diseases such as encephalitis, Cerebellar ataxia, Guillain- Barr syndrome, transverse myelitis, bell's Palsy, myasthenia gravis, neuropathy. (Miravalle et al., 2010) Treatment used – antiviral agents, corticosteroids, Theraphylctulose, Neomycin, L- ORNITHINE-L- ASPARTATE(Miravalle et al., 2010).

5.5 INFLUENZA VIRUS

Encephalopathy is the second most common neurological complication associated with influenza. (Ekstrand, 2012)Seizures are the most common neurologic complication of influenza. (Ekstrand, 2012) Multiple sclerosis, central nervous system demylenating disease, Guillain- Barre syndrome and other diseases caused by influenza virus which effects the brain(Miravalle et al., 2010). There are several symptoms are observed such as Mild confusion, Disorientation, Hallucination, Behavioral changes, Meaningless speech, Aphasia, Delirium, Lethargy, Somnolence, Coma and so on. (Ekstrand, 2012) *OSELTAMIVIR*, *ZANAMIVIR*, and *STEROIDS* are used as treatment for the influenza virus(Shah et al., 2014).

5.6 MEASLES

Measles also named as rubeola; it is generally spreads through respiratory secretions. Measles is a highly contagious human disease(Bale, 2014). Measles caused diseases such as acute encephalomyelitis, sub-acute measles encephalitis, sub-acute measles encephalitis, sub-acute sclerosing phaencephalitis (SSPE)(Miravalle et al., 2010) Symptoms observed in measles are Ataxia, Choreoathetosis, Paralysis, Intractable Seizure, Cerebral edema, etc. Intravenous therapy with *RIBAVIRIN* has been used in the measles. In SSPE (sub-acute sclerosing phaencephalitis) may benefit with *ISOPRINOSINE*. Measles can cure by vaccination using the combined measles-mumps-rubella (MMR) vaccine(Bale, 2014).

5.7 MUMPS

Patients with mumps have symptoms like Drowsiness, Convulsions, Headache, Psychoses, Ataxia and Hemiplegia Diseases caused by mumps virus are as amyotrophic lateral Sclerosis, mumps meningitis(Miravalle et al., 2010). Treatment of mumps virus includes fluid and electrolyte control, pain therapy and antiepileptic treatment(Tyor & Harrison, 2014).

DIAGNOSIS OF MUMPS	
Mumps virus infection diagnosed by detecting	<ul style="list-style-type: none"> • Mumps virus in saliva, throat washings or CSF • Mumps virus-specific IgM in serum specimen • Four fold or greater elevations in mumps virus-specific IgG titers in acute and convalescent sera • Mumps virus RNA in CSF or buccal swabs by using RT-PCR

Figure 2: diagnosis of mumps

5.8 HUMAN PARVOVIRUS B19

Human parvovirus B19 is a small single-stranded DNA virus related to several animal parvovirus (Bale, 2014). Diseases caused by human parvovirus b19 such as encephalitis, aseptic meningitis, stroke, peripheral neuropathy (Miravalle et al., 2010). Patients have symptoms like Headache, Vomiting, Lethargy, Irritability, Poor oral intake, Ataxia, Seizures, Focal signs, etc. At present, human parvovirus b19 cannot be prevented by vaccination. Hand washing and other hygienic measures may potentially decrease the risk of infection (Bale, 2014).

5.9 RABIES

Rabies virus is caused by non-segmented, antisense, single-stranded RNA viruses of the family Rhabdoviridae and genus Lyssavirus. Viruses are not live outside of hosts and are inactivated by sunlight, heat and desiccation (Nigg & Walker, 2009). Diseases caused by rabies virus such as meningoencephalitis, acute disseminated encephalitis, cranial & peripheral neuropathies, transverse myelitis, Guillain-Barre syndrome, etc. (Miravalle et al., 2010). Symptoms observed in rabies are Neuropsychiatric disturbance, Autonomic dysfunction, Sensory alteration, Fluctuating consciousness, Ascending paralysis. Antiviral drug is used in the treatment i.e. *FAVIPIRAVIR* (Hemachudha & Hemachudha, 2021).

