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ORIGINAL ARTICLE

Social distancing and bacteraemia in the time of COVID-19

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Key words
social distancing, bacteraemia, pneumococcal bacteraemia, COVID-19, respiratory microorganism.

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Abstract

Background: Social distancing was the predominant strategy used to mitigate the spread of Coronavirus disease 2019 (COVID-19) at the start of the COVID-19 pandemic.
Aims: To study the impact of social distancing on the incidence of bacteraemia. The number of admitted patients with positive blood cultures in April–May 2020 in one tertiary medical centre was compared with the number during the same period in the previous 3 years (April–May 2017–2019).
Methods: Retrospective review of all positive blood cultures from January to July in the years 2017–2020.
Results: There were fewer cases of Streptococcus bacteraemia as well as coagulase-negative *Staphylococcus bacteraemia* and other possible contaminated blood cultures in April–May 2020. Compared with the previous 3 years, the incidence of *Streptococcus pneumoniae* bacteraemia among all bacteraemias was lower in April–May 2020 (5%) than in 2017–2019 (12.0%; 95% confidence interval 10.3–14.1%). In general, fewer cases of bacteraemia caused by oropharynx organisms were observed in April–May 2020; only 6 cases versus 31 (95% confidence interval 10–53) during the same period in 2017–2019. Only one case of *S. pneumoniae* bacteraemia was observed in April–May 2020 and its percentage among all bacteraemias was lower in April–May 2020 (0.4%) than during the same period in 2017–2019 (3.3%).
Conclusion: The incidences of streptococcal bacteraemia and bacteraemia of organisms transmitted through respiratory secretions were lower when there were social distancing restrictions. Adopting measures of social distancing may decrease the morbidity from bacteraemia caused by oropharynx and respiratory bacteria.

Introduction

Social distancing is an umbrella term for limitations and restrictions on personal interactions and movements. It is intended to prevent the spread of infections and includes a myriad of measures, such as avoiding physical contact, school and workplace closures, limitations on mass gatherings, travel restrictions and stay-at-home orders (lockdowns). There is a considerable amount of data indicating that the spread of diseases caused by infectious agents that are transmitted through the human-to-human route could be limited by social distancing measures.[1,2] In addition, even before the COVID-19 era, data showed that wearing a surgical face mask may prevent respiratory infection[3] and contamination of blood cultures.[4] As infectious agents have various routes of transmission (i.e. oral ingestion, aerosol transmission and direct contact) and differ by transmission rate, the efficacy of social distancing changes according to the specific measure and organism. It is a common conclusion that social distancing reduces the incidence of diseases caused by organisms that are spread by close human-to-human contact.

Throughout history, measures of social distancing have been adopted by different societies in different times.[5] Studies on the 1918 and 2007 influenza pandemics have shown that social distancing can be an effective measure to mitigate the spread of infectious diseases. The public health measures that were applied during the severe acute respiratory syndrome (SARS) pandemic were found to be effective in containing the outbreak of the disease.[2,6,7]

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Table 1 Cases of bacteraemia caused by common microorganisms during April–May 2017–2019, compared with April–May 2020

Organism	2017 (*n*)	2018 (*n*)	2019 (*n*)	2017–2019, mean (95% CI)	2020 (*n*)
All Streptococci†	42	33	31	35 (21–50)	11
S. pneumoniae	13	8	8	10 (2–17)	1
Potential contaminant‡	103	95	89	96 (78–113)	60
Coagulase negative Staphylococcus§	97	94	88	93 (82–104)	60
Klebsiella pneumoniae	16	13	13	14 (10–18)	18
Pseudomonas aeruginosa	14	10	6	10 (0–20)	6
Staphylococcus aureus	30	26	15	24 (4–43)	15

†*Streptococcus*(S) *pyogenes* (GAS), *S. pneumoniae*, *S. agalactiae* (GBS), *S. dysgalactiae*, *S. gallolyticus*, *S. gorodoni*, Group G Streptococcus, *S. intermedius*, *S. parasanguinis*, *S. sanguinis*, *S. vestibularis*, *oralis*, *S. zooepidemicus* species of *S. viridans* group.
‡Potential contaminant: *Bacillius* spp., *Cornybacterium* spp., *Micrococcus* spp., *Staphylococcus coagulase* negative (most of the potential contaminants, 337 of total 347).
§Some of the coagulase-negative Staphylococcus cultures represent true infection; data to discriminate between true infection and contamination were not available. CI, confidence interval.

