Autopsy Education and Rate: Effect of the COVID-19 Pandemic

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ABSTRACT

Autopsy training is required for board certification by the American Board of Pathology and may be affected by autopsy rate. It is unclear whether the COVID-19 pandemic has affected autopsy education and rate. Prior to the pandemic, our autopsy gross organ review lectures at the Brown University pathology residency program were in-person and used a detective style to discover the pathological lesions followed by an integrated discussion of anatomic and clinical pathology. During the COVID-19 pandemic, these lectures became remote and there was a noticeable impact on the involvement and responsiveness of the audience compared to in-person teaching. Certain qualities of face-to-face teaching can be difficult to be reproduced through virtual teaching, including the detective style to look for pathological lesions and the ability to palpate lesions from gross specimens. Our results showed that the autopsy case number increased during the COVID-19 pandemic, but the overall autopsy rate did not significantly change.

KEYWORDS: autopsy education, autopsy rates during COVID pandemic, medical autopsies, pathology education

INTRODUCTION

Autopsy has two general categories: medico-legal (forensic) and medical (hospital) autopsies. Forensic autopsies are performed in medical examiner offices in the USA, whereas hospital autopsies are performed to answer specific questions that family members or physicians may have, including cause of death, disease extent, treatment effectiveness, or hospital quality assurance.[1] Autopsy training is a requirement for pathology residents and plays an important role in their education. The autopsy aids in the education of residents by providing teaching materials for clinical and pathological correlations and provides an opportunity for pathology residents to enhance their knowledge of normal and abnormal anatomy and histology.

Autopsy training consists of a combination of autopsy rotations and lectures. In autopsy rotations, pathology residents review clinical history, perform external examination of the body, eviscerate (usually with assistance of a diener) and dissect organs, identify any gross abnormalities, review microscopic slides, and draft a final autopsy report. At our Brown University pathology residency program, lectures are both didactic and case-based with autopsy gross organ review. The latter involved in-person teaching prior to the COVID-19 pandemic, but was changed to remote teaching during the pandemic. Remote teaching was used by many universities due to requirements of social distancing and "lockdown" during the COVID-19 pandemic.[2-4]

Recent reduction in the number of autopsies may affect autopsy education. In the United States, hospital autopsy rates have been steadily dropping over the past 50 years, decreasing from 40%–60% prior to 1970 to now less than 10%.[5] Decreasing number of hospital autopsies has made the completion of 50 autopsies difficult in many pathology residency training programs. In response to lower number of autopsies, the American Board of Pathology reduced the minimum autopsy number required for board certification in anatomic pathology from 50 to 30 autopsies beginning in August 2020.[6] However, the importance of adequate training in autopsy was demonstrated in the COVID-19 pandemic as early understanding of the pathogenesis of COVID-19 was obtained through autopsies, leading to improved treatments for COVID-19 patients. It is unclear whether concerns of potential risks of exposure to SARS-CoV-2 through aerosols generated during dissection of lungs, infusion of formalin into lungs, and during opening skulls with an oscillating saw affect the overall autopsy rate.

In this study, we discuss the format of the autopsy gross organ review lectures at the Brown University pathology residency program before and during the pandemic and hypothesized that education of residents suffered and that autopsy rates were impacted by the COVID-19 pandemic.

FORMAT OF BROWN UNIVERSITY PATHOLOGY RESIDENCY PROGRAM

1a. Comparison of a new format with an old one

The Brown University Pathology Residency Program at Rhode Island Hospital used a format consisting of organ reviews of two autopsy cases and PowerPoint presentations before 2017 (old format). After 2018, we removed PowerPoint presentations and increased autopsy cases from two to four within the one-hour lecture (new format). Residents' responses were obtained from those experiencing both formats.

1b. Detective style of discovery of abnormal pathological findings

Before reviewing organs, the resident performing the autopsy provided a brief clinical summary to his/her peers. Some critical histories related to autopsy findings were not provided, such as the history of cancer. Residents were required to find pathological abnormalities by themselves. For some interesting cases, a few microscopic pictures for gross-microscopic correlation were provided after organ reviews.

