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SARS-CoV-2: the key issues

SARS-CoV-2: kluczowe informacje

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Keywords

Covid-19 epidemic, pediatric ENT, Sars-Cov-2, 2020 epidemic

Summary

At the end of 2019, in the industrial city of Wuhan, which is the capital of the Chinese province of Hubei, a new coronavirus disease (nCoV-19) began to erupt. At the beginning, the scale of the threat posed by the virus was underestimated, and the information coming from China was residual and does not provide a complete picture of the situation. Since then, nCoV-19 has spread to 183 different countries around the world, causing many cases and thousands of deaths. On March 11, World Health Organization (WHO) Director-General Tedros Adhanom Ghebreyesus officially declared the COVID-19 outbreak a pandemic. This review work aims to provide some basic information about the virus (SARS-CoV-2) and the disease it causes (COVID-19). In addition, it covers diagnostic methods, recommended management and methods to reduce the extent of infection. This is a kind of summary of the state of knowledge at the end of April 2020.
To summarize main observations based on the review of world literature on the subject is driving us into conclusion that the transmission mechanisms of SARS-CoV-2 are not fully recognized. The spread of the virus from human to human occurs mainly through respiratory drops; symptomatic infections spectrum ranges from mild to critical, with a significant prevalence of mild/asymptomatic cases. Molecular test for the SARS-CoV-2 virus RNA is currently recommend. Other test include rapid direct SARS-CoV-2 antigen or indirect antibody detection, lung CT and LUS. Recommendation for ENT surgical procedures are collected in The International Paediatric Otolaryngology Group (IPOG) statement published on the 14th of April 2020.Personnel involved in aerosol generating procedures should be fitted with PPE.

Słowa kluczowe

epidemia Covid-19, laryngologia dziecięca, Sars-Cov-2, epidemia 2020

Streszczenie

Pod koniec 2019 roku w przemysłowym mieście Wuhan, będącym stolicą chińskiej prowincji Hubei, rozpoczęła się epidemia nowej choroby wirusowej (nCoV-19). Skala zagrożenia wywołana przez koronawirusa była początkowo bagatelizowana ze względu na szczątkowe i wybiórcze informacje przekazywane z Chin. Od tego czasu nCoV-19 rozprzestrzenił się w 183 krajach na całym świecie, wywołując objawy infekcji i zgony w nieporównywalnej do tej pory skali. 11 marca dyrektor generalny Światowej Organizacji Zdrowia (WHO) Tedros Adhanom Ghebreyesus oficjalnie ogłosił wybuch pandemii COVID-19. Artykuł przedstawia podstawowe informacje dotyczące wirusa SARS-CoV-2 i choroby, którą powoduje: COVID-19. Podsumowuje metody diagnostyczne, zalecane postępowanie czy sposoby ograniczania zasięgu epidemii. Zawarte w pracy dane prezentują stan wiedzy z końca kwietnia 2020 roku.

Przegląd dostępnej literatury światowej skłania do wniosku, że mechanizmy przenoszenia SARS-CoV-2 nie zostały w pełni poznane, a rozprzestrzenianie się wirusa pomiędzy ludźmi odbywa się głównie drogą kropelkową. Spektrum objawów zakażeń waha się od łagodnych do krytycznych, ze znaczną przewagą występowania przypadków łagodnych/bezobjawowych. Obecnie rekomendowaną metodą diagnostyczną jest molekularny test wykrywający obecność RNA wirusa SARS-CoV-2. Inne, dostępne testy (tzw. szybkie) obejmują metody bezpośrednie – wykrycie antygenu SARS-CoV-2, lub pośrednie – wykrycie swoistych przeciwciał. Oddziały SOR mogą przybliżyć rozpoznanie za pomocą TK płuc lub LUS. Wykazano, że personel obecny przy zabiegach o podwyższonym ryzyku emisji aerozoli powinien być bezwzględnie wyposażony w profesjonalne środki ochrony indywidualnej (ŚOI). Zalecenia dotyczące procedur chirurgicznych laryngologii dziecięcej zawarte zostały w opracowaniu Międzynarodowej Grupy Otolaryngologii Pediatrycznej (IPOG) opublikowanym 14 kwietnia 2020 roku.