The Coronavirus disease 2019 (COVID-19) pandemic started in China in December 2019 and began to spread rapidly throughout the world during the first quarter of 2020. COVID-19 is caused by SARS coronavirus 2 (SARS-CoV-2), a respiratory virus that spreads by the human-to-human route through respiratory secretions in close contact.[8] Therefore, the immediate, primary and most effective strategy that has been adopted in most countries is restrictive social distancing.[9,10] In Israel, such measures were implemented in February–March 2020, with limitations on mass gatherings, and escalated in April to a full stay-at-home order. Human interactions were limited to essential activities, such as essential work, purchasing food and medications, and medical treatment. In addition, 2 m social distancing was implemented in all settings outside the home, including in work and public places, wearing a face mask became mandatory and public gatherings were prohibited. A lockdown was declared on 7 April. The restrictions were gradually lifted during May 2020.11

The objective of the present study was to examine whether social distancing reduced the incidence of bacteraemia due to pathogens and contamination of blood cultures. Our hypothesis is that the incidence of bacteraemia caused by bacteria that are transferred through the human-to-human route (i.e. droplet, direct contact and fomite transmission) would be lower during the period of social distancing, and that the restrictive hand hygiene policy that accompanied social distancing would decrease the incidence of contamination of blood cultures.

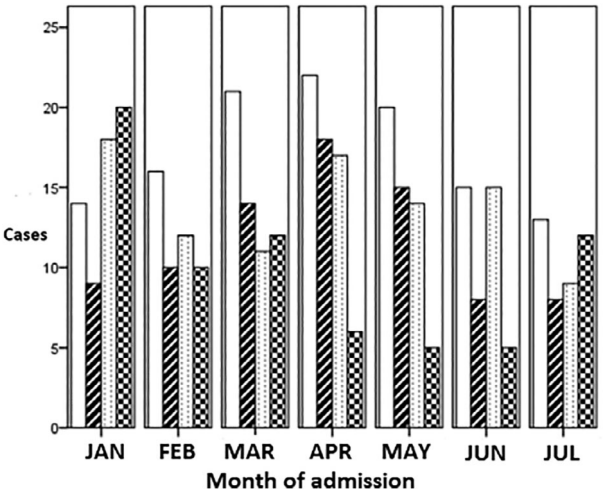

Figure 1 All cases of streptococcal bacteraemia (*n*) during January–July, 2017–2020. (□), 2017; (▨), 2018; (⬚), 2019; (▩), 2020.

Methods

The present study was conducted at the Shaare Zedek Medical Center, a 1000-bed university-affiliated tertiary care centre. It is one of the two major medical centres serving the Jerusalem area's population of 1 million people. We conducted a retrospective review of all positive blood cultures from January through July in the years 2017–2020. Blood cultures taken on admission and during hospitalisation were included. Blood cultures taken 72 h after admission were defined as hospital-acquired bacteraemia. Bacteria such as coagulase-negative *Staphylococcus, Bacillus* spp., *Corynebacterium* spp. and *Micrococcus* spp. were defined as possible contaminants. Data were retrieved from electronic medical records. In patients with multiple positive cultures of the same organism during a single period of hospitalisation, only the initial culture result was included for analysis and all subsequent cultures were excluded. We analysed the number of positive blood cultures according to groups of microorganisms and specific microorganisms in April–May of the years 2017–2019 and compared it with the number of

Table 2 Cases of bacteremia of selected organism groups during April–May, 2017–2019, compared with April–May 2020

Main characteristics of bacteremia organism	2017 (*n*)	2018 (*n*)	2019 (*n*)	2017–2019, mean (95% CI)	2020 (*n*)
Bacteria transmitted through respiratory secretions†	16	11	14	14 (7–20)	2
Microbiota of oral cavity‡	13	11	19	14 (4–25)	4
Oropharynx organisms§	39	22	33	31 (10–53)	6
Microbiota of colon¶	90	85	75	83 (64–102)	83
Enteropathogenic bacteria††	1	3	3	2 (0–5)	4
Nosocomial bacteremia‡‡	53	42	37	44 (24–64)	23