5.10 ROTAVIRUS

Rotavirus diagnosed by various methods including EIA, immune electron microscopy and RT-PCR. (Lynch et al., 2001) Diseases caused by rubella such as axonal neuropathy and aseptic meningitis. Symptoms are observed like Lethargy, Convulsions, Seizures, Coma, Afebrile, Confusion, Vomiting, Generalized bleeding, Dehydration, Fever, Epilepsy, etc (Lynch et al., 2001). Treatment is used i.e. Rotavirus vaccines in seizure reduction (Rivero-Calle et al., 2016).

5.11 RUBELLA

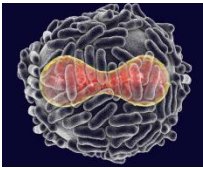
Rubella virus is a non-arthropod-borne member of the RNA Toga virus family. (Bale, 2014) Diseases caused by rubella such as chronic meningoencephalitis. Symptoms are observed when rubella virus affects the brain such as Seizures,

Hemiparesis, Mental retardation, cerebral edema, etc. (Cooper et al., n.d.) In Rubella treatment of amantadine and isoprinosine has been used (Tyor & Harrison, 2014).

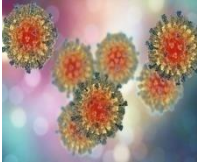

5.12 EPSTEIN-BARR VIRUS

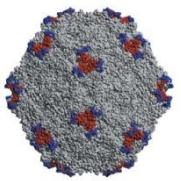


Epstein-Barr virus is a double stranded DNA virus. It is a member of the herpes virus family. The viral genome of EBV is contained in an icosahedral capsid. The Epstein-Barr virus caused diseases such as meningitis, encephalomyelitis, myeloradiculitis, encephalomyeloradiculitis and polyradiculitis. (Serafini et al., 2007) The acute EBV infection is a common complication of aseptic meningitis. (Tselis, 2014) Some symptoms are observed like seizures, confusion, meningeal signs, headache, cognitive disorder, cognitive disorder, polyradiculopathy, double vision, somnolence, etc (Bathoorn et al., 2011). Treatment used in EBV are antiviral and immunosuppressive drugs i.e. *corticosteroids* and *acyclovir* (Tselis, 2014).

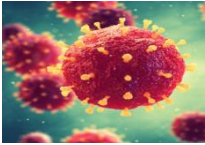

TABLE 4: EFFECT OF VIRUS ON BRAIN

S.N O.	VIRUSES	DISEASES CAUSED	ORGAN EFFECTED	SIGN AND SYMPTOMS	TREATMENT	REFERENCE
1.	SMALL POX VIRUS 	CRANIAL NEUROPATHIES ASEPTIC MENINGITIS POST-VACCINIAL ENCEPHALITIS ACUTE DISSEMINATED ENCEPHALITIS TRANSVERSE MYELITIS GUILLAIN-BARRE SYNDROME	BRAIN	<ul style="list-style-type: none"> • Headache • Vomiting • Change in mental state • Signs of meningeal irritation • Paralyzes 		(Lewis & Glaser, n.d.) (Miravalle et al., 2010) (Dolgopol et al., n.d.)
2.	VARICELLA ZOSTER VIRUS	ASEPTIC MENINGITIS ENCEPHALITIS CEREBELLAR ATAXIA GAIT DISORDER NEUROPATHIES			<ul style="list-style-type: none"> • Drowsiness • Headache • Dizziness • Ataxia • Slurred speech • Convulsions 	<i>ACYCLOVIR</i> is used for treatment.

