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Addressing the risk of monkeypox exposure during gastrointestinal endoscopy

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Abstract

The current monkeypox virus (MPV) outbreak is now a global health concern. MPV, a zoonotic double-stranded DNA virus, may be transmitted from human to human or by contaminated surfaces. Understanding the clinical characteristics and risks of MPV transmission are important, especially for health care workers, who may unknowingly encounter the virus while fulfilling their clinical responsibilities. The World Health Organization has recognized this orthopoxvirus outbreak as a public health emergency and the knowledge gaps regarding MPV's transmission are likely to have contributed to its spread. Instituting proper infection controls in all settings, including the endoscopy suite, is critical to stemming this developing epidemic. Direct contact with skin lesions is the primary mode of transmission, and anorectal lesions are the most common skin manifestation. Hence, gastroenterologists and endoscopists are very likely to see patients with MPV infection. In this context, patients may present with symptoms of proctitis, or lesions may be encountered unexpectedly during anoscopy, sigmoidoscopy, or colonoscopy. In consequence, preprocedural exams and endoscopic procedures may increase exposure risk, especially if characteristic lesions go unrecognized. In this review, we provide background epidemiological and virological information, but focus on the potential risk of MPV exposure during gastrointestinal endoscopy and evaluate current practices regarding personal protective equipment and post-procedure instrument and endoscopy suite decontamination.

Keywords Monkeypox virus, infection prevention, endoscopy, contamination, personal protective equipment

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Introduction

The current outbreak of monkeypox virus (MPV; mpox) infection has raised substantial concerns at the World Health Organization (WHO) and the United States (US) Centers for Disease Control and Prevention (CDC); as of October 13, 2022, 72,874 cases across 109 countries have been reported [1]. As this outbreak progresses, it is important to understand the risks posed to both healthcare workers (HCWs) and the persons they treat. Here, we focus specifically on the potential risks of MPV transmission associated with gastrointestinal endoscopic procedures.

The prolonged incubation period, lack of adequate stores of vaccine, and knowledge gaps regarding MPV infection have all contributed to its spread. Instituting proper infection controls in all settings is key to stemming this developing epidemic. Endoscopy suites are no exception, especially as the close contact with patients during endoscopy may pose particular exposure risks. Although, to date, no cases of endoscopic transmission of MPV have been reported, our concerns in this regard were heightened when a member of our endoscopy staff was recently quarantined because of acute MPV infection; persons who underwent endoscopy in that suite within 10 days of this diagnosis were notified of potential exposure, although no specific recommendations were made.

Previous and more recent experiences dealing with other viral epidemics, specifically those due to acquired immunodeficiency syndrome (AIDS), caused by infection

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with the human immunodeficiency virus (HIV), and COVID-19, caused by SARS-CoV-2, have now persuaded the gastroenterology community to apply standard preventative measures, including the wearing of personal protective equipment (PPE), to reduce the potential for MPV transmission. Nonetheless, we must address the observation that MPV infection poses unique challenges that may require more specific measures. In this context, to understand what these unique challenges might entail, it is important to compare the virological, epidemiological, and clinical features of these 3 viral diseases.

Virological and epidemiological characteristics of MPV

Whereas HIV lentivirus and SARS-CoV-2 comprise single-stranded RNA virions, MPV, first identified in 1970 in people residing in the Democratic Republic of the Congo, is a zoonotic double-stranded DNA virus belonging to the *Orthopoxvirus* genus in the *Poxviridae* family (Fig. 1, Table 1) [2]. MPV is endemic in western and central Africa and, following the eradication of smallpox, emerged as the foremost orthopoxvirus infecting humans [3]. MPV is highly pathogenic,