1c. Integration of anatomic and clinical pathology

The pathology attending reviewed the clinical history and pathological findings beforehand. Teaching points of clinical pathology were prepared. For example, when a patient had HIV, residents were taught how to look for infections of specific organisms based on the patient's lymphocyte count. In patients with acute pancreatitis, residents were taught the methods of amylase and lipase measurements, different types of amylase, the sensitivity and specificity of these assays, the time course of abnormal changes and the factors affecting measurements. In patients with sepsis, residents were taught the features of a bacterium, including how to culture the bacterium, which culture medium to use and what morphology was on the culture plate and on gram staining.

1d. Autopsy lectures after March 2020 (COVID-19 pandemic period)

Due to social distancing rules during the COVID-19 pandemic, autopsy lectures were changed to online lectures through Zoom. Residents presented images of autopsy cases. Each case was discussed as described above.

METHODS

Residents' Evaluations

Between July 2019 and February 2020 (before the COVID-19 pandemic in Rhode Island), evaluations were received from six in-person autopsy organ review lectures. During the COVID-19 pandemic (March 2020–March 2021), evaluations were obtained from four Zoom online lectures.

An anonymous evaluation form was provided to the residents. Six categories were scored, including 1) discovery and discussion of abnormal pathological findings; 2) discussion of cause of death; 3) understandability; 4) involvement and responsiveness of audience; 5) integration of anatomic and clinical pathology; and 6) overall educational activity. Each category was scored from 1 (lowest) to 5 (highest). Statistical analysis between score 5 and score 1–4 was performed by using Chi square test.

Effect of the COVID-19 pandemic on autopsy rate

Autopsy rate was calculated during a period from March 2019 to February 2020 (before COVID-19 pandemic in Rhode Island) and that from March 2020 to February 2021 (COVID-19 pandemic period). Death and autopsy numbers were also analyzed. Statistical analysis for comparison of autopsy rates was performed by using Chi square test. The study was approved by the Institutional Review Board (IRB) at Rhode Island Hospital and performed according to our institution IRB guidelines.

RESULTS

1. Teaching format of Brown University Pathology Residency Program and the effect of the COVID-19 pandemic

1a. Comparison of the new format with the old one

Feedback was received from six residents who had experiences with both formats. All six residents felt that the format without PowerPoint presentations was better and they learned more from having at least four cases per lecture instead of two cases. In addition, the integrated discussion about each case was better than PowerPoint presentations. With PowerPoint presentations, residents tended to just read off the slides and move onto next case. The format without PowerPoint presentations was more engaging and interactive.

1b. Discovering abnormal pathological findings

The Brown University pathology residency program had 12 residents in the academic year of 2019–2020. Out of 6 lectures between July 2019 and February 2020 (before the COVID-19 pandemic), 34 evaluation forms were received. The discovery of abnormal pathological findings received a score of 5 from all 34 evaluations (100%) (**Table 1**). The course required the residents to first identify the lesions in the gross specimens. However, sometimes small pathological lesions were missed because residents covered the lesions with their hands while holding the specimen. The approach to first identify the unknown lesions significantly increased their interests. In addition, residents felt that they retained the lessons better when they had to examine the organs for pathology by themselves. Seniors and chief residents were more involved in teaching by sharing their findings.

During the COVID-19 pandemic (March 2020–March 2021), abnormal pathological findings were discovered on the images instead of gross organs. Residents missed feeling the textures of the lesions by hands. Sometimes, residents forgot to take a picture of an interesting lesion. The discovery of abnormal pathological findings received a score of 5 in 18 out of 20 evaluations (90%). The difference was not statistically significant when compared with before COVID-19 (90% vs 100%, P>0.05, **Table 1**).