Introduction

An outbreak of a novel coronavirus disease-19 (nCoV-19) infection began at the end of 2019 in Wuhan, a city in the Hubei Province of China (1). Since then, nCoV-19 spread in 183 different countries in the world, causing 2'899'833 cases and confirmed 203'055 deaths (as of April 25th, 2020 https://gisanddata.maps.arcgis.com/apps/opsdashboard/index.html#/bda7594740fd40299423467b48e9ecf6). The virus is now known as the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) previously, it was referred to as 2019-nCoV. The disease it causes is called coronavirus disease 2019 (COVID-19).

On March 11, World Health Organization (WHO) Director-General Tedros Adhanom Ghebreyesus officially declared the COVID-19 outbreak a pandemic (2). Worldwide public health groups have issued recommendations for preventing, diagnosing and treating the illness. This article will discuss the epidemiology, clinical features, diagnosis, management, and prevention of COVID-19.

Discussion

Epidemiology

Because information on the transmissibility of COVID-19 is not fully documented and confirmed, understanding of the transmission risk is incomplete. It is known that nowadays person-to-person spread of SARS-CoV-2 is thought to occur mainly via respiratory droplets, resembling the spread of influenza. Virus can infect another person when infected human coughs, sneezes, or talks via droplets having direct contact with the mucous membranes. Another fact is that human coronaviruses can remain infectious on surfaces for a number of days (3). In advance, transmission of COVID-19 from aerosol and other surfaces is possible (3, 4). It is also known that one key mechanism of transmission can be through self-inoculation from contaminated surfaces (e.g., through failure to observe proper hand hygiene and frequent face touching that is an unconscious common behavior). The confirmation that hands are the reason of auto-contamination may be found inter alia at the Yen Lee Angele Kwok's work. Together with colleagues looked at behavioral characteristics involving medical students at the University of New South Wales in a longitudinal observational study, which was published in the February 1, 2015 issue of the American Journal of Infection Control (5). Researchers assessed face-touching behavior as a potential for virus transmission and self-inoculation. The study showed that, on average, of 26 students, each touched their face 23×/h. Of all face touches, 44% (1024/2346) involved contact with a mucous membrane whereas 56% (1322/2346) of contacts involved nonmucosal areas. Of mucous membrane touches observed, 36% (372/1024) involved the mouth, 31% (318/1024) involved the nose, 27% (273/1024) involved the eyes, and 6% (61/1024) were a combination of these regions.

Taking under consideration presence of SARS-CoV-2 in specimens obtained from sites other than the nasopharyngeal swab (which is the routine method used to confirm clinical diagnosis of COVID-19) the conclusion is that 93% positive samples for live virus were at bronchoalveolar lavage fluid, 72% in sputum, 63% in nasal swabs, 46% in fibrobronchoscope brush biopsy, 32% in pharyngeal swabs, 29% in feces, 1% in blood, and 0 in urine. These results suggest that SARS-CoV-2 may be transmitted via the fecal route. Data were obtained from January 1 through February 17, 2020 at 3 hospitals in the Hubei and Shandong provinces and Beijing, China, with 1070 specimens collected from 205 infected patients (6).

Taking those data together, Kampf et al. concluded that studies looking at decontamination are the key one. They reviewed 22 studies examining the use of biocidal agents as chemical disinfection to inactivate the virus. Again, the researchers confirmed that both SARS and MERS can remain on metal, glass, and plastic for up to 9 days and showed that surface disinfection with solutions such as 62 to 71% ethanol, 0.5% hydrogen peroxide, or 0.1% sodium hypochlorite within one minute can eradicate the presence of the virus. Other biocidal agents such as 0.05 to 0.2% benzalkonium chloride or 0.02% chlorhexidine digluconate were shown to be less effective (7).

