



The Impact of COVID-19-Related Delays on Surgical Management of Peritoneal Surface Malignancies

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The COVID-19 pandemic has presented the oncologic community with unique challenges, requiring triage of surgical care, with 64 % to 87 % of cancer patients reporting a delay in surgery during the height of the pandemic in 2020.¹ The impact of these delays on the oncologic outcomes of patients with peritoneal surface malignancies (PSMs) is unknown. We aimed to characterize this impact at our institution.

METHODS

This retrospective review at a single, academic, high-volume PSM institution investigated adult patients with PSM whose oncologic operations were delayed due to the COVID-19 pandemic. Time to surgery (TTS) was defined as the number of days from the decision to operate to the actual date of surgery. Imaging and operative reports were reviewed to assess for evidence of radiologic or occult (noted at time of surgery) disease progression. Overall survival was defined as time from the decision to operate to death or the last follow-up visit.

Descriptive statistics of baseline characteristics were performed, with continuous variables reported as medians, and categorical variables reported as frequencies and percentages. Kaplan-Meier analysis was performed for survival estimates, with a log-rank test for comparison.

RESULTS

Results are detailed in Table 1. The study identified 27 patients (63 % female and 100 % Caucasian). The median age was 60 years (range, 39–84 years). Of the 27 patients, 15 had an appendiceal primary, 3 had a colorectal primary, 3 had a mesothelioma primary, 2 had a gastric primary, 2 had an ovarian primary, 1 had a sarcoma primary, and 1 had a thymoma primary. Although the majority sustained a delay due to triage of non-emergent cases, two patients had operations postponed after contracting COVID-19. The median TTS was 72 days (range, 47–218 days).

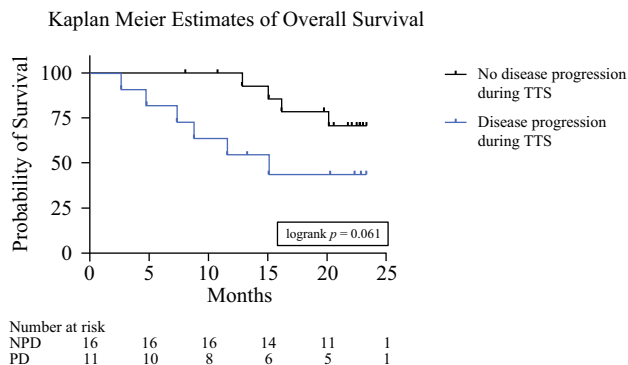
During the TTS, 11 (40.7 %) of the 27 patients had radiologic or occult progression. Two patients did not have radiology available for review and thus could not be evaluated for radiologic progression. Five patients did not undergo their oncologic operation (2 had radiologic progression that precluded surgery, 2 had operations aborted due to occult progression, and 1 was lost to follow-up evaluation before undergoing surgery). Other impacts included initiation or continuation of systemic chemotherapy for nine patients (33.3 %) and additional surgical intervention for two patients (7.4 %).

During a median follow-up period of 22.1 months, 10 patients (37 %) died. The median overall survival among the patients who had disease progression during TTS was 15.1 months, whereas the median was not reached among the patients who did not experience progression (hazard ratio, 3.13; 95 % confidence interval, 0.832–11.76; $p = 0.061$). Although this was not statistically significant, a clear trend was demonstrated in the Kaplan Meier curves (Fig. 1).

TABLE 1 Baseline characteristics and oncologic outcomes

| <i>Baseline characteristics</i> | <i>n (%)</i> |
|---|--------------|
| No. of patients | 27 |
| Median age at diagnosis: years (range) | 60 (39–79) |
| Female sex | 17 (63) |
| <i>Race</i> | |
| Caucasian | 27 (100) |
| Other | 0 (0) |
| <i>Primary tumor</i> | |
| Appendiceal | 15 (56) |
| Colorectal | 3 (11) |
| Ovarian | 2 (7) |
| Gastric | 2 (7) |
| Mesothelioma | 3 (11) |
| Sarcoma | 1 (3) |
| Thymoma | 1 (3) |
| <i>Cause of delay</i> | |
| Triage of non-emergent case | 25 (93) |
| Patient contracted COVID-19 | 2 (7) |
| Median TTS: days (range) | 72 (47–218) |
| <i>Oncologic outcomes</i> | |
| <i>Radiologic progression</i> | |
| Progression of disease | 9 (33) |
| Unable to assess | 2 (7) |
| <i>Occult progression of disease</i> | |
| Progression of disease | 2 (7) |
| Unable to assess | 3 (11) |
| <i>Did not undergo oncologic operation</i> | |
| Progression precluding resection | 2 (7) |
| Aborted due to occult progression | 2 (7) |
| Lost to follow-up | 1 (3) |
| Initiation or continuation of systemic therapy | 9 (33) |
| Repeat staging laparoscopy prior to cytoreduction | 2 (7) |

TTS, time to surgery

**FIG. 1** Kaplan-Meier estimates of overall survival comparing patients who had progression of disease during the time-to-surgery period (PD) with those who did not (NPD)

DISCUSSION

This study was the first to evaluate the impact of the COVID-19 pandemic on oncologic outcomes in PSM. Delays in operative intervention had negative effects, including disease progression, resectability, need for additional interventions, and survival.

The pandemic has affected nearly every aspect of cancer care, including early detection,² treatment,³ and survivorship.⁴ Although at certain disease sites, the impact of a delay to surgery can be mitigated by use of alternative therapies, such as neoadjuvant endocrine therapy for hormone-positive breast cancer,⁵ the often-limited efficacy of systemic therapies in PSM posed a challenge in our cohort.

This study had several limitations, including its retrospective nature and small sample size. Furthermore, it was performed at a high-income institution with a largely well-insured Caucasian population. Due to the pandemic's magnification of health care inequities⁶ it is expected that the outcomes from delays may be more profound among an underserved population.

Despite these limitations, we demonstrated the negative impact of COVID-19-related delays on oncologic outcomes in PSM. The long-term effects of the pandemic on oncologic care continue to evolve. These effects should be considered in future decisions regarding anticipated recurrent surges of COVID-19.

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