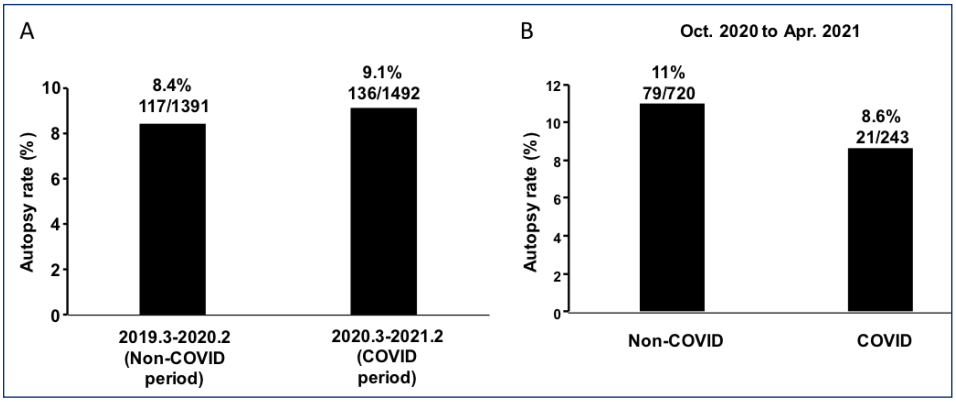
1c. Integration of anatomic and clinical pathology

Integration of anatomic and clinical pathology also received a score of 5 from all 34 evaluations (100%) before the COVID-19 pandemic. Clinical pathology questions were

Table 1. Evaluation scores of autopsy organ review lectures

			Score				P value (score 5 vs score 1–4)
Category	Group	Number	1–2	3	4	5	
Abnormal findings discovered and discussed	Non-COVID	34	0	0	0	34 (100%)	P>0.05
	COVID	20	0	1 (5%)	1 (5%)	18 (90%)	
Cause of death discussed	Non-COVID	34	0	0	0	34 (100%)	**P<0.05**
	COVID	20	0	1 (5%)	2 (10%)	17 (85%)	
Understandability	Non-COVID	34	0	0	0	34 (100%)	P>0.05
	COVID	20	0	0	2 (10%)	18 (90%)	
Involvement & responsiveness of audience	Non-COVID	34	0	0	0	34 (100%)	**P<0.05**
	COVID	20	0	1 (5%)	2 (10%)	17 (85%)	
Review anatomic and clinical pathology knowledge	Non-COVID	34	0	0	0	34 (100%)	P>0.05
	COVID	20	0	0	2 (10%)	18 (90%)	
Overall educational activity	Non-COVID	33	0	0	1 (3%)	32 (97%)	P>0.05
	COVID	20	0	1 (5%)	2 (10%)	17 (85%)	

Figure 1. Autopsy rates before and during the COVID-19 pandemic.
A. Autopsy rate over a year before the COVID-19 pandemic was 8.4%, whereas it was 9.1% (136/1492) during the COVID-19 pandemic. The difference was not statistically significant (P>0.05).
B. During the COVID-19 pandemic between October 2020 and April 2021, the autopsy rate for non-COVID patients was 11%, whereas it was 8.6% in patients with COVID-19. The autopsy rate was slightly lower in COVID-19 patients, but the difference was not statistically significant.



first asked and then explained, which made the lecture more interactive. During the COVID-19 pandemic, the integration of anatomic and clinical pathology received a score of 5 in 18 out of 20 evaluations (90%), a difference which was not statistically significant when compared with before COVID-19 (90% vs 100%, P>0.05, **Table 1**).

Similarly, the understandability of lectures received a score of 5 in 100% evaluations before COVID-19 and 90% during COVID-19. The overall education activity received a score of 5 in 97% evaluations before COVID-19 and 85% during COVID-19. Both differences had no statistical significance (**Table 1**)

However, both the involvement and responsiveness of the audience and the discussion of the cause of death received a score of 5 in 85% evaluations during the COVID-19 pandemic, which were significantly lower than those before COVID-19 (85% vs 100%, P<0.05, **Table 1**).