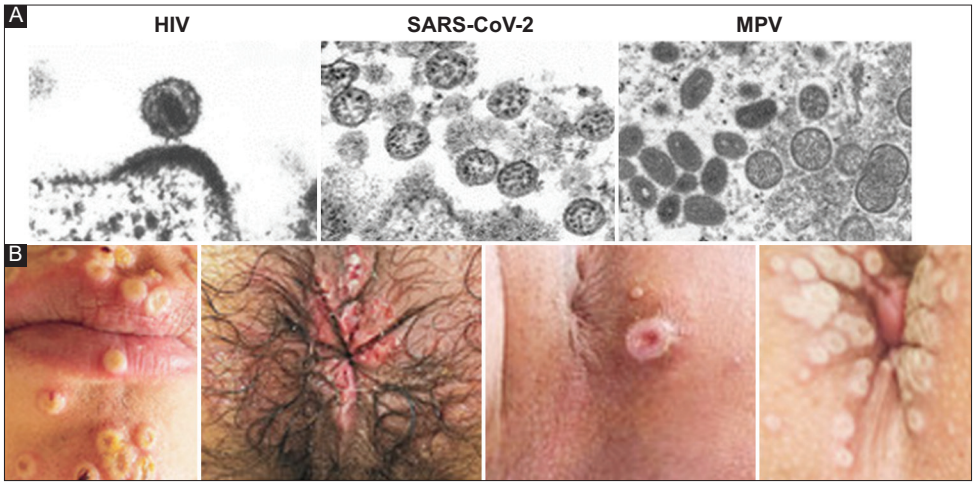

Figure 1 Appearance of monkeypox virus (MPV) viral particles and cutaneous lesions. (A) Electron micrographs of human immunodeficiency virus (HIV), SARS-CoV-2, and MPV viral particles (images obtained from the US Centers for Disease Control and Prevention and National Institute of Allergy and Infectious Diseases). (B) Examples of peri-oral (left panel) and anogenital (3 right panels) MPV lesions. Several images reveal crusting lesions that pose the risk of shedding and aerosolization (images modified from [7])

Table 1 Comparison of viral and epidemiological characteristics of HIV, SARS-CoV-2, and MPV

Characteristics	HIV	SARS-CoV-2	MPV
Virology	Single-stranded RNA lentivirus	Single-stranded RNA coronavirus	Double-stranded DNA poxvirus
Risk of exposure during endoscopy	Low	High	Unknown
Modes of peri- endoscopy transmission	Mucous membrane exposure to saliva, blood, or other fluids, contaminated or damaged endoscopes	Exposure to aerosol droplets or body fluids, less likely transmission by contaminated equipment	Direct contact with lesions, aerosol droplets, or contaminated equipment
Transmission by fomites	Unlikely	Possible but likely rare	Most likely
Durability outside body	7 days	3 hours*	Days to weeks at room temperature; months or longer at <4°C
Resistance to thermal inactivation (65°C)	-	+	+++
Methods of inactivation	Chemical disinfectants* UV radiation	Chemical disinfectants UV radiation	Chemical disinfectants UV radiation

*Chemical disinfectants include glutaraldehyde, chlorine, phenolics, alcohol, iodine, and quaternary ammonium

HIV, human immunodeficiency virus; MPV, monkeypox virus; UV, ultraviolet

with similar manifestations to smallpox; yet, degrees of disease severity are often influenced by the route of transmission, host susceptibility, and quantity of viral inoculum (Table 1) [4]. MPV isolates are categorized into distinct genetic Congo Basin and West African clades. The current MPV outbreak is due to the West African clade, associated with a lower virulence and a case fatality rate of ~1% [5]. From 1970-1999, MPV outbreaks were reported in numerous African countries, with 404 confirmed and 500 suspected cases, but accurate reports are hindered in those nations by limited surveillance programs [6].

Prior smallpox vaccination appears protective against MPV; increased susceptibility to MPV in individuals born after 1970, following the cessation of the successful smallpox eradication campaign, may have contributed to the current rise in cases globally. The first MPV cases outside Africa occurred in the US in 2003, with over 70 reported cases linked to animal contact with an infected pet prairie dog. Despite small outbreaks in other European and Asian countries, research and funding have been limited [7]. As of late July 2022, over 25,000 cases had been reported worldwide, with 10 deaths (case fatality rate: 0.04%); as of September 30, 2022, the CDC reports that 26,049 cases of MPV have been diagnosed in the US alone [1].

The natural course of untreated patients is typically mild and self-limited to prodromal symptoms followed by a rash; yet a third of patients may develop complications such as proctitis, tonsillitis, paraphimosis, or abscess [8]. Immunocompromised hosts and delays in treatment probably contribute to the risk of MPV infection and mortality [9]. Patients can be treated with antivirals or vaccinia immune globulins [10]. However, our knowledge of the outcomes of those treated with antiviral therapy is limited to a small subset of patients in current studies, with no defined change in the natural disease course [7].