†*Streptococcus pneumoniae*, *Haemophilus influenzae*, *Neisseria meningitidis*.
‡*Streptococcus constellatus*, *S. mitis*, *S. parasanguinis*, *S. salivarius*, *S. viridans*, *S. vestibularis*, *S. gordonii*.
§Bacteria transmitted through respiratory secretions and Microbiota of oral cavity.
¶*Enterobacteriaceae* spp., *Enterococcus* spp., *Bacteroides* spp.
††*Campylobacter* spp., *Listeria monocytogenes*, Salmonella group C, Salmonella group D.
‡‡First positive blood culture taken >72 h from admission, all bacteria. CI, confidence interval.

positive cultures during the months of social distancing in April–May 2020. Percentages of groups of organisms or specific organisms associated with bacteraemia were checked against all other bacteria in April–May 2020 and compared with the same period in the previous 3 years. In addition, for every year, cases of bacteremias were compared between months of social distancing in 2020 (April–May) with the months without social distancing (January–March and June–July).

In light of our assumption that the relative reduction in admissions was not equally distributed, with less reduction in severe cases such as patients with bacteraemia, we did not compare the relative number of bacteraemia cases to admissions, but to the absolute number of cases of bacteraemia. The exception is contaminated cultures, which were measured and compared relatively with total admissions.

We calculated 95% confidence intervals (CI) for 2017–2019 in order to compare the single observation in 2020 to the average of the previous 3 years. The statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 24.0 (IBM Corp., Armonk, NY, USA).

Results

Between 1 January and 31 July in the years 2017–2020, a total of 4076 patients were found to have positive blood cultures: 2017, $n = 1048$; 2018, $n = 1043$; 2019, $n = 1077$; and 2020, $n = 908$. A total of 1104 positive blood cultures were found during the months of April–May in those 4 years: 2017, $n = 323$; 2018, $n = 287$; 2019, $n = 269$; and 2020, $n = 225$. Table 1 presents the number of cases of bacteraemia in April–May according to common microorganisms.

There were fewer cases of streptococcal bacteraemia from 1 April to 31 May 2020 compared with the same period in the previous 3 years (Table 1). The percentage of streptococcal bacteraemia among all other cases of bacteraemia was lower in 2020 in comparison with the previous 3 years (5.0 vs 12.0%; 95% CI 10.3–14.1). In contrast with the previous 3 years, streptococcal bacteraemia had a nadir in April 2020 (Fig. 1).

One case of bacteraemia caused by *Streptococcus pneumoniae* was found in April–May 2020, compared with between 8 and 13 such cases in the same period over the previous 3 years.

The percentage of *S. pneumoniae* bacteraemia among total cases of bacteraemia was lower in April–May 2020 in comparison with the previous 3 years (0.4 vs 3.3%; 95% CI 1.7–4.9).

Clustering bacterial groups revealed fewer cases of bacteraemia caused by oropharynx organisms (Table 2). In contrast, in April–May 2020, there was no decrease in the number of cases of bacteraemia caused by microbiota of the colon and enteropathogenic bacteria.

There were fewer hospital admissions in April–May 2020, during which time there were 11 271 admissions to the adult emergency department and 3079 admissions to the paediatric emergency department. During April–May of 2017–2019, the average number of admissions was 15 260 (95% CI 14 780–15 740) to the adult emergency department and 5440 (95% CI 4818–6061) to the paediatric emergency department.

There was a lower absolute number of cases of coagulase-negative *Staphylococcus bacteraemia* and of all potentially contaminated blood cultures found in April–May 2020 compared with the same period in the previous 3 years (Tables 1,2). However, this difference was no longer observed when the ratio of contaminated blood cultures to total admissions was compared (0.41 vs 0.45%; 95% CI 0.37–0.53).

Discussion

As the primary and immediate measure to mitigate the spread of COVID-19 was social distancing, we

encountered a unique opportunity to study the impact of social distancing on other aspects of infectious diseases. The goal of the present study was to examine the effect of social distancing on the incidence of bacteraemia.