2. Effect of the COVID-19 pandemic on autopsy rate

Autopsy rate may affect autopsy education. Therefore, autopsy rate was calculated before and during the COVID-19 pandemic. Autopsy rate over a year before the COVID-19 pandemic (between March 2019 and February 2020) was 8.4% (117/1391), whereas it was 9.1% (136/1492) during the COVID-19 pandemic (March 2020–February 2021) (**Figure 1A**). The difference was not statistically significant. During the COVID-19 pandemic between October 2020 and April 2021, the autopsy rate for non-COVID patients was 11%, whereas it was 8.6% in patients with COVID-19 (**Figure 1B).** The autopsy rate was slightly lower in COVID-19 patients, but the difference was not statistically significant. The death number and the percentage of death of patients with COVID-19 among all deaths reached a peak in December 2020 (**Figure 2**), whereas the death number in non-COVID patients was relatively stable. The autopsy number also reached the peak in December 2020 and January 2021 (**Figure 3A**). From October 2020 to February 2021, the total autopsy number increased by 38-200%, when compared with one year ago (October 2019 to February 2020, **Figure 3B**). The autopsy rate also increased from 7.9% before COVID-19 (from October 2019 to February 2020) to 10.7% during the same months of the COVID-19 pandemic, but the increase did not have the statistical significance.

DISCUSSION

1. Effect of the COVID-19 pandemic on autopsy education

Autopsy gross organ review is a crucial education opportunity to expose residents, particularly those who are rotating

Figure 2. Death numbers during the COVID-19 pandemic in Rhode Island hospital.

A. The death number in patients with COVID-19 reached a peak in December 2020, whereas the death number in non-COVID patients was relatively stable. **B.** The ratio of death number of patients with COVID-19 over the total death number reached a peak in December 2020.

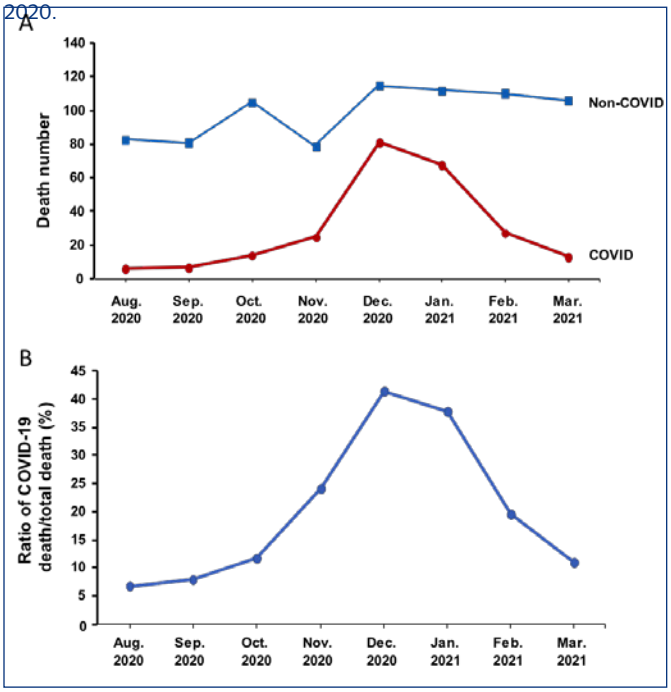
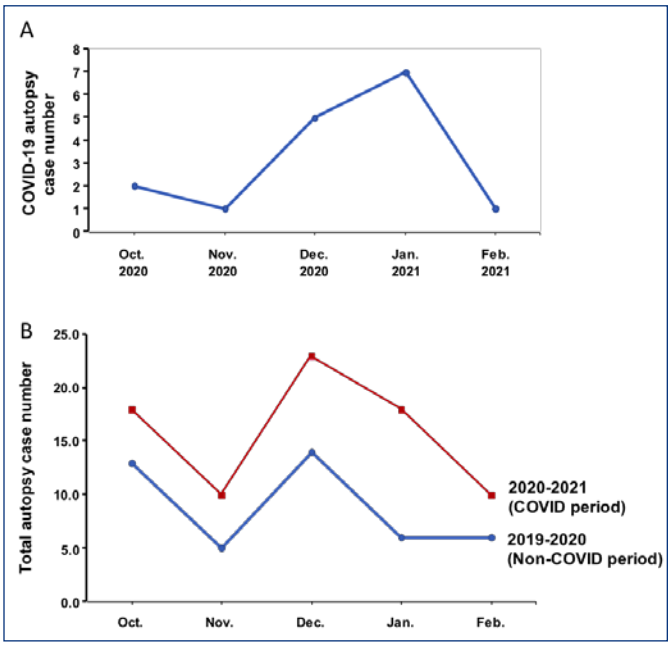


Figure 3. Autopsy numbers.

