Original Article

Eur J Breast Health 2022; 18(4): 306-314
DOI: 10.4274/ejbh.galenos.2022.2022-4-4

The Influence of Screening Mammography Cessation and Resumption on Breast Cancer Presentation and Treatment: A Multi-Hospital Health System Experience During the Early COVID-19 Pandemic

Holly Mason[1], Ann-Kristin Friedrich[1], Shiva Niakan[2], Danielle Jacobbe[3], Jesse Casaubon[1], Aixa Pérez Coulter[1,4]

[1]Department of Surgery, UMass Chan Medical School-Baystate, Massachusetts, USA
[2]Department of Obstetrics and Gynecology, UMass Chan Medical School-Baystate, Massachusetts, USA
[3]The Center for Cancer and Blood Disorders, Texas, USA
[4]Office of Research, Epidemiology/Biostatistics Research Core, Baystate Medical Center, Massachusetts, USA

ABSTRACT

Objective: To assess the impact of the coronavirus disease-2019 (COVID-19) pandemic screening restrictions on the diagnosis and treatment of breast cancer in a single health system.

Materials and Methods: We performed a retrospective, cohort investigation of breast cancer patients at a multi-institution health system from March 1, 2019 to December 31, 2020 with two time periods related to the pandemic: "Early phase" (March 18 – June 7) reflecting the time of the screening mammography moratorium and "Late phase" (June 8 – December 31) to reflect the time once screening mammography resumed. 2020 was compared to 2019 to exclude potential differences from temporal or seasonal changes. Variables included demographics, COVID related-deferral, cancer specific data, method of detection, type of treatment recommended and received.

Results: Fewer patients presented with a breast cancer diagnosis during Early phase 2020 when compared to any other time period. Numbers increased significantly in Late phase 2020; total numbers of patients seen in 2020 approached but did not completely reach that of 2019. When compared to other time periods, patients who presented during the moratorium on screening were younger, more likely to be black, had a higher Body Mass Index, and were more likely to have a human epidermal growth factor receptor 2 positive tumor. There was a slight increase in size of presenting tumor and node positivity, although no differences in breast or axillary surgical management were identified.

Conclusion: Despite an increase in tumor size and positive nodal status seen during the screening moratorium, surgical treatment was not negatively impacted.

Keywords: Breast cancer; COVID-19; neoadjuvant systemic therapy; surgery

Cite this article as: Mason H, Friedrich AK, Niakan S, Jacobbe D, Casaubon J, Pérez Coulter A. The Influence of Screening Mammography Cessation and Resumption on Breast Cancer Presentation and Treatment: A Multi-Hospital Health System Experience During the Early COVID-19 Pandemic. Eur J Breast Health 2022; 18(4): 306-314

Key Points

- A slight increase in presenting tumor size and positive nodal status was identified after screening mammography was halted.
- Although endocrine therapy was offered as a temporizing measure during the lockdown, there was low uptake.
- Ultimate surgical treatment was not impacted by screening cessation.

Corresponding Author:
Holly Mason; holly.mason@baystatehealth.org

Received: 20.04.2022
Accepted: 27.06.2022
Available Online Date: 01.10.2022

©Copyright 2022 by the Turkish Federation of Breast Diseases Societies / European Journal of Breast Health published by Galenos Publishing House.

Introduction

Coronavirus disease-2019 (COVID-19) has affected healthcare delivery more than any other crisis in recent memory. The World Health Organization first announced concerns about a coronavirus-related pneumonia in Wuhan, China on January 5, 2020. The first documented COVID-19 positive patient in the United States occurred on January 21, 2020 (1). In Massachusetts, the first case was documented on February 1, 2020 (2). A state of emergency was declared on March 10, 2020 with cessation of all elective procedures as of March 16, 2020. Screening imaging was halted at our institution on March 18, 2020 and resumed June 8, 2020.

