Human Papillomavirus (HPV)

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Disease Name: Human Papillomavirus (HPV)

Means of Transmission: Transmission occurs with direct skin-to-skin contact. Sexual transmission, usually via vaginal or anal sex, is common, though oral sex is also a means of transmission. Infants are also at risk of infection at birth if the mother has HPV.

Usual Reservoirs: “Humans are the only natural reservoir of HPV.” Although, viruses of the same family may affect other species.

Etiologic Agent: Human Papillomavirus (HPV)

General Characteristics: HPV is a non-enveloped virus with circular, double stranded DNA 8kb long. It is an extremely prevalent sexually transmitted infection, infecting a great majority of sexually active men or women within their lifespan, regardless of number of partners. The different strains of the virus can infect various parts of the body, such as the genital region or the hands and face. The strains are labeled either high or low-risk, depending on their relationship with cancer, though HPV-caused cancer is considered rare. Typically, HPV infections go away without treatment while persistent HPV infections cause warts or cancer. The 13 known cancer-causing HPV strains work by transforming the host cell and replicating viral DNA inside the host cell’s nucleus. When these transformed cells multiply, a tumor forms. Currently, HPV is the leading cause of cervical cancer cases worldwide.

Key Tests for Identification: Regular (every 3 years) Pap smears are recommended for women, beginning at age 21. These tests take a sample of cervical tissue to detect abnormal cell changes that could be indicative of cervical cancer. If cancer is suspected, the HPV test can help detect the 13 high-risk strains associated with cervical cancer. The Food and Drug Administration has approved the Digene Hybrid Capture 2 (hc2) High-Risk HPV DNA Test for use in the United States. This test works by using nucleic acid hybridization to form a viral DNA-probe-hybrid. Antibodies added and bound to this hybrid would emit light, indicating the presence of HPV DNA in cervix cells, although absence of light could be due to HPV DNA in undetectable levels. It is important to note that these tests are specific to cancer screening, so they are not recommended to men, and there is no approved test for HPV in the mouth or throat. An HPV diagnosis can also be reached by a health professional’s visual inspection of any genital warts. In the absence of warts, a vinegar (acetic acid) solution test may be used. This test shows HPV infected areas by turning them white.

Historical Information: In 1907, transmission experiments on human warts helped us understand their viral nature. Richard Shope’s work on rabbit growths in the 1930s sparked hypotheses that viruses had some relationship with cancers. Shope was able to prove that the growths were caused by a virus, which came to be called the Shop Papilloma Virus. His colleague, Peyton Rous furthered
Shope’s research by confirming that the growths were indeed benign tumors. This would confirm the cancer-causing ability of certain viruses in mammals. After studying genital warts and biopsies of cervical cancer tissue in the 1970s, Harald zur Hausen suspected that there might be different kinds of HPV. In 1979, Lutz Gissmann and Ethel-Michele de Villiers were able to isolate HPV-6 for the very first time, leading to the isolation of many other types of HPV. After zur Hausen’s team isolated HPV 16 and 18, he hypothesized that those types had a relationship with cervical cancer, though early peas with pharmaceutical companies to develop a vaccine failed. Isolation of the different types of HPV lead to a better understanding of the virus’ mechanism of action. In 2008, zur Hausen was awarded the Nobel Prize in Medicine for his findings.

Signs and Symptoms:
It is common for HPV to go undetected for extended periods of time because, often, the infection proceeds without symptoms and can even disappear without treatment. The warts caused by certain types of HPV are often found in clusters throughout the genital region and described as often painless, itchy, cauliflower-like and flesh-colored in appearance. The patient can be assured that these warts will not develop into cancer. Some warts caused by HPV may be too small or internal, complicating visualization.

Microbial Virulence Mechanisms:
HPV replicates on the basal cells of the epithelium. HPV binds to cells through its L1 capsid protein (aided by the L2 minor capsid protein) to the receptors on the host cell’s surface. After binding, the virus then uses endocytosis to be absorbed. The time period between binding and viral gene expression is long, taking 24 hours to detect in lab settings. After 12 hours, and L2-genome complex forms and the virus is uncoated. The exact method of transport for the L2-genome complex is unknown, but it is able to reach the nucleus after 24 hours, at which point, transcription can begin.

Control or Treatment:
Currently no treatment specific to HPV exists. Visibal warts may go away on their own, or persist. Medications prescribed can help remove these. Abnormal cell changes detected by a pap smear do not always become cancer, if treated properly. Regular screenings remain the best method for preventing cancer.

Current Outbreaks:
  **Global**: The WHO has deemed HPV as the most common sexually transmitted viral infection and has estimated that the virus is linked to 99% of worldwide cases of cervical cancer. In 2008 there were an estimated 529,000 new cases of cervical cancer and 247,000 deaths worldwide.
  **Local**: The CDC estimated the number of new STIs at about 20 million in 2008. Of these new incidences of infection, 49% (or 14.1 million) were due to HPV. The number of estimated new and existing cases of HPV is estimated at 79.1 million.

Prevention:
There are currently two HPV vaccines (Cervarix and Gardasil) approved by the FDA to prevent the most common high-risk HPV types. These vaccines are recommended for girls at age 11-12 and are administered in three doses. Gardasil is recommended for boys at age 11-12, also
administered in three doses. These vaccines work best when taken as recommended and before
becoming sexually active.15

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