Oral Vaccines: From Mouth to Mucosal Immunity

Oral vaccines stop pathogens in their tracks before they get a chance to cause disease.

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A mouthful of benefits

For those daunted by the sharp sting of needles, oral vaccines offer an alternative route to immunity. Oral vaccines leverage the body's mucosal surfaces, such as those in the digestive tract, as battlegrounds to neutralize harmful pathogens before they can infiltrate the bloodstream and wreak havoc on other tissues (1). This process, known as mucosal immunity, gives oral vaccines a distinct edge in the ongoing battle against infectious diseases.

Surviving the digestive system

To elicit mucosal immunity, oral vaccines must first survive the low pH of the stomach. The oral poliovirus vaccine, for instance, contains a weakened version of the poliovirus that resists stomach acidity and digestive enzymes due to having no lipid envelop that gastric enzymes can disrupt (2). Once it survives the stomach, the virus replicates primarily in the small intestine.

Hacking into the intestinal immune system

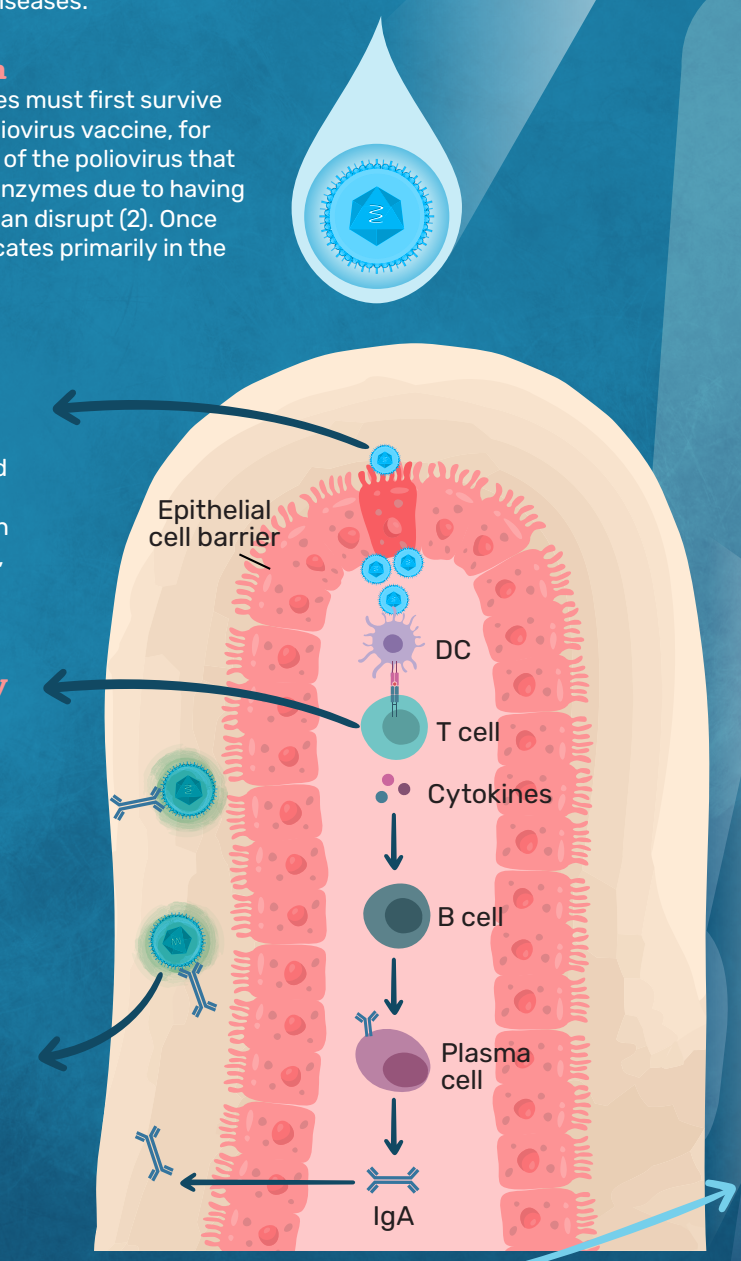
The virus passes the protective cell barrier of the small intestine by attaching to microfold cells, specialized epithelial cells that line the inner surface of the small intestine (3). Within the small intestine, the virus replicates, attracting dendritic cells (DCs) (4).

Generating adaptive immunity

An adaptive immune response ensues, which prepares the recipient for a future viral infection. DCs capture the virus and break down its viral proteins into fragments that they present to T cells (5). In response, T cells release cytokines to stimulate B cells to become plasma cells, prompting the secretion of IgA antibodies against the viral antigens (6).

Preventing infection spread

IgA antibodies integrate into the protective mucosal layer covering the epithelial cell barrier. If the active virus infects the host, IgA antibodies trap the virus in mucus and neutralize it (7). This prevents the virus from attacking other tissues and limits the replication and spread of the pathogen.



Eliminating pathogens

The gut's muscle movements guide the virus-filled mucus blobs down the digestive tract. This material transforms into fecal matter in the colon and is ultimately expelled from the body (8).

The upper hand

Unlike systemic immunity, which primarily targets pathogens once they have invaded tissues, mucosal immunity neutralizes pathogens at the mucosal surfaces where they first enter the body, such as the digestive, respiratory, and urogenital systems (9). Oral vaccines mimic the natural route of infection for many pathogens, enabling the immune system to mount a fast response at the site of entry (10).

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