Routine screening mammography has resulted in earlier detection of breast cancer and a reduction in the extent of treatment. Screening has been so effective that the benefit of self breast exam (SBE) and clinical breast exam (CBE) have been called into question (3, 4). The American Cancer Society currently advises against CBE in women undergoing screening and against SBE for women of any age (5). Some studies have questioned the benefit of SBE even in regions of the world where mammography is not readily available, as discussed in a 2003 Cochrane review (6).

Screening imaging cessation would be expected to have an impact on the detection of early breast cancer and therefore result in a more advanced stage at presentation and worse outcomes (7-10). What is less clear is how COVID-19 restrictions would affect the number of patients presenting with palpable (and likely more advanced) cancers in a population accustomed to screening mammography and discouraged to perform SBE.

The goal of this study was to assess the impact these restrictions had on the diagnosis of breast cancer presentation and the therapies offered. We hypothesized that the disruption of the availability of screening imaging and "routine" CBE would result in a delay in the diagnosis of breast cancer, increased stage at presentation, and altered treatment recommendations. We also hypothesized that there would be a decrease in patients presenting with breast cancer, due both to a lack of screening and patients purposefully delaying the evaluation of palpable abnormalities due to fear of contracting COVID-19 while seeking medical care.

Materials and Methods

We conducted an Institutional Review Board (IRB)-approved retrospective, cohort study at a 720-bed tertiary care center with three regional hospitals in Western Massachusetts. We identified patients presenting with a new breast cancer diagnosis from March 1, 2019 to December 31, 2020 using the institution's IRB-approved Breast Disease Patient Repository, a secure, HIPAA compliant REDCap database, which is prospectively maintained. All patients with a new breast cancer diagnosis who presented between March 18 – December 31, 2020 were included in the study and compared to all patients with a breast cancer diagnoses who presented between March 18 – December 31, 2019. March 18th, the first day of the screening moratorium in 2020, was chosen as the start date. Exclusion criteria were those patients with breast cancer who presented outside this time frame. Supplemental information was obtained from the health system's electronic medical record.

We created two time period groups referred to as "Phases". The first time period reflected the pause in screening mammography (Early phase: March 18 – June 7, 2020) and the second time period reflected screening mammography resumption (Late phase: June 8 – December 31, 2020). We compared groups from 2020 (during COVID) to 2019 (before COVID) to assess whether any potential differences were due to COVID-19 and not to temporal or seasonal changes.

Eligible encounters were uploaded to a REDCap database, hosted by Tufts Clinical and Translational Science Institute (Grant Number UL1TR001064) for abstraction from the electronic medical record. Variables collected included patient age, gender, ethnicity, Body Mass Index (BMI), COVID deferral (treatment was treatment delayed or not), cancer specific data [specifically AJCC 8th edition clinical stage, grade, hormone receptor status and human epidermal growth factor receptor 2 (HER2) status], and method of detection (including imaging, self-detected, clinically detected). The type of treatment (surgery first *versus* neoadjuvant therapy) and the type of neoadjuvant therapy (chemotherapy *versus* endocrine therapy) that would have been recommended if the COVID pandemic had not occurred, as well as the surgical treatment of breast (lumpectomy, mastectomy, none) and surgical treatment of axilla (sentinel node biopsy, axillary dissection, completion axillary dissection, none) that patients ultimately received were also collected.

Statistical Analysis

All variables were checked for completeness and plausibility using frequencies (percentage, categorical) and means/ranges (continuous, ordinal). Descriptive statistics were calculated for baseline time periods from 2019 (prior to the COVID pandemic) and 2020 (after the onset of the COVID pandemic), including percentages for binary categorical variables, means (standard deviation) and medians (interquartile range) for continuous variables. The t-test was used for continuous variables and Fisher's Exact test for categorical variables. In order to further evaluate temporal trends within our data, we conducted stratified analysis among Early phase 2020 versus Early phase 2019, Late phase 2020 versus Early phase 2019 and Early phase 2020 versus Late phase 2020. Statistical significance was set at an alpha of 0.05. Data were analyzed using STATA 16 (StataCorp, College Station, TX, USA).