Clinical features

The incubation period of COVID-19 infection continues approximately 5.2 days (8). The period from the onset of COVID-19 symptoms to death is dependent on the age of the patient and status of the patient's immune system and ranged from 6 to 41 days with a median of 14 days (9). It is statistically shorter among patients > 70-years old compared with those under the age of 70 (9). Major initial symptoms of COVID-19 include fever, cough, anosmia/hyposmia, muscular soreness and dyspnea. Some patients showed atypical symptoms, such as diarrhea, vomiting, sputum production, headache, haemoptysis, diarrhoea, and lymphopenia (10-12). However, the clinical phenotype is confounded by the fact that 25.2% patients had at least one other underlying medical condition (13-16).

Data collected in China revealed that during the first and second phase of the epidemic patients were older, more likely to be male, and likely to have exposure to the seafood market. Clinically, they had more bilateral patchy shadows, or ground glass opacity in the lungs (11, 13, 14). Nowadays it is obvious that virus infection is not selective in age. It was reported even in a 1-month-old infant (17-19). The current statistical summaries show that out of 44 672 confirmed cases, 77.8% are between 30 and 69 years old and 51.4% are male (17). The spectrum of symptomatic infection ranges from mild to critical; most infections are not severe (11, 13, 14, 16). Based on the report of the Chinese Center for Disease Control and Prevention that included over 44,500 confirmed infections with an estimation of disease severity (20): Mild (no or mild pneumonia) was reported in 81%; Severe disease (e.g., with dyspnea, hypoxia, or > 50% lung involvement on imaging within 24 to 48 hours) was reported in 14%; Critical disease (e.g., with respiratory failure, shock, or multiorgan dysfunction) was reported in 5%. Disclosed overall case fatality rate was 2.3%; no deaths were reported among noncritical cases.

For the time being, there is no evidence for intrauterine infection by vertical transmission in women who developed COVID-19 during late pregnancy and no evidence that pregnant women are more susceptible compared with other adult patients (21).

Although currently the number of new infections is decreasing, the COVID-19 epidemic is still ongoing. Knowledge of SARS-CoV-2 is systematically improved.