				<ul style="list-style-type: none"> • Delirium • Dysarthria • Coma 		
3.	<p>HEPATITIS A</p> 	<p>ENCEPHALITIS</p> <p>STROKES</p> <p>TRANSIENT ISCHEMIC ATTACKS</p> <p>POLYNEUROPATHY</p>		<ul style="list-style-type: none"> • Albuminocytologic dissociation • Slowing of nerve conduction velocity • Diffuse multifocal hyperintensities in cerebral white matter 	<p>Treatment used- IVIG, Plasma exchange</p> <p>Steroids</p> <p>Supportive care, Antibiotics</p> <p>Corticosteroids</p> <p>Anticonvulsants</p> <p>Intravenous methylprednisolone</p>	<p>(Miravalle et al., 2010)</p> <p>(Lewis & Glaser, n.d.)</p> <p>*CHINDO MALLUM</p>
4.	<p>HEPATITIS B</p> 	<p>ENCEPHALITIS</p> <p>CEREBELLAR ATAXIA</p> <p>GUILLAIN-BARRE SYNDROME</p> <p>TRANSVERSE MYELITIS</p> <p>BELL'S PALSY</p> <p>MYASTHENIA GRAVIS</p> <p>NEUROPATHY</p>			<p>Treatment used – antiviral agents, corticosteroids, Theraphylctulose, Neomycin, L-ORNITHINE-L-ASPARTATE</p>	<p>(Miravalle et al., 2010)</p> <p>*CHINDO MALLUM</p>
5.	<p>INFLUENZA VIRUS</p> 			<ul style="list-style-type: none"> • Mild confusion • Disorientation • Hallucination • Behavioral changes 	<p>Treatment with <i>OSELTAMIVIR</i>, <i>ZANAMIVIR</i>, and STEROIDS</p>	<p>(Lewis & Glaser, n.d.)</p> <p>(Miravalle et al., 2010)</p> <p>(Shah et al., 2014)</p> <p>(Ekstrand, 2012)</p>

		<p>MULTIPLE SCLEROSIS</p> <p>CENTRAL NERVOUS SYSTEM DEMYELINATING DISEASE</p> <p>GUILLAIN-BARRE SYNDROME</p>	BRAIN	<ul style="list-style-type: none"> • Meaningless speech • Aphasia • Delirium • Lethargy • Somnolence • Coma 		
6.	<p>MEASLES</p> 	<p>ACUTE ENCEPHALOMYELITIS</p> <p>SUBACUTE MEASLES ENCEPHALITIS</p> <p>SUBACUTE SCLEROSING PHAENCEPHALITIS (SSPE)</p>		<ul style="list-style-type: none"> • Ataxia • Choreoathetosis • Paralysis • Intractable Seizures • Cerebral edema 	<p>Intravenous therapy with <i>RIBAVIRIN</i>.</p> <p>In SSPE may benefit with <i>ISOPRINOSINE</i>.</p> <p>Measles can cure by vaccination using the combined measles-mumps-rubella (MMR) vaccine.</p>	<p>(Lewis & Glaser, n.d.)</p> <p>(Miravalle et al., 2010)</p> <p>(Bale, 2014)</p>
7.	<p>MUMPS</p> 	<p>AMYOTROPHIC LATERAL SCLEROSIS</p> <p>MUMPS MENINGITIS</p>		<ul style="list-style-type: none"> • Drowsiness • Convulsions • Headache • Psychoses • Ataxia • Hemiplegia 	<p>Include fluid and electrolyte control, pain therapy and antiepileptic treatment.</p>	<p>FORMERLY CAPTAIN</p> <p>*PAUL LEWIS</p> <p>* WILLIAM TYOR</p> <p>*AUGUSTO MIRAVALLE</p>
8.	<p>HUMAN PARVOVIRUS B19</p>	<p>ENCEPHALITIS</p> <p>ASEPTIC MENINGITIS</p>		<ul style="list-style-type: none"> • Headache • Vomiting • Lethargy • Irritability 	<p>Hand washing and other hygienic measures may potentially decrease the risk of infection.</p>	<p>*PAUL LEWIS</p> <p>*JAMES F. BALE</p> <p>* AUGUSTO MIRAVALLE</p>

		<p>STROKE</p> <p>PERIPHERAL NEUROPATHY</p>		<ul style="list-style-type: none"> • Poor oral intake • Ataxia • Seizures • Focal signs 		
9.	<p>RABIES</p> 	<p>MENINGOENCEPHALITIS</p> <p>ACUTE DISSEMINATED ENCEPHALITIS</p> <p>CRANIAL & PERIPHERAL NEUROPATHIES</p> <p>TRANSVERSE MYELITIS</p> <p>GUILLAIN-BARRE SYNDROME</p>		<ul style="list-style-type: none"> • Neuropsychiatric disturbance • Autonomic dysfunction • Sensory alteration • Fluctuating consciousness • Ascending paralysis 	<p>Antiviral drug are used i.e. <i>FAVIPIRAVIR</i></p>	<p>*PAUL LEWIS</p> <p>*AUGUSTO MIRAVALLE</p> <p>*PASIN HEMACHUD HA</p>
10.	<p>ROTAVIRUS</p> 	<p>AXONAL NEUROPATHY</p> <p>ASEPTIC MENINGITIS</p>	BRAIN	<ul style="list-style-type: none"> • Lethargy • Convulsions • Seizures • Coma • Afebrile • Confusion • Vomiting • Generalized bleeding • Dehydration • Fever • Epilepsy 	<p>ROTAVIRUS VACCINES are used n seizure reduction.</p>	<p>*PAUL LEWIS</p> <p>*AUGUSTO MIRAVALLE</p> <p>*MAUREEN LYNCH</p> <p>*IRENE RIVERO-CALLE</p>