Results

We identified a total of 583 patients with breast cancer who presented between March 18, 2019 and December 31, 2020. In 2019, Early phase and Late phase consisted of 88 and 217 patients, respectively, for a total of 305 patients, whereas in 2020 Early and Late phase included 27 and 252 patients, respectively, for a total of 279 patients. Demographics, clinical characteristics, cancer specific data and treatment data for the study population are shown in Table 1. Patients who presented during Early phase 2020 were younger ($p<0.01$) and were more likely to be black ($p = 0.05$) than during the other three phases. Tumors were more likely to be HER2 positive ($p<0.01$) as seen in Figure 1. In the cohort analysis, there was no difference in tumor size ($p = 0.24$) or lymph node positivity ($p = 0.11$). Metastatic disease at presentation was equally infrequent among all phases. There was no difference in the type of breast surgery ($p = 0.95$) or axillary treatment ($p = 0.39$) that the patients ultimately received, regardless of the pandemic, as seen in Figure 2.

Sensitivity analysis was performed to compare the period of the moratorium on screening mammography (Early phase 2020) against the other phases (Tables 2-4). This confirmed the absence of a treatment difference in the surgical management of the breast and axilla that was seen in analysis of the entire cohort (Table 1), even when other differences were noted.

Table 1. Demographic, clinical, cancer specific and treatment data, n = 583

	Early phase 2019	Late phase 2019	Early phase 2020	Late phase 2020	*p*-value
n (%)	88 (15.1)	216 (37.0)	27 (4.6)	252 (43.2)	
***** Patient Characteristics**	***	***	***	***	***
Age, mean (SD)	60.0 (14.6)	61.5 (13.2)	54.8 (18.6)	64.0 (13.8)	<0.01
Race/Ethnicity, n (%)					
Caucasian	69 (78.4)	166 (76.9)	21 (77.8)	198 (78.6)	
African American	5 (5.7)	10 (4.6)	5 (18.5)	11 (4.4)	
Hispanic/Latino	7 (8.0)	19 (8.8)	0 (0.0)	18 (7.1)	
Ashkenazi	1 (1.1)	1 (0.5)	0 (0.0)	8 (3.2)	
Asian	2 (2.3)	6 (2.8)	0 (0.0)	9 (3.6)	
Not recorded/blank	4 (4.5)	10 (4.6)	1 (3.7)	2 (0.8)	
Other	0 (0.0)	4 (1.9)	0 (0.0)	6 (2.4)	0.05
***** Clinical Characteristics**	***	***	***	***	***
BMI, median (IQR)	28.1 (8.7)	29.2 (9.2)	30.6 (13.1)	28.8 (8.8)	0.24
Method of Detection, n (%)	***	***	***	***	***
None	0 (0.0)	1 (0.5)	0 (0.0)	2 (0.8)	
Imaging	63 (71.6)	142 (65.4)	0 (0.0)	187 (74.5)	
Self-detected	25 (28.4)	65 (30.0)	27 (100.0)	56 (22.3)	
Clinically detected	0 (0.0)	9 (4.1)	0 (0.0)	6 (2.4)	<0.01
*****Cancer Specific Data**					
Type of Cancer, n (%)					