Diagnosis

As reflected in the EU recommendations (22), accurate and timely COVID-19 laboratory testing is the key issue of the management of COVID-19 for supporting decisions on infection control strategies, slowing down the pandemic and detecting asymptomatic cases that could spread the virus further if not isolated. Global testing is essential for COVID-19 control. Molecular tests which detect the SARS-CoV-2 virus RNA are currently recommend (22). The specimens should be collected from both the upper respiratory tract (naso- and oropharyngeal samples) and lower respiratory tract such as bronchoalveolar lavage (firstly), endotracheal aspirate, or expectorated sputum. The BAL samples should only be possessed from mechanically ventilated patients (22, 23). Those samples require storage at 4°C. Amplification of the genetic material is through a reverse polymerase chain reaction (RT-PCR). Test should be repeated for verification if it was positive and further due to evaluate for viral clearance prior to patient being released from observation (23). However, these tests require multiple reagents, well-equipped laboratory facilities and highly skilled technologists. Currently, supply shortages and infrastructure restrictions are limiting testing capacity. Therefore, rapid antigen tests for COVID-19 are thought to be solution for decrease the pressure on laboratories and expand testing capacity to meet the most urgent medical and public health needs. Rapid tests are qualitative or semi-quantitative in vitro diagnostics (IVDs) which involve non-automated procedures (24). These tests take around 10-30 minutes in order to get a result (compared with 4 hours to 3 days for molecular tests, especially if samples must be transported to a distant testing laboratory). Additionally, rapid tests are relatively simple to perform and interpret. There are two types of COVID-19 rapid tests currently in use: direct SARS-CoV-2 antigen detection and indirect antibody detection tests (25). Unfortunately, even these tools are insufficient for medical needs. Therefore, radiologist came with help determining COVID-19 possible CT patterns. According to Yan and Liming (26), CT has a low rate of missed diagnosis of COVID-19 (3.9%, 2/51) and thus may be useful as a standard method for the diagnosis of COVID-19. Ai et al. concluded that chest CT may be used as a primary tool for detecting COVID-19 in epidemic areas (27) and Fang et al. reported CT findings of pneumonia in 50 of 51 patients with RT-PCR–proven COVID-19 (28). These publications present sensitivity for the diagnosis of COVID-19 reported as 98 and 97%, respectively (26-28). The authors underlined the fact that CT findings were positive for viral infection before laboratory results in 37 of 53 (69.8%) patients (26). Ground-glass opacity (GGO) and consolidation are two main signs of COVID-19 lesions on CT images (26-28). Together, researchers of these publications, promoted the conclusion that the above observations in the CT imagining should induce radiologists to suggest COVID-19 as a possible diagnosis (26-29). On the other hand, all the CT features seen on the initial chest CT examinations of patients with COVID-19 such as GGO, consolidation, interlobular septal thickening, vascular enlargement, air bronchogram sign, and air trapping – are similar to the CT features of SARS and MERS and viruses from a different family, such as adenovirus (26). Consequently, positive CT results are only believable if the pretest probability of COVID-19 is high. But every time CT imaging suggests a viral infection, patients with suspected disease can be isolated and treated in time so that the management of patients will be optimized (26, 30).

Currently, the main focus is on the search for a fast, sensitive and safe COVID-19 diagnostic method. So far, the standard method involves doing an objective examination and carrying out radiological tests, such as chest radiography or chest CT. This means that the possibility of contamination of the medical devices and nosocomial spreading of the virus is undisputed. There is a huge risk of spreading COVID-19 over healthcare workers (among doctor, nurses, radiology technicians, cleaning stuff, etc.) and already hospitalized patients who have a higher risk of developing severe ARDS. Lung Ultrasound (LUS) can identify changes in the physical state of superficial lung tissue that correlates histopathologic findings and can be identified on CT but remain hidden in a large percentage of chest radiographs (31, 32). Since CT scanning is often not available in emergency departments, the use of ultrasound is now essential in the safe management of the COVID-19 outbreaks. Examination with LUS at Emergency Department can be executed by doctor with only one companion thereby reducing the number of people potentially infected (34). It should also not be underestimated that, in experimental models of ARDS, LUS has proved capable of detecting lung lesions before the development of hypoxemia (32).

Poggiali independently of Soldati et al. (32, 33) strongly suggest diagnostic accuracy of LUS and recommend it in the following situations:

- triage (pneumonia/non-pneumonia) of symptomatic patients at home as well as in the prehospital phase,
- diagnostic suspicion and awareness in the emergency department setting,
- prognostic stratification and monitoring of patients with pneumonia on the basis of the extension of specific patterns and their evolution toward the consolidation phase in the emergency department setting,
- treatment of intensive care unit patients with regard to ventilation and weaning,
- monitoring the effect of therapeutic measures (antiviral or others),
- reducing the number of health care professionals exposed during patient stratification (a single clinician would be necessary to perform an objective medical examination and imaging investigation directly at the patient's bed) (32).

Management

Some patients with suspected or confirmed and documented COVID-19 suffer or may suffer (due belonging of a high-risk group) a more serious illness and require hospital care. The treatment of such patients is to ensure adequate infection control with professional treatment of the underlying disease. Therefore international groups of pediatric ENT surgeons have developed guidelines to organize and bring together all necessary procedures in one document. The International Paediatric Otolaryngology Group (IPOG) in a document of 14th of April 2020 presented number of recommendations from various academic centers from different countries (35-45). The closest to Polish reality seem to be the indications of British Association for Pediatric Otolaryngology (BAPO). According to it, most paediatric laryngological diseases do not pose a serious threat to life and health if their treatment is postponed by 3 months, therefore operating clinics and outpatient clinics should postpone the planned treatment in those situations. Diseases that do not meet this condition, including rapidly enlarging neck masses, must be recognized and treated immediately.

