EFFECT OF COVID-19 PANDEMIC RESPONSE MEASURES ON ACUTE RESPIRATORY PATHGEN INCIDENCE AT A NEW YORK CITY CANCER CENTER

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Introduction

The SARS-CoV-2 pandemic has resulted in a unique scenario with respect to the transmission of upper respiratory tract pathogens. In the beginning of March 2020, emergency measures were implemented in New York City to curb the spread of SARS-CoV-2, including closure of schools and non-essential businesses, adherence to social distancing guidelines, and the recommendation that individuals wear face coverings. The mode of transmission of SARS-CoV-2 is similar to the mode of transmission of other acute upper respiratory pathogens. Therefore, it is hypothesized by this study that there would be a decrease in acute respiratory pathogen detection in the Memorial Sloan Kettering Cancer Center population after the onset of the COVID-19 pandemic in comparison to previous years. This retrospective cohort study consists of MSKCC patients receiving a multiplex respiratory pathogen PCR test from August 1, 2014 until July 31, 2020. Data was collected so that each unique patient was counted once per year, counting a positive result for a respiratory pathogen if they tested positive. This study investigates the effect the COVID-19 pandemic had on other respiratory viruses, therefore COVID-19 test results are omitted from the study. Using March 22, 2020 as the time of exposure the 2019-2020 viral year is compared to the previous 5 years for both a pre-exposure group and a post-exposure group using multivariable logistic regression. A large reduction in the odds of testing positive for a respiratory virus were observed for most pathogen categories.

Methods

Data was extracted from the MSKCC laboratory informatic system (LIS) databases, deidentified, and compiled into a database for statistical analysis. Test results were treated as belonging to a particular viral year in order to capture each viral cycle. The seasonality of respiratory pathogens has been well established with influenza, coronavirus, and RSV prevailing in winter and early spring months, rhinovirus and para-influenza viruses peaking in spring and fall, and adenovirus prevailing year-round. In order to account for the natural seasonal variability in respiratory pathogen prevalence, the 2019-2020 viral season will be compared to the same time period in previous seasons. Each viral year was defined as August 1 to January 31 of the following year. To better estimate disease incidence and to remove duplicate testing, the data was cleaned so that each unique patient’s test result for each pathogen was only counted once per viral year, counting the positive result if they tested positive that year. This study investigates the effect the COVID-19 pandemic had on other respiratory viruses, therefore COVID-19 test results are omitted from the study. The testing methodology of all test results in the data set were the film array respiratory pathogen multiplex PCR panel produced by BioMerieux as well as an influenza and RSV multiplex PCR test provided by Cepheid. To determine if there was a reduction in respiratory pathogens after COVID-19 pandemic mitigation interventions were put in place on March 22, 2020, the data were divided into three exposure groups. The first group, the reference group, included all test results from August 1, 2014 until July 31, 2019, encompassing 5 viral seasons. The second group, the pre-exposure group, includes all test results from August 1, 2019, the beginning of viral year 2019-2020, until March 22, 2020, when the implementation of COVID-19 mitigation strategies occurred. The third group is the post-exposure group consisting of all test results from March 23 2020 until July 31, 2020. These 3 time periods were coded in the data set as “1” for the reference group, “2” for the pre-exposure group, and “3” for the post-exposure group. Chi square tests for association between the demographic characteristics of sex, age, and race and either a positive or negative result were performed (Table 1).

Methods (Cont.)

Multiple binary logistic regressions using test result (positive or negative) as the response variable and “time period” as the explanatory variable while controlling for sex, age, and race, were then independently performed between the pre-exposure group (period 2) and the reference group (period 1) as well as the post-exposure (period 3) group and the reference group (period 1) for the corresponding time periods for each pathogen. This means that the pre-exposure group, results from August 1, 2019 – March 22, 2020, is being compared to results from August 1 – March 29 for each previous year going back to 2014. Similarly, the post-exposure group, results from March 23, 2020 - July 31, 2020, is being compared to results from March 23 - July 31 for each previous year going back to 2015. For the post-exposure regression models for Influenza B and Mycoplasma pneumoniae, Firth’s Bias Reduced Logistic Regression was performed due to the complete separation introduced into the model due to zero cases of positive results for these pathogens during the post-exposure time period. All data analysis was performed using R Studio statistical software.

Results

Population characteristics appear in Table 1. Chi square tests showed significant association for sex, race, and gender with respiratory virus positivity. Males appear to have higher positivity for respiratory virus than females. Pediatric patients had significantly higher percent positivity rate for respiratory viruses than patients older than 18. While white and African American patients did not have significantly different proportions of infections but the proportion of these groups was significantly lower than the other racial groups considered in the model. In order to visualize the seasonality and comparison of positivity rates, monthly positivity rates for each pathogen were calculated. The highest positivity rate for the 2014-2019 months was plotted as columns while the pre-exposure and post-exposure groups of 2019-2020 were plotted as lines on top of the 2014-2019 group as seen in Figure 1. Comparing the pre-exposure group of 2019-2020 to the reference group of 2014-2019 using multiple logistic regression showed no statistical difference in odds for coronavirus, Mycoplasma pneumoniae, parainfluenza virus, and respiratory syncytial virus. The odds of testing positive for influenza B or adenovirus were higher in the pre-exposure period of 2019 than in the 5 years prior, whereas the odds of testing positive for human metapneumovirus, human rhinovirus, enterovirus, and influenza A for the same period comparison were reduced. For the post-exposure group comparison, the odds of testing positive for all pathogens were significantly reduced compared to the previous 5 years except for adenovirus which showed no significant difference in the odds of testing positive.

Discussion

This study has several limitations. Firstly, it is an observational study that measures association and therefore cannot establish causation between exposure and outcome. Additionally, this study cannot account for potential changes in testing practices that may have occurred as a result of the Covid-19 pandemic. It is possible that the rate of positive respiratory pathogen tests went down because any individual exhibiting acute upper respiratory disease was isolated and ruled out as a COVID-19 case prior to testing. The authors of this study did not have access to isolation practices for the post-exposure group compared to previous years. This would not be expected to drastically change the positivity rate for respiratory viruses but there is potential for this to be the case. Finally, this study has no way of determining which Covid-19 measure was responsible for the observed decrease in odds of testing positive for a respiratory virus in the post-exposure group. This study provides valuable data that can be used to guide infection control practices in a post-pandemic cancer center environment. The observed decrease in odds of an individual in the patient population testing positive for almost all of the common respiratory pathogens provided guidance that could be used to justify retaining some of the infection control practices that were employed during the pandemic in order to curtail all respiratory infections as well as future outbreaks of SARS-CoV2.

Table 1. Population Characteristics and Respiratory Pathogen Test Positivity by Period

Table 2. Respiratory Pathogen Positivity Rates and Odds Ratios Pre and Post COVID-19

References


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