Invasive carcinoma NOS or Invasive carcinoma with Ductal and lobular features	0 (0.0)	6 (2.8)	0 (0.0)	7 (2.8)	
IDC-invasive ductal carcinoma	63 (71.6)	149 (69.0)	23 (85.2)	168 (66.7)	
ILC-invasive lobular carcinoma	9 (10.2)	16 (7.4)	1 (3.7)	20 (7.9)	
DCIS-ductal carcinoma *in situ*	16 (18.2)	32 (14.8)	3 (11.1)	46 (18.2)	
Other	0 (0.0)	13 (6.0)	0 (0.0)	11 (4.4)	0.31
Endocrine therapy taken as part of the COVID deferral, n (%)	0 (0.0)	0 (0.0)	6 (22.2)	0 (0.0)	<0.01
ER Positive, n (%)	68 (84.0)	175 (83.7)	21 (80.8)	196 (85.6)	0.90
PR Positive, n (%)	58 (71.6)	153 (73.2)	18 (69.2)	162 (71.1)	0.95
HER2 Positive, n (%)	8 (9.9)	25 (11.9)	9 (39.1)	18 (8.2)	<0.01
Grade 1, n (%)	25 (31.3)	71 (34.6)	6 (26.1)	73 (33.5)	
Grade 2, n (%)	38 (47.5)	81 (39.5)	8 (34.8)	92 (42.4)	
Grade 3, n (%)	17 (21.3)	53 (25.9)	9 (39.1)	53 (24.3)	0.06
Clinical T-stage, mean (SD)	1.1 (0.8)	1.2 (0.8)	1.5 (1.1)	1.2 (0.9)	0.24
Clinical N-stage, mean (SD)	0.1 (0.3)	0.1 (0.3)	0.2 (0.6)	0.1 (0.3)	0.11
Distant metastases present, n (%)	2 (2.3)	3 (1.4)	1 (3.7)	6 (2.4)	0.80
***** Treatment Data**	***	***	***	***	***
Initial treatment recommendation (if not in the COVID pandemic in 2020), n (%)					
Surgery first	73 (83.0)	179 (82.5)	17 (63.0)	209 (83.3)	
Neoadjuvant therapy	15 (17.0)	38 (17.5)	10 (37.0)	42 (16.7)	0.07
Type of Neoadjuvant therapy recommended (if not in the COVID pandemic in 2020), n (%)					
Chemotherapy	14 (93.3)	33 (84.6)	9 (90.0)	35 (81.4)	
Endocrine therapy	1 (6.7)	6 (15.4)	1 (10.0)	8 (18.6)	0.69
Ultimate surgical treatment of breast, n (%)					
Lumpectomy	57 (79.2)	147 (81.2)	13 (81.3)	171 (82.2)	
Mastectomy	15 (20.8)	34 (18.8)	3 (18.8)	37 (17.8)	0.95
Ultimate surgical treatment of axilla, n (%)					
Sentinel node biopsy	51 (69.9)	110 (60.4)	11 (64.7)	127 (60.8)	
Axillary dissection	1 (1.4)	3 (1.6)	1 (5.9)	5 (2.4)	
None	21 (28.8)	69 (37.9)	5 (29.4)	77 (36.8)	0.39

BMI: Body Mass Index; SD: standard deviation; IQR: interquartile range; HER2: human epidermal growth factor receptor 2; ER: estrogen receptor; PR: progesterone receptor; COVID: coronavirus disease; NOS: not otherwise specified

During the initial screening moratorium (Early phase 2020), only 27 patients presented with breast cancer compared to 88 patients in the same time period in 2019 (Table 2). Patients in Early phase 2020 who presented with a new diagnosis of breast cancer were noted to have a higher BMI (30.6 *versus* 28.1, $p = 0.05$).

All tumors were self-detected (100%) during Early phase 2020, compared with 28% (n = 25) in the same time period the year prior.

