Simultaneous cleaving of viral capsid and DNA/RNA. A fast way to screen for virucidal efficacy

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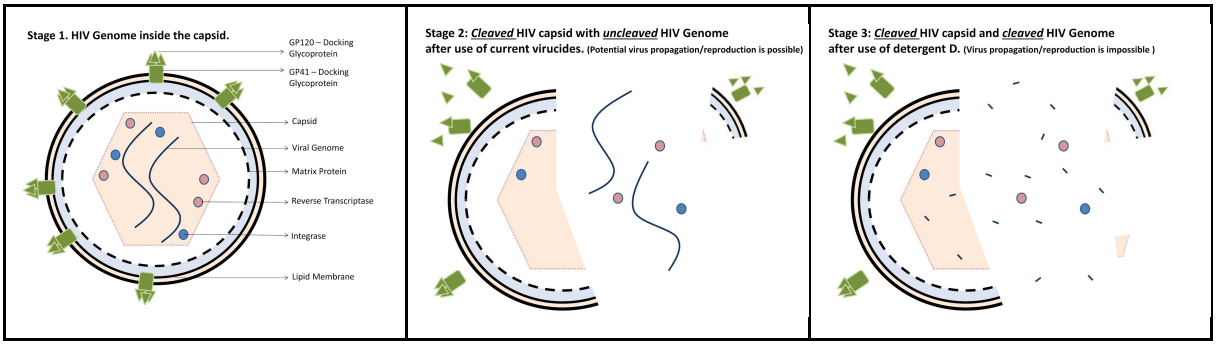
Every couple of months, new viral strains are reported in the media. This prompts requests to hospital infection control specialists to confirm virucidal efficacy of instrument reprocessing cycle (Instrument reprocessing cycles) against the emerging virus.

As there are no reliable cell-based assays for the infectivity of even the most notorious viruses (HIV, Hep B), let alone emerging viruses, the answers are not straightforward. The current broad virucidal claim is supported by cell culture-based virucidal assays (eg ASTM1053 or EN16777) on three viral strains that date back to the 1950's. Extrapolating the ASTM1053-validated virucidal efficacy to emerging viruses is quite risky when taking the sophisticated resistance mechanisms employed by these viruses into account.

Since viruses are essentially DNA (or RNA) genomic strands enveloped in a protein capsid, until the early 2000s there was a consensus that merely damaging viral capsid was equivalent to the loss of virus infectivity.

Recently more and more data indicate that viruses may reproduce from the viral genome alone [1-3]: Due to a multitude of reasons - from a compromised immune system to dysregulated endocytosis - viral nucleic acids can be taken into human cells, evading the cell's immune sensing mechanisms.

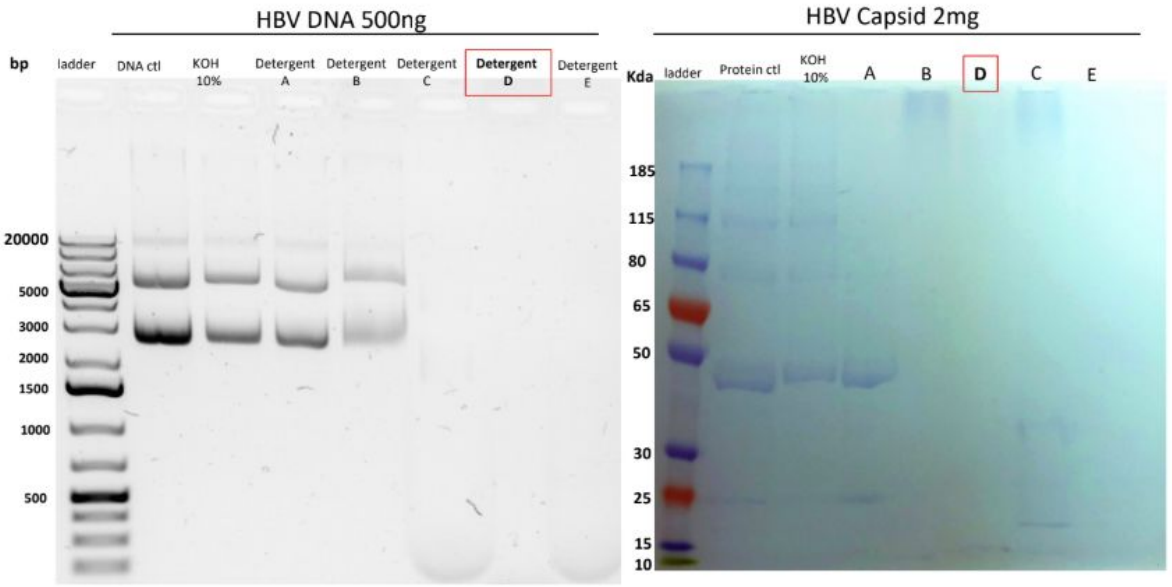


The above data (quite rightfully) is creating concern amongst hospital staff over the safety in exposure to reusable instruments that might harbour intact viral genome. As reported at 2018' WFHSS - DNA of Hepatitis B survives throughout some instrument reprocessing cycles. Similarly, DNA of HIV persists intact through certain common chemical disinfection cycles. Uncertainties about the infectivity of the intact viral genome in the current prone to litigation environment have already resulted in the lengthening of Instrument reprocessing cycless - for example, A0=600 was increased to A0=3000 in washer disinfectors due to possibility of HBV survival.

We present a fast, reliable and inexpensive screening for virucidal efficacy. The virucidal efficacy corresponds to the concurrent denaturation of both viral DNA/RNA and capsid proteins. Therefore the virucidal capacity of a disinfectant can be reliably resolved upon challenging with the viral loads characteristic of an active phase of chronic viral infection - ~20,000 IU per mL (or 105 copies/ml) and screening for both biological components. If both capsid protein and DNA are cleaved, the disinfectant or Instrument reprocessing cycles posses the desired complete virucidal activity.

Using the above method we screened some of the Australia-marketed medical instrument detergents. We found that many of these detergents (even with prion deactivation and 'digest all biological matter' claims) are completely ineffective in cleaving DNA and have poor efficacy in denaturing capsid proteins. Promisingly at least one detergent (detergent D) demonstrated an impressive ability to cleave both DNA- and capsid protein during 10 min at 40C cycles.

This DNA and capsid protein denaturation correlates well with the virucidal efficacy tested as per ASTM1053



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2. Beachboard, D. C., & Horner, S. M. (2016) Innate immune evasion strategies of DNA and RNA viruses. *Current opinion in microbiology*, *32*, 113-119.
3. Pol, S. (2013). Management of HBV in immunocompromised patients. *Liver International*, *33*, 182-187