A. The autopsy number reached a peak in December 2020 and January 2021. **B.** From October 2020 to February 2021, the total autopsy number increased by 38–200%, when compared with one year ago (October 2019 to February 2020).



not through the autopsy service, to more autopsy training. This course used to be in-person prior to the COVID-19 pandemic. Since the first COVID-19 case was reported in Rhode Island in March 2020,[7] the course became remote through Zoom. Over the course of the COVID-19 pandemic, similar changes were made by many colleges and universities worldwide as well as in medical field, including pathology.[2-4]

Our study found that the involvement and responsiveness of the audience was affected by the transition from in-person to remote teaching. This may be due to multiple factors. One concern was poor internet connectivity as reported in literature,[3] although this has not been an issue at our institution. The second factor could be audio problems, including echoes and background noises from different environments. It has been reported that remote teaching and learning may encounter interruption due to unintended activation of "sleep mode" on the computer, poor sound quality and limited viewing due to small screen size.[8] The third concern is the level of distractions during remote teaching as educators cannot as easily pick up the residents' responses or know whether they are listening when the video feature is turned off. It has been shown that the remote learning quality may be worse than in-person learning, particularly for those who are not willing to learn independently.[9] Hayden, Navedo and Gordon found that the issue in communication between educators and students through the virtual platform can become a barrier in fully understanding the complexity of a case.[10] This might explain why in this study there were a lower percentage of evaluations receiving a score of 5 on the discussion of the cause of death via remote learning.

In addition, certain activities of in-person education cannot be reproduced through remote teaching. This includes learning through hands-on exploration of gross organ specimens to look for pathological lesions by both palpation and visual inspection, like a detective. Similar impact was observed in the teaching of anatomy, where the pandemic affected the areas of laboratory sessions and cadaveric dissections.[11]

In short, education in autopsy was impacted by the COVID-19 pandemic. Certain activities of in-person teaching cannot be reproduced during the remote teaching.

2. Effect of the COVID-19 pandemic on autopsy rate

Hospital autopsy rates have been declining in the United States[5] in the past decades partially because of advances in imaging technology which give physicians more confidence in their diagnoses. Recent policy changes may further decrease hospital autopsies as the Centers for Medicare and Medicaid Services (CMS) eliminated the requirement of an autopsy program for hospitals to qualify for Medicare reimbursement on September 30, 2019.[12] However, the importance of autopsy was shown during the pandemic as autopsies play a key role in understanding the pathophysiology of COVID-19. Early autopsies demonstrated microvascular

thrombosis and marked inflammatory changes in patients with COVID-19,[13] which led to the inclusion of antithrombotic therapy in some national treatment guidelines for patients of COVID-19.[14] That might in part explain why autopsy rates and case numbers were slightly higher during the COVID-19 pandemic than prior to it, although the change was not statistically significant. The death number of COVID-19 and the percentage of death of patients with COVID-19 among all deaths as well as the total number of autopsies per month peaked in December 2020 and January 2021 at Rhode Island Hospital, coinciding with the second peak of COVID-19 cases and deaths in our state.[15] To my knowledge, this is the first report of a comparison of the autopsy rates between before and during the COVID-19 pandemic.

Interestingly, autopsy rates in COVID-19 patients were slightly lower than that in non-COVID patients. This discrepancy may be due to the fact that causes of death are known in most patients with COVID-19 who died from respiratory failure. This slightly lower autopsy rate in patients with COVID-19 did not appear to affect the overall autopsy education in our program because the total number of autopsies increased during the COVID-19 pandemic and because there was a high prevalence of autopsy cases of COVID-19 patients in our hospital. In non-major academic institutes, the autopsy rate of COVID-19 patients may be much lower, affecting autopsy education in these centers. In fact, many local community hospitals around our hospital stopped performing autopsies and occasionally transferred autopsies to our hospital.

In conclusion, the autopsy rates were not affected by the COVID-19 pandemic, but the overall number of autopsy cases increased and the pandemic demonstrated the importance of autopsy as a key factor in understanding the pathophysiology of disease. If policies that require each hospital to perform a certain percentage of autopsies are not reinstated, autopsy rates may continue to trend downwards and the education of our future trainees may be further impacted.

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