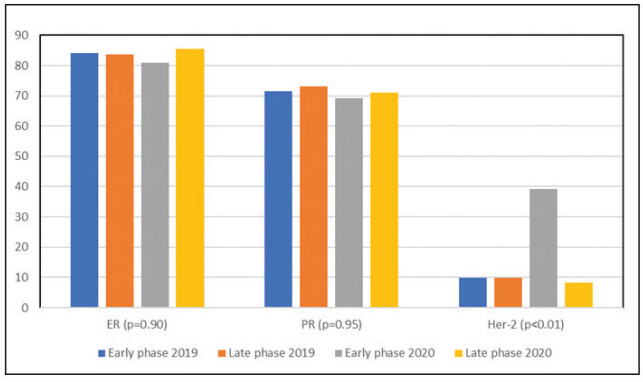


Figure 1. Percent of patients with ER, PR and HER2 positivity by COVID pandemic phase

HER2: human epidermal growth factor receptor 2; ER: estrogen receptor; PR: progesterone receptor

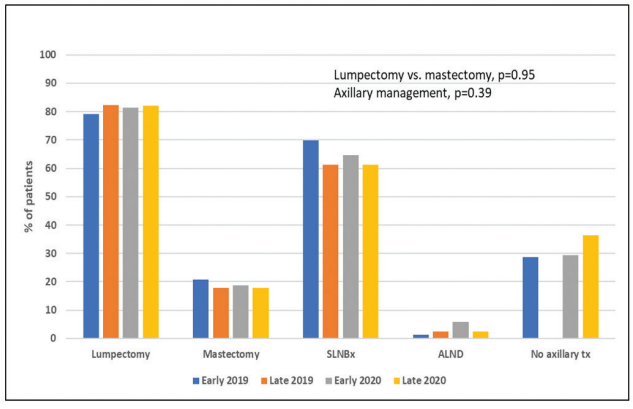
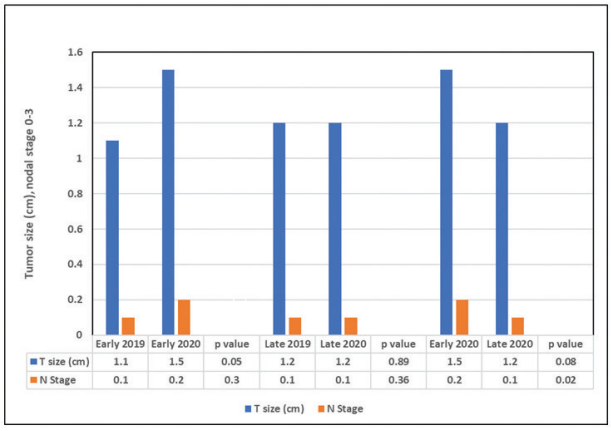


Figure 2. Surgical treatment by study phase



	Early 2019	Early 2020	p value	Late 2019	Late 2020	p value	Early 2020	Late 2020	p value
T size (cm)	1.1	1.5	0.05	1.2	1.2	0.89	1.5	1.2	0.08
N Stage	0.1	0.2	0.3	0.1	0.1	0.36	0.2	0.1	0.02

Figure 3. Tumor size and nodal status by study phase

There was no difference in tumor type, grade or receptor status when compared to the tumors diagnosed the previous year, but a slightly larger tumor size was observed among the new diagnoses during the pandemic (average T-stage of 1.5 *versus* 1.1, $p = 0.05$, Table 2 and Figure 3) although analysis of the entire cohort included in the study did not show significance ($p = 0.24$, Table 1).

During Early phase 2020, patients were more likely to be treated with neoadjuvant therapy (37.0 *versus* 17.0%, $p = 0.03$). There was no difference between the type of neoadjuvant treatment that was chosen (endocrine versus chemotherapy, $p = 0.67$). Only 6 out of 21 patients (21.4%) who were ER positive agreed to take endocrine therapy during the deferral period. There was no difference in surgical treatment of the breast or the axilla when surgery was eventually performed (Table 2).

Screening mammography resumed in the latter part of 2020 and was compared to the same time period the previous year (Late phase 2019 to 2020, Table 3). Patients diagnosed with breast cancer in the second half of 2020 were older than those diagnosed the year before (64 *versus* 61.5 years, $p = 0.04$). All other clinical characteristics, T- and N- stage and treatment types were similar.