The management of obstructive sleep apnea associated with adenotonsillary hypertrophy is most controversial. It was found that as a general rule, adenotonsillectomy should be delayed. The only exception is when postponed surgery may result in irreversible cardiopulmonary complications or require intubation. Full AGP-PPE precautions should be taken during surgery.

Given the above observations and the fact that the hospital's performance is approaching its limits before the collapse, crisis management should aim to minimize patient admission and risk of harm at the same time. In the IPOG guidelines for individual surgical procedures we find.

Foreign bodies

The presence of button batteries remains absolutely critical and requires surgical intervention. Just like ingested foreign bodies causing dysphagia. In other cases, foreign bodies in the ear, nose and throat should be treated conservatively. If there is a risk of a significant airway obstruction or if postponement of the intervention can cause long-term consequences (e.g. for acute objects), urgent surgery is recommended. In children with positive anamnesis for foreign body aspiration to the airway, in the absence of stridor, dyspnea or radiological markers, wait and watch strategy with CXR repetition is recommended.

Periorbital abscess

An external approach is recommended where vision is at risk and where the conservative measures have failed.

Fractured nose

If there is no hematoma of the nasal septum, it is recommended not to proceed reposition of the nasal bone.

Acute mastoiditis

Acute mastoiditis should be treated conservatively. If necessary, needle aspiration of the subperiosteal abscess should be taken under consideration. Diagnostic CT scans should be performed only when the symptoms progress despite conservative management. Intracranial complications should not be treated with a ventilation tube. If the

operation is necessary due to life-threatening complications, the use of the drill should be abandoned and the patient should be absolutely verified for COVID-19.

Neck abscess

Infective cervical masses should be managed as outpatient as possible. Progressively augmentation of the cervical or retropharyngeal collections may require surgical treatment with full personal protective equipment (PPE).

Airway compromise

Inevitably, a small number of children will require urgent endoscopic airway assessment. In case of infectious diseases, conservative management and therapies based on anti-reflux drugs and oral steroids are recommended.

Tracheostomy

Nowadays, a planned tracheostomy should be avoided. Inevitably, tracheostomy should be performed with full personal protective equipment, using an unfenestrated, cuffed tracheostomy tube.

Tracheostomy tube changes should be minimized. There is an urgent need to train the parents of children who underwent tracheostomy before the COVID-19 pandemic in order to be discharged from hospital as soon as possible.

Prevention

Measures to reduce the spread of COVID-19 are focused on control of the sources of infection (e.g. amount reduction of respiratory secretion by covering the nose and mouth), the use of appropriate personal protective equipment (PPE) when caring for COVID-19 patients, early identification and isolation of suspected patients or environmental disinfection. The next step is to reduce the spread of infection among hospitalized patients with suspected or documented COVID-19 by using appropriate personal protective equipment (PPE). Literature reports from the early period of the epidemic in China show that as many as 43% of 138 patients acquired the infection due to hospitalization (13).

Therefore, it is now recommended to examine patients for clinical symptoms of COVID-19 (e.g. fever, cough, dyspnea, anosmia/hyposmia) before admission to the health care facility. It is optimal to perform a triage over the phone before the patient actually arrives at the facility. It should be stressed that most patients with COVID-19 symptoms can be treated at home with telemedicine (11, 13, 14, 16). Patients requiring additional assessment should be referred to a dedicated clinic. In specially designated health care units, it is advisable to retest for symptoms of airway infections. Separate waiting rooms should be designated for patients at higher risk of COVID-19 infection, where the seats should be at least two meters apart.

