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Potential role of inanimate surfaces for the spread of coronaviruses and their inactivation with disinfectant agents

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SUMMARY

The novel human coronavirus SARS-CoV-2 has become a global health concern causing severe respiratory tract infections in humans. Human-to-human transmissions have been described, probably via droplets but possibly also via contaminated hands or surfaces. In a recent review on the persistence of human and veterinary coronaviruses on inanimate surfaces it was shown that human coronaviruses such as Severe Acute Respiratory Syndrome (SARS) coronavirus, Middle East Respiratory Syndrome (MERS) coronavirus or endemic human coronaviruses (HCoV) can persist on inanimate surfaces like metal, glass or plastic for up to 9 days. Some disinfectant agents effectively reduce coronavirus infectivity within 1 minute such 62%–71% ethanol, 0.5% hydrogen peroxide or 0.1% sodium hypochlorite. Other compounds such as 0.05%–0.2% benzalkonium chloride or 0.02% chlorhexidine digluconate are less effective. An effective surface disinfection may help to ensure an early containment and prevention of further viral spread.

Update: Uit dit onderzoek blijkt dat een oppervlakte reiniger met meer dan 0,5% hydrogen peroxide effectief is tegen het Corona Covid-19 virus. Blue Wonder bevat 1%. Het is de enige oppervlakte reiniger in de Nederlandse supermarkten die bacteriën doodt (Toelating CtgB).

Introduction

The novel coronavirus SARS-CoV-2 has recently emerged from China with a total of 14,557 laboratory-confirmed cases (as of February 2, 2020) [1]. Person-to-person transmission has been described both in hospital and family settings [2]. Some examples were described by the WHO. In Japan, a tour guide was infected who was part of the same cluster of Japanese cases who had contact with tourists from Wuhan. In Germany, a case was described that was part of the cluster in Bavaria. And in Thailand, a taxi driver was confirmed as infected who had no travel history to China. In addition, in France a healthcare worker was diagnosed with SARS-CoV-2 acute respiratory disease who treated two patients later identified as probable cases [3]. It is therefore of utmost importance to prevent any further spread in the public and healthcare settings.

Persistence of coronaviruses on inanimate surfaces

It has been postulated that coronaviruses can be transmitted from contaminated dry surfaces including self-inoculation of mucous membranes of the nose, eyes or mouth [4,5]. One ml of sputum has been described to contain approximately 10^8 viral copies [6]. In a recent review all

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available data on the persistence of coronaviruses on inanimate surfaces were summarized [7]. Most data were described with the endemic human coronavirus (HCoV) strain 229E which can remain infectious for 2 h - 9 d on different types of materials. A higher temperature such as 30°C or 40°C is associated with a shorter persistence of highly pathogenic Middle East Respiratory Syndrome (MERS) coronavirus. Few comparative data obtained with SARS-CoV indicate that persistence was longer with higher inocula. In addition it was shown at room temperature that HCoV-229E persists better at 50% relative humidity compared to 30% [8].

Inactivation of coronaviruses by disinfectant agents in suspension tests

Ethanol (78%—95%), iso-propanol (70%—100%), the combination of 45% iso-propanol with 30% n-propanol, glutardialdehyde (0.5—2.5%), formaldehyde (0.7%—1%) and povidone iodine (0.23%—7.5%) readily inactivated coronavirus infectivity by approximately 4 $\log_{10}$ or more. Sodium hypochlorite required a concentration of at least 0.21% to be effective. Hydrogen peroxide was effective with a concentration of 0.5% and an exposure time of 1 min. Data obtained with benzalkonium chloride at reasonable contact times were conflicting. Within 10 min a concentration of 0.2% revealed no efficacy against coronavirus whereas a concentration of 0.05% was more effective. In contrast, 0.02% chlorhexidine digluconate was basically ineffective [7].

Inactivation of coronaviruses by biocidal agents in carrier tests

62%—71% ethanol reduced coronavirus infectivity within 1 min exposure time by 2.0—4.0 $\log_{10}$.0.1%—0.5% sodium hypochlorite and 2% glutardialdehyde were also quite effective with a reduction of viral infectivity $>$ 3.0 $\log_{10}$ in 1 min. 0.04% benzalkonium chloride, 0.06% sodium hypochlorite and 0.55% ortho-phthalaldehyde, however, were less effective [7].

Discussion

Contamination of frequent touch surfaces in healthcare settings are a potential source of viral transmission. Data on the transmissibility of coronaviruses from contaminated surfaces to hands were not found. However, it could be shown with influenza A virus that a 5 s contact is sufficient to transfer 31.6% of the viral load to the hands [9]. The transfer efficiency was lower with parainfluenza-virus 3 (1.5%) [10]. Although the viral load of coronaviruses on inanimate surfaces is not known during an outbreak situation it seems plausible to reduce the viral load on surfaces by disinfection, especially on frequent touch surfaces in the immediate patient surrounding where the highest viral load can be expected.

The WHO recommends "to ensure that environmental cleaning and disinfection procedures are followed consistently and correctly. Thoroughly cleaning environmental surfaces with water and detergent and applying commonly used hospital-level disinfectants (such as sodium hypochlorite) are effective and sufficient procedures." [11] The typical use of bleach is at a dilution of 1:100 of 5% sodium hypochlorite resulting in a final concentration of 0.05% [12]. The recently published data with coronaviruses suggest that a concentration of 0.1% is effective in 1 min [7]. That is why it seems appropriate to recommend a dilution 1:50 of standard bleach in the coronavirus setting. For the disinfection of small surfaces ethanol (62%—71%; carrier tests) revealed a similar efficacy against coronavirus [7]. Ethanol at 70% ethanol is also recommended by the WHO for disinfecting small surfaces [12].

Conclusions

On inanimate surface human coronaviruses can remain infectious for up to 9 d. A surface disinfection with 0.1% sodium hypochlorite, 0.5% hydrogen peroxide or 62%—71% ethanol can be regarded as effective against coronaviruses within 1 min. A similar effect can be expected against the SARS-CoV-2.

Conflicts of interest

None.

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