When Early phase 2020 was compared to Late phase 2020 (Table 4), patients who presented with breast cancer in the first part of the year were younger (54.8 *versus* 64 years, $p<0.01$). HER2 positivity was higher in Early phase 2020 (11.5 *versus* 8.2%, $p = 0.02$) but there were no differences in grade or hormone receptor status between groups. The average N stage was higher when compared to after resumption of screening (0.2 *versus* 0.1, $p = 0.02$) but this did not increase use of axillary node dissection ($p = 0.39$). Neoadjuvant therapy was recommended in 37.0% of cases during the Early phase 2020 compared with 17.0% during the Late phase 2020 ($p = 0.01$).

Discussion and Conclusion

The abrupt cessation of screening imaging and elective procedures immediately caused concern about worse cancer outcomes. Within one week of the lockdown, a strategy was developed locally to address management of new cancer patients by optimizing use of endocrine therapy where possible until the COVID-19 Pandemic Breast Cancer Consortium recommendations were released (11). Other guidelines were generated over the next several months that supported similar strategies (12-14).

During the Early phase 2020, which represents our time of strict COVID lockdown, we observed a decrease in the number of patients with a new breast cancer diagnosis. As expected, all newly diagnosed cancers were self-detected with a statistically significant difference in mean tumor size. It is not surprising that more of these self-palpated cancers were HER2 positive which is indicative of a more aggressive subtype. We hypothesize that patients, upon learning about the pause of routine screening, were more likely than before to perform a self-examination and, as a result, were noticing these tumors. Once routine screening resumed, however, no significant difference in tumor size was seen between patients whose cancers were detected by imaging compared to self-examination.

Neoadjuvant therapy was recommended more often in the first phase, as surgeries including for oncologic reasons were halted at this time. The impact of delay to surgical treatment in breast cancer patients has been studied in large datasets and is predicted to result in worse all-cause mortality (15, 16). The effects of the pandemic-related

treatment delays on survival and recurrence in patients who chose to decline neoadjuvant endocrine therapy, as was our experience, will have to be further evaluated in the future. In Late phase 2020, it was determined that breast surgery could occur safely (17, 18). Oncologic teams resumed pre-pandemic protocols which allowed most patients to have surgery as a first treatment.

Similar to our local experience, screening mammography rates nationally increased and remain elevated once moratoriums were removed despite the persistence of COVID, although underserved populations are less likely to resume screening or more likely to cancel and not reschedule (19-21). We planned for the resumption of screening almost as soon as the moratorium started, due to recognition of the importance of planning and messaging (22, 23).

Table 2. Comparison of patient and breast cancer characteristics Early phase 2019 to Early phase 2020

	Phase 1 2019	Phase 1 2020	*p*-value
n (%)	88 (76.5)	27 (23.5)	
Age, mean (SD)	60.0 (14.6)	54.8 (18.6)	0.13
BMI, median (IQR)	28.1 (8.7)	30.6 (13.1)	0.05
***** Method of Detection**	*******	*******	*******
Method of detection, n (%)			
None	0 (0.0)	0 (0.0)	
Imaging	63 (71.6)	0 (0.0)	
Self-detected	25 (28.4)	27 (100.0)	
Clinically detected	0 (0.0)	0 (0.0)	<0.01
***** Cancer Specific Data**			
Grade, n (%)			
Grade 1	25 (31.3)	6 (26.1)	
Grade 2	38 (47.5)	8 (34.8)	0.22
Grade 3	17 (21.3)	9 (39.1)	
Tumor Specific Data			
ER positive status, n (%)	68 (84.0)	21 (80.8)	0.71
PR positive status, n (%)	58 (71.6)	18 (69.2)	0.82
HER2 positivity, n (%)	8 (9.9)	3 (11.5)	0.35
Stage			
Clinical T-stage, mean (SD)	1.1 (0.8)	1.5 (1.1)	0.05
Clinical N-stage, mean (SD)	0.1 (0.3)	0.2 (0.6)	0.30
Distant metastases present, n (%)	2 (2.3)	1 (3.7)	0.68
***** Treatment Data**	*******	*******	*******
Initial treatment recommendation, n (%)			
Surgery first	73 (83.0)	17 (63.0)	
Neoadjuvant therapy	15 (17.0)	10 (37.0)	0.03
Type of neoadjuvant therapy, n (%)			
Chemotherapy	14 (93.3)	9 (90.0)	
Endocrine therapy	1 (6.7)	1 (10.0)	0.76
Ultimate surgical treatment of breast, n (%)			
Lumpectomy	57 (79.2)	13 (81.3)	
Mastectomy	15 (20.8)	3 (18.8)	0.85
Ultimate surgical treatment of axilla, n (%)			
Sentinel node biopsy	51 (69.9)	11 (64.7)	
Axillary dissection	1 (1.4)	1 (5.9)	
None	21 (28.8)	5 (29.4)	0.52