Clinical characteristics of MPV infection

The classical presentation of MPV mirrors that of smallpox, characterized by a febrile prodrome associated with mucocutaneous and systematic features (i.e., fever, lethargy, lymphadenopathy, myalgia, and headache). After the prodrome, skin lesions begin in the mouth, and spread to the face, trunk, and extremities. In the current outbreak, the clinical presentation has distinctive features: in 528 MPV infections from 16 countries, the initial lesions were limited primarily to the anogenital region, with later spread to the body, limbs and face (Fig. 1). Interestingly, most persons infected with MPV had fewer than 10 skin lesions, which can delay diagnosis [7]. Anorectal lesions can be associated with rectal pain, proctitis, tenesmus, and diarrhea [7,11]. Notably, in the current outbreak, systemic prodromal symptoms may occur only after anogenital or mucosal lesions develop. Thus, gastroenterology consultation may be sought before MPV is diagnosed, an important consideration for those referred for upper or lower endoscopy.

The median duration from exposure to symptoms is 7 days, and PCR data suggest mucocutaneous lesions may contain viable MPV particles for up to 21 days after symptom onset [7,12]. Over 14-21 days after their initial appearance, skin lesions that began as macules progress to papular, vesicular, and pustular lesions before crusting scabs are shed (Fig. 1) [13].

Route of MPV transmission

MPV, a durable DNA virus, can be transmitted via human-to-human or animal-to-human contact, contact with infected body fluids and skin lesions, as well as contact with virus-contaminated fomites [5]. While prior outbreaks were associated with travel to endemic areas in Africa or contact with imported animals, the current outbreak has been primarily driven by sexual transmission, largely among men who have sex with men (MSM) [7,14]. MPV has been detected in seminal fluid and prolonged shedding was demonstrated in an individual co-infected with HIV [15]. In the previously described cohort from 16 countries, 98% of persons with MPV infection were MSM, of whom 41% were coinfected with HIV [7]. Similar epidemiology was noted in a UK cohort [11]. Sexual transmission may explain why the clinical presentation and symptoms in the current outbreak are distinct from previous descriptions of MPV disease.

As with the HIV epidemic, it is likely that MPV infection will spread progressively beyond the MSM population to infect others who come in contact with lesions or contaminated surfaces. In this respect, reports of nosocomial and household contact-associated infections highlight the need for caution among HCWs [16-18]. A German hospital study identified substantial contamination of surfaces and fabrics in 2 MPV patient rooms [19]. The virus's ability to survive for prolonged periods on surfaces outside the body is concerning, as objects in the endoscopy unit, such as bed sheets, computers, endoscopes and accessories, can serve as potential modes of transmission. An exposed HCW not wearing PPE developed MPV symptoms 18 days after exposure [20]. Given the aerosolization of respiratory secretions during upper endoscopy, MPV transmission via respiratory droplets is an important concern for gastroenterology and anesthesiology teams. Endoscopy and anesthesia personnel may be infected through viral contact with their mucous membranes, or by touching or otherwise contacting MPV disseminated on surfaces within the endoscopy suite.

Prevention, procedural modifications, and post-exposure mitigation of MPV infection

Understanding the clinical presentation and modes of transmission highlights the importance of implementing effective strategies to prevent MPV spread to HCWs and patients. While ongoing clinical trials investigate novel treatments and vaccines, it is critical to develop protective strategies for staff and patients in endoscopy settings. Rapid detection, isolation, contact tracing, and vaccination of close contacts, all decrease the risk of MPV transmission [21,22].

Since MPV lesions commonly manifest in the anorectal area prior to the onset of systemic symptoms, gastroenterologists may unknowingly come into direct contact with MPV during rectal exams and colonoscopy. The potential for contamination in the endoscopy room represents a considerable concern. As MPV can also be transmitted by contact with fomites or contaminated objects and poxviruses can remain viable and infectious in the environment for days to weeks, there are concerns regarding the cleaning and handling of linens, counter tops, computer keyboards and screens, endoscopes and accessories. Our experience with acute MPV infection in an HCW is a case in point. Despite the low-risk exposure, since the individual infected with MPV was wearing PPE, all patients and staff were informed of possible MPV exposure. Following active surveillance and contact tracing, to our knowledge, there was no secondary transmission of MPV.