Bacteraemia is described as invasion of the bloodstream by bacteria in the course of bacterial infection.[12] Although there are a few other settings when blood cultures are collected, they are mostly collected from patients who present with signs and symptoms of sepsis or disseminated infection. The majority of positive blood cultures represent a true infection, except in some cases when the bacteria are common contaminants, such as coagulase-negative *Staphylococcus*, most *Corynebacterium* spp. and related genera, *Bacillus* spp. and *Micrococcus* spp.[13]

There was a decrease in hospital admissions in April–May 2020, which may be explained by the public having fears of being infected with COVID-19 at hospitals, the lockdown itself and reduction of admissions from outpatient clinics.

Nevertheless, since bacteraemia is associated with significant morbidity, it was presumed that patients with bacteraemia would have continued to present for review. This is supported by our finding of a comparable number of cases of community-acquired *Enterobacteriaceae bacteraemia* in April–May of 2017–2019 (44) compared with April–May of 2020 (49; 95% CI 21–67). Enterobacteriaceae typically cause urinary tract infections, cholecystitis, intraabdominal abscesses and other gastrointestinal infections.[14] Therefore, it seems that the observed reduction in the number of bacteraemia cases caused by bacteria (oropharynx microorganisms) was genuine.

The decreased number of cases of streptococcal bacteraemia is primarily due to a decrease in *S. pneumoniae* and oral streptococcal bacteraemia (Tables 1,2). Oral *Streptococcus* spp. are the primary colonisers of the oral cavity and may migrate into the bloodstream due to mechanical manipulation of the oral mucosa. They often cause transient bacteraemia, but in high-risk patients, the bacteraemia can persist and lead to endocarditis.[15] There was a similar number of confirmed cases of endocarditis during the months studied, but there was a lower incidence of oral cavity bacteraemia in April–May 2020. This finding could be explained either by decreased numbers of elective oral manipulations (such as dentist visits or oral surgery) during the period of social distancing restrictions and/or fewer hospital admissions due to mild symptoms of transient bacteraemia, which could have resolved spontaneously without leading to a hospital admission.[16]

Streptococcus pneumoniae spreads through human-to-human contact through respiratory droplets and asymptomatically colonises the upper respiratory tract, nasal cavity and sinuses. However, in some patients, it can become pathogenic.[17] Invasive pneumococcal disease (IPD) is defined as an infection confirmed by the isolation of *S. pneumoniae* from the blood or other normally sterile fluid (joint, cerebrospinal or peritoneal fluid). IPD has severe symptoms, and the overall mortality rate is 15–20%. Due to the severity of IPD, we assumed that almost all cases would have been admitted to the hospital. Therefore, the decline in *S. pneumoniae* bacteraemia is real and not due to a decrease in hospital admissions in April–May 2020.

There was no decrease in cases of bacteraemia due to Enterobacteriaceae (Gram-negative bacteraemia) and colonic microbiota. This represents a reasonable finding because most of these cases of bacteraemia are not related to social distancing.

The fewer cases in April–May 2020 of coagulase-negative *Staphylococcus* and other possible contaminated blood cultures (Tables 1,2) may be explained by the decrease in total admissions during this period of the COVID-19 pandemic. This probably also explains the decrease in nosocomial bacteraemia (>72 h after admission; Table 2).

These data are in accordance with findings from a study from Singapore, where a decline in hospital admissions due to *S. pneumoniae* was reported during the COVID-19 pandemic. The diagnosis of *S. pneumoniae* disease was made by a positive test for urinary antigen in that study.[18]

The main limitation of the present study is the possibility that patients with bacteraemia were not admitted to the hospital due to their concerns of becoming infected with COVID-19 in the hospital environment. This limitation is most relevant to the findings for oral flora bacteraemia, which can cause transient bacteraemia that resolves spontaneously. In addition, this is an observational study on bacteraemia rate; a difference in one observation could be a random finding or due to causes other than social distancing. Therefore, further studies are needed in order to evaluate the impact of social distancing on bacteraemia.

Conclusion

We demonstrated a lower number of cases of bacteraemia caused by oropharynx and respiratory-transmitted bacteria, especially *S. pneumoniae* bacteraemia, during the period of social distancing. Our findings suggest that embracing measures of social distancing can decrease bacteraemia due to *S. pneumoniae* and other respiratory bacteria.

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