BMI: Body Mass Index; SD: standard deviation; IQR: interquartile range; HER2: human epidermal growth factor receptor 2; ER: estrogen receptor; PR: progesterone receptor

Nearly the same number of mammograms were performed in 2020 as in 2019 using extended hours and weekend schedules to accommodate social distancing guidelines and the backlog patients. Our institution diagnosed 279 patients with breast cancer during the pandemic in 2020, 92% of the number of patients diagnosed in 2019 and less of a decrease than we had feared.

Once screening imaging or routine clinical examination is not available, patients become reliant on self-examination for cancer detection. During the Early phase 2020, the time of strict COVID lockdown, the number of patients presenting with a new cancer diagnosis decreased as all newly diagnosed cancers were self-detected. A small, statistically significant difference was seen in mean tumor size, but this did not impact ultimate surgical treatment. No significant difference in tumor

Table 3. Comparison of patient and breast cancer characteristics: Late phase 2019 *versus* Late phase 2020

	Phase 2 2019	**Phase 2 2020**	***p*-value**
n (%)	216 (46.2)	252 (53.8)	
Age, mean (SD)	61.5 (13.2)	64.0 (13.1)	0.04
BMI, median (IQR)	29.2 (9.2)	28.2 (8.7)	0.49
***** Method of Detection**	*******	*******	*******
None	1 (0.5)	2 (0.8)	
Imaging	141 (65.3)	188 (74.6)	
Self-detected	65 (30.1)	56 (22.2)	
Clinically detected	9 (4.2)	6 (2.4)	0.13
***** Cancer Specific Data**	*******	*******	*******
Grade, n (%)			
Grade 1	71 (34.6)	73 (33.5)	
Grade 2	81 (39.5)	92 (42.2)	
Grade 3	53 (25.9)	53 (24.3)	0.85
Tumor Specific Data			
ER positive status, n (%)	175 (83.7)	196 (85.6)	0.59
PR positive status, n (%)	153 (73.2)	162 (71.1)	0.62
HER2 positivity, n (%)	25 (11.9)	18 (8.2)	0.32
Stage			
Clinical T-stage, mean (SD)	1.2 (0.8)	1.2 (0.9)	0.89
Clinical N-stage, mean (SD)	0.1 (0.3)	0.1 (0.3)	0.36
Distant metastases present, n (%)	3 (1.4)	6 (2.4)	0.43
***** Treatment Data**	*******	*******	*******
Initial treatment recommendation, n (%)			
Surgery first	178 (82.4)	209 (82.9)	
Neoadjuvant therapy	38 (17.6)	43 (17.1)	0.88
Type of neoadjuvant therapy, n (%)			
Chemotherapy	32 (82.1)	36 (81.8)	
Endocrine therapy	7 (17.9)	8 (18.2)	0.98
Ultimate surgical treatment of breast, n (%)			
Lumpectomy	146 (80.7)	171 (82.2)	
Mastectomy	35 (19.3)	37 (17.8)	0.69
Ultimate surgical treatment of axilla, n (%)			
Sentinel node biopsy	111 (61.0)	128 (61.2)	
Axillary dissection	1 (0.5)	5 (2.4)	
Completion axillary dissection	2 (1.1)	0 (0.0)	
None	68 (37.4)	76 (36.4)	0.21