Nosocomial infections of HCWs not wearing or despite wearing PPE can be reduced through postexposure vaccination and active surveillance [23]. To prevent disease, if available, the JYNNEOS vaccine should be administered within 4 days of exposure. If given after this period, vaccination may lessen disease severity, but not prevent disease. Tecovirimat, an inhibitor of the orthopoxvirus VP37 envelope wrapping protein, FDA-approved to treat smallpox, is anticipated to be effective against monkeypox and can be used under the expanded access investigational new drug protocol. However, access to antivirals and vaccines may be limited, so recognizing populations at risk is important to prevent or limit transmission.

The COVID pandemic resulted in universal use of PPE, including N95 respirators, by personnel in endoscopy suites, likely to reduce the risk of nosocomial MPV transmission, especially following unrecognized exposures. Unlike HIV and SARS-CoV-2, MPV can be transmitted efficiently via contact with contaminated surfaces. Consequently, to avoid MPV infection, it may be prudent to double-glove and employ extra care when doffing PPE after leaving the procedure room. Post-procedure, the CDC recommends wet cleaning methods and advises against sweeping, vacuuming or dry dusting rooms, which can resuspend and aerosolize dried crusts from MPV skin lesions [24]. Furthermore, esophageal intubation or other procedures that expose oral secretions should be conducted using airborne pathogen precautions [24]. For waste management, the CDC advises that potentially MPV-contaminated materials can be handled as regular medical waste, similarly to soiled dressings or sharps.

There appears to be a lack of standardized methods for handling procedure-related equipment in centers where many HCWs and patients interact daily in a close setting. Reprocessing endoscopes is inherently a highly aerosolizing process through the flushing and brushing of channels [25]. Steam sterilization is not used, since the endoscopes are heat sensitive; instead, guidelines recommend the use of high-level disinfectants via mechanical and detergent cleaning, followed by rinsing and drying [25,26]. While there is no direct evidence regarding the effectiveness of disinfectants against MPV, there are abundant data on the effectiveness of common disinfectants, e.g., ethanol, hydrogen peroxide, glutaraldehyde and acetic acid, against the vaccinia virus which causes smallpox. Soaking for 10 min in 0.02% glutaraldehyde, a disinfectant commonly used to process endoscopes, successfully produced a 4-log reduction in viable vaccinia virus [27]. While these data are probably applicable to MPV, direct evidence is lacking. Experiences with SARS-CoV-2 suggest that immediate bedside preprocessing of endoscopes may reduce or prevent cross contamination. To prevent aerosolization of viral particles, laundry suspected of MPV contamination should be handled in separate laundry bags and not shaken before washing at high heat or discarding [24]. The CDC provides guidance for MPV in the healthcare setting, with recommendations including proper use of PPE (including wearing gowns, gloves, eye protection, and surgical masks or N95 respirators) and single room standard precautions [24].

Fortunately, implementation of the more stringent changes in PPE associated with COVID-19 should provide adequate protection for endoscopy staff and patients. To our knowledge, no regulatory bodies are recommending additional changes to PPE based on the monkeypox epidemic. Moreover, as with COVID-19 policies, we mandated isolation of the infected staff member with active surveillance of those in close contact. In addition, given the lack of new monkeypox-related guidelines, we have not changed our routine policies regarding postprocedural room or instrument decontamination. Hence, unless we perform a procedure on a known case of monkeypox, we have not altered postprocedural endoscope processing or room decontamination. Of course, these policies may change as new information becomes available.

Concluding remarks

Within the past 40 years, after the HIV and SARS-CoV-2 pandemics, MPV represents the third major viral outbreak that the gastroenterology community must address. In response to the first 2 pandemics, endoscopic practices were modified by enforcing progressively more stringent use of PPE to reduce exposure risk to both healthcare personnel and patients. The potential risk of MPV exposure during gastrointestinal endoscopy is likely to escalate as the numbers of cases increase. We learned that a rapid response to possible MPV exposure, open communication with staff and patients, and post-exposure surveillance are likely to alleviate anxiety and reduce the risk of viral transmission. It is also critical to avoid stigmatizing MSM as we design infection control protocols. We anticipate that formalized guidelines from relevant gastroenterology and endoscopy societies will be forthcoming as the MPV epidemic progresses.

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