11.	RUBELLA 	CHRONIC MENINGOENCEPHALITIS		<ul style="list-style-type: none"> • Seizures • Hemiparesis • Mental retardation • Cerebral edema 	AMANTADINE and ISOPRINOSINE has been used.	*LOUIS Z. COPPER *PAUL LEWIS *WILLIAM TYOR
12.	EPSTEIN-BARR VIRUS 	MENINGITIS ENCEPHALOMYELITIS MYELORADICULITIS ENCEPHALOMYELORADICULITIS POLYRADICULITIS		<ul style="list-style-type: none"> • SEIZURE • CONFUSION • MENINGEAL SIGNS • HEADACHE • COGNITIVE DISORDER • POLYRADICULOPATHY • DOUBLE VISION • SOMNOLENCE 	Antiviral and immunosuppressive drugs are used <i>CORTICOSTEROIDS</i> and <i>ACYCLOVIR</i>	*BARBARA SERAFINI *ERIK BATHOORN *A.C. TSELIS

6. EFFECT OF VIRUS ON HEART

cardiac infection caused by hepatitis c virus, human immunodeficiency virus, adenovirus, cytomegalovirus, enterovirus, human parvovirus b19, coxsackie virus, epstein-barr virus, and rhinovirus.

HEPATITIS C VIRUS

Hepatitis C virus cause the diseases such as Myocarditis, Dilated cardiomyopathy, Hypertrophic cardiomyopathy, Arrhythmogenic right ventricular cardiomyopathy, Left ventricular aneurysm. (Matsumori, 2005) Patient may have symptoms like Carotid plaque, Ischemic stroke, Angina, Myocardial infarction, etc. As a medication, prednisone, ritiumab, cyclophosphamide, plasmapheresis, beta- blockers, antiviral therapies are prescribed (Terrier et al., 2013).

HUMAN IMMUNODEFICIENCY VIRUS

Diseases caused by HIV (Human Immunodeficiency Virus) such as pericardial effusion, Myocarditis, Thrombosis and embolism, Arterial aneurysm, dilated cardiomyopathy, Endocarditic, coronary artery disease. Shortness of breath, Pedal edema, Sweating, Weight loss, Septic emboli, etc. symptoms are observed. (Restrepo et al., 2006) As a treatment we use Oxygen therapy, diuretics, oral anticoagulants, statin therapies (Atorvastatin, Rosuvastatin or Pitavastatin).

ADENOVIRUS

Myocarditis, Dilated cardiomyopathy, febrile illness, pericardial effusion, Congestive heart failure, these further diseases are caused by adenovirus. (Kallewaard et al., 2009) Antiviral drugs are prescribed such as Acyclovir, ganciclovir, Intravenous ribavirin, etc (Munoz et al., n.d.).

CYTOMEGALOVIRUS

Cytomegalovirus caused the diseases such as Ischemic cardiomyopathy, Hypertrophic obstructive cardiomyopathy, Endomyocardial fibrosis (Santos et al., 2014). Patients may have symptoms like Myocardial infarction, Persisting gallop rhythm, Cardiomegaly, Left bundle branch blocked, Leukemia, Toxoplasmosis, Malignant lymphoma (Wink & Schmitz, n.d.). Antiviral drugs are recommended such as Ganciclovir, Cidofovir. (Kytö et al., 2005)

ENTEROVIRUS

The enteroviruses are the genus of the family Picornaviridae and show similar morphological, structural, molecular properties and replication strategies. Diseases caused by Enterovirus such as Polio-like illness, Myocarditis (Terrier et al., 2013) Symptoms are observed like Chest pain, Cardiac arrhythmias, Cardiomegaly, Poor ventricular function, Systemic hypotension, Congestive heart failure, pulmonary oedema, myocardial ischaemia, etc (Tebruegge & Curtis, 2009). Pleconaril, Bproz-194, Mdl-860, Enviroxime, Enviradone, Rupintrvir these drugs are used for the treatment of Enterovirus.