The COVID-19 pandemic requires strict restrictions on visits to hospital facilities. Visitors exempt from this obligation should also be examined for exposure and symptoms of COVID-19. Individuals who have been confirmed or shown to be exposed to the infection within the last fourteen days should not be admitted to a healthcare facility.

Healthcare workers should self-monitor themselves for fever and other symptoms of COVID-19 and absolutely stay home in case of illness. There is a negative example based on a report from a hospital in King County, Washington, D.C., where among 48 health care workers (who subsequently confirmed the COVID-19 infection), 65% reported to work for an average of two days despite the occurrence of COVID-19 symptoms (45).

All patients and visitors should be equipped with a face shield at the entrance to the health care facility (respirators or other type of face masks) to control the source of infection (46). Masks should be worn at all time during hospital stay. The above recommendation also applies to health care workers. The surgical or medical mask should be used while performing professional duties related to patient care. Only when faced with a limited number of supplies, facial clothing can be rationed to employees and service providers, who are not directly involved in the patient's care (46).

The optimal hand hygiene includes a wash immediately before and after each contact with the face garment. Canvas masks should be changed in case of dirt, moisture or breathing difficulties. They should be washed regularly (e.g. daily and after soiling).

The idea of common use of masks comes down to limiting the transmission of SARS-CoV-2 from asymptomatic carriers of viruses (47, 48). Although there are no clinical data confirming this approach, cases of COVID-19 transmission from healthcare professionals have been reported (49). In areas with high population density, screening for symptoms of infection seems insufficient in the face of pre-symptomatic or asymptomatic transmission (50). Therefore, all health care workers should use standard and specialized personal protective equipment (i.e. gown, gloves and face mask – FFP2 type preferred with additional eye or face protection) when assessing each patient with undiagnosed respiratory infection, even with a negative history of COVID-19.

In case of admission patients with suspected or confirmed COVID-19, each patient should be placed in a single room with closed doors and a dedicated bathroom. If the facility conditions do not allow it, patients with confirmed COVID-19 can be grouped within one room (46).

Patients undergoing aerosol-generating procedures should be placed in a single room with negative pressure.

In times of the COVID-19 pandemic, the organisation of work in the operating theatre goes far beyond listed above scope and the readers are referred to the recommendations prepared by leading Polish surgeons – Prof. UJ, Michał Pędziwiatr and Michał Nowakowski under the guidance of the National Consultant in General Surgery Prof. Grzegorz Wallner (51).

Conclusions

1. The transmission mechanisms of SARS-CoV-2 are not explicitly and precisely tested. The spread of the virus from human to human occurs mainly through respiratory drops resembling the spread of influenza.
2. For symptomatic infections, their spectrum ranges from mild to critical, with the indication that most infections are not of a severe type. The number of cases of absence or mild pneumonia is about 81%.
3. Molecular tests which detect the SARS-CoV-2 virus RNA are currently recommend.
4. COVID-19 rapid direct SARS-CoV-2 antigen or indirect antibody detection tests are a necessary alternative diagnostic aid. So are lung CT and LUS.
5. Recommendation for paediatric ENT surgical procedures are collected in a large document of The International Paediatric Otolaryngology Group (IPOG) statement published on the 14th of April 2020.
6. A key element in the care of patients with suspected or documented COVID-19 is to reduce the transmission of SARS-CoV-2. This includes universal source control, early identification and isolation of suspected patients, use of appropriate personal protective equipment (PPE) and environmental disinfection.
7. Personnel involved in aerosol generating procedures should be fitted with N95 respirators. The CDC allows using surgical masks only in case of lack of professional equipment.
8. Although currently the number of new infections is decreasing in some regions, the COVID-19 epidemic is still ongoing.

Conflict of interest
Konflikt interesów

None
Brak konfliktu interesów

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