HUMAN PARVOVIRUS B19

Diseases caused by human parvovirus b19 such as Idiopathic Dilated cardiomyopathy, Myocarditis, Congestive heart failure, coronary artery disease, and Erythema infectiosum. Symptoms caused by these diseases like Anemia, Aplastic crises, Hydrops fetalis, Arthritis, Vasculitis, etc (Breinholt et al., 2010). The treatments for human parvovirus b19 are (IFN- β) Interferon- β , intravenous immunoglobulin (IVIG).

COXSACKIE VIRUS

Herpangina, Myopericarditis, Febrile illness, Pleurodynia these further diseases are caused by Coxsackie virus. Symptoms caused by these diseases like Arrhythmia, Heart failure, Pericarditis, Myocardial infarction, etc (Serafini et al., 2007). The (IFN- β) Interferon- β can be prescribed for treatment (Kytö et al., 2005).

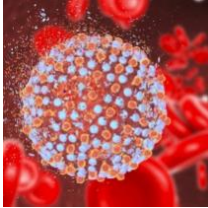
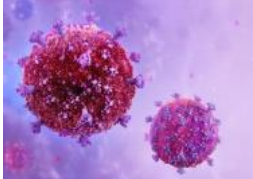
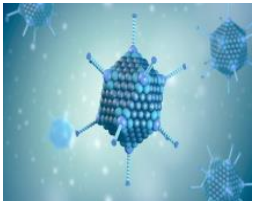
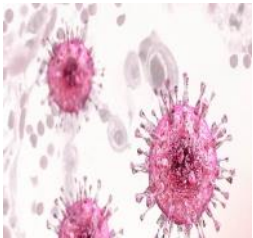
EPSTEIN-BARR VIRUS

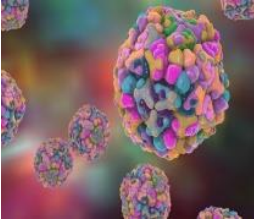
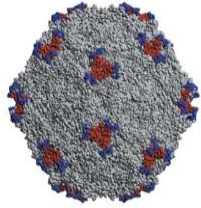
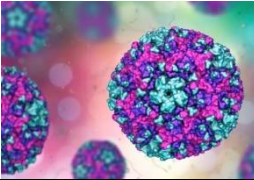

Myocarditis, Ischemic heart disease, dilated cardiomyopathy these diseases are caused when Epstein-Barr virus triggers. Heart failure, Chest pain, impaired exercise tolerance, Arrhythmia, Conduction disturbance, Peripheral edema, Hepatosplenomegaly, etc. are observed when heart diseases are caused. Anti-inflammatory medication, immunomodulator therapy with corticosteroids, immunologic treatments prescribed (Mutlu et al., 2011)


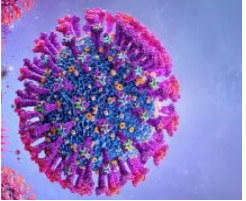
RHINOVIRUS

Rhinoviruses are most commonly caused the Myocarditis. There are symptoms observed like Chest pain, Faint, Cardiac shock, Palpitation, etc. As a treatment, Intravenous immunoglobulin, Dobutamin, Digoxin, Lopril, Lasix, Aldacton are recommended (Dtm et al., 2017).

TABLE 5: EFFECT OF VIRUS ON HEART

S.NO.	VIRUSES	DISEASES	ORGAN EFFECTED	SIGN & SYMPTOMS	TREATMENT	REFERENCE
1.	HEPATITIS C VIRUS 	Myocarditis, Dilated cardiomyopathy, Hypertrophic cardiomyopathy, Arrhythmogenic right ventricular cardiomyopathy, Left ventricular aneurysm	HEART	<ul style="list-style-type: none"> • Carotid plaque • Ischemic stroke • Angina • Myocardial infarction 	PREDNISONE, RITUIIMAB, CYCLOPHOSPHAMIDE, PLASMAPHERESIS, BETA-BLOCKERS, ANTIVIRAL THERAPIES	(Matsumori, 2005) (Terrier et al., 2013)
2.	HUMAN IMMUNODEFICIENCY VIRUS 	Pericardial effusion, Myocarditis, Thrombosis and embolism, Arterial aneurysm, Dilated cardiomyopathy, Endocarditic, coronary artery disease		<ul style="list-style-type: none"> • Shortness of breath • Pedal edema • Sweating • Weight loss • Septic emboli 	Oxygen therapy, diuretics, oral anticoagulants, statin therapies (ATORVASTATIN, ROSUVASTATIN OR PITAVASTATIN)	(Restrepo et al., 2006) (Bloomfield & Leung, 2017)
3.	ADENOVIRUS 	Myocarditis, Dilated cardiomyopathy, Febrile illness, Pericardial effusion, Congestive heart failure		<ul style="list-style-type: none"> • Myocardial infarction • Persisting gallop rhythm • Cardiomegaly • Left bundle branch blocked • Leukemia • Toxoplasmosis 	Acyclovir, ganciclovir, Intravenous ribavirin,	(Kallewaard et al., 2009) (Munoz et al., n.d.)
4.	CYTOMEGALOVIRUS 	Ischemic cardiomyopathy, Hypertrophic obstructive cardiomyopathy, Endomyocardial fibrosis		Ganciclovir, Cidofovir	(Santos et al., 2014) (Kytö et al., 2005) (Wink & Schmitz, n.d.)	

				<ul style="list-style-type: none"> • Malignant lymphoma 		
5.	ENTEROVIRUS 	Polio-like illness, Myocarditis	HEART	<ul style="list-style-type: none"> • Chest pain • Cardiac arrhythmias • Cardiomegaly • Poor ventricular function • Systemic hypotension • Congestive heart failure • Pulmonary oedema • Myocardial ischaemia 	PLECONARIL, BPROZ-194, MDL-860, ENVIROXIME, ENVIRADONE, RUPINTRVIR	(Tebruegge & Curtis, 2009)
6.	HUMAN PARVOVIRUS B19 	Idiopathic Dilated cardiomyopathy, Myocarditis, Congestive heart failure, coronary artery disease, Erythema infectiosum		<ul style="list-style-type: none"> • Anemia • Aplastic crises • Hydrops fetalis • Arthritis • Vasculitis 	(IFN- β) Interferon- beta, intravenous immunoglobulin (IVIG)	(Breinholt et al., 2010)
7.	COXSACKIE VIRUS 	Herpangina, Myopericarditis, Febrile illness, Pleurodynia		<ul style="list-style-type: none"> • Arrhythmia • Heart failure • Pericarditis • Myocardial infraction 	(IFN- β) Interferon- beta	(Kytö et al., 2005) (Serafini et al., 2007)
8.	EPSTEIN-BARR VIRUS 	Myocarditis, Ischemic heart disease, Dilated		<ul style="list-style-type: none"> • Heart failure • Chest pain 	Anti-inflammatory medication, immune-	

		cardiomyopathy		<ul style="list-style-type: none"> • Impaired exercise tolerance • Arrhythmia • Conduction disturbance • Peripheral edema • Hepatosplenomegaly 	modulator therapy with corticosteroids, immunologic treatments	(Mutlu et al., 2011)
9.	RHINOVIRUS 	Myocarditis		<ul style="list-style-type: none"> • Chest pain • Faint • Cardiac shock • Palpitation 	Intravenous immunoglobulin, Dobutamin, Digoxin, Lopril, Lasix, Aldacton	(Dtm et al., 2017)

7. CONCLUSION

To summarize, viruses are highly diverse infective agents that affect various organs and cause a wide range of diseases, necessitating specialized antiviral treatments. Viruses are distinguished by their reliance on host cells for replication, their inability to grow outside living cells, and the absence of cellular structures and metabolic activity. They differ in size, symmetry, and genetic material, with DNA and RNA viruses having distinct replication strategies and structural characteristics. Virus identification and growth are complex processes, and understanding their properties is critical for developing effective antiviral strategies and treatments.

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