BMI: Body Mass Index; SD: standard deviation; IQR: interquartile range; HER2: human epidermal growth factor receptor 2; ER: estrogen receptor; PR: progesterone receptor

size was seen between patients whose cancers were detected by imaging compared to self-examination once imaging was performed. In Late phase 2020, care returned to normal and most patients underwent surgery first when it was found that breast surgery could occur safely (17, 18).

Tonneson et al. (24) did not see a difference in the stage of presentation when looking at patients who presented between March and August 2020. We were able to also look at patients in the six months after screening resumed to determine if there was any difference in presentation. Sensitivity analysis revealed a marginal difference in T-stage (1.5 *versus* 1.1, $p = 0.08$) and a small but statistically significant difference in N stage (0.2 *versus* 0.1, $p = 0.02$). Ultimately, we did not see a resulting difference between lumpectomy and mastectomy rates, nor was there a difference in axillary treatment (Figure 2).

Early-stage breast cancer diagnosis relies on effective screening programs, facilitates greater rates of breast conservation and allows some women to avoid radiation and axillary sentinel node biopsy as part of the Choosing Wisely campaign (25-27). A logical consequence

Table 4. Comparison of patient and breast cancer characteristics: Early phase 2020 *versus* Late phase 2020

	Phase 1 2020	Phase 2 2020	p-value
n (%)	27 (9.7)	252 (90.3)	
Age, mean (SD)	54.8 (18.6)	64.0 (13.1)	<0.01
BMI, median (IQR)	30.6 (13.1)	28.2 (8.7)	0.06
***** Method of Detection**	*******	*******	*******
Method of Detection, n (%)			
None	0 (0.0)	2 (0.8)	
Imaging	0 (0.0)	188 (74.6)	
Self-detected	27 (100.0)	56 (22.2)	
Clinically detected	0 (0.0)	6 (2.4)	<0.01
***** Cancer Specific Data**	*******	*******	*******
Grade, n (%)			
Grade 1	6 (26.1)	73 (33.5)	
Grade 2	8 (34.8)	92 (42.2)	
Grade 3	9 (39.1)	53 (24.3)	0.30
Tumor Specific Data			
ER positive status, n (%)	21 (80.8)	196 (85.6)	0.51
PR positive status, n (%)	18 (69.2)	162 (71.1)	0.85
HER2 positivity, n (%)	3 (11.5)	18 (8.2)	0.02
Stage			
Clinical T-stage, mean (SD)	1.5 (1.1)	1.2 (0.9)	0.08
Clinical N-stage, mean (SD)	0.2 (0.6)	0.1 (0.3)	0.02
Distant metastases present, n (%)	1 (3.7)	6 (2.4)	0.68
***** Treatment Data**	*******	*******	*******
Initial treatment recommendation, n (%)			
Surgery first	17 (63.0)	209 (82.9)	
Neoadjuvant therapy	10 (37.0)	43 (17.1)	0.01
Type of neoadjuvant therapy, n (%)			
Chemotherapy	9 (90.0)	36 (81.8)	
Endocrine therapy	1 (10.0)	8 (18.2)	0.53
Ultimate surgical treatment of breast, n (%)			
Lumpectomy	13 (81.3)	171 (82.2)	
Mastectomy	3 (18.8)	37 (17.8)	0.92
Ultimate surgical treatment of axilla, n (%)			
Sentinel node biopsy	11 (64.7)	128 (61.2)	
Axillary dissection	1 (5.9)	5 (2.4)	
None	5 (29.4)	76 (36.4)	0.62

BMI: Body Mass Index; SD: standard deviation; IQR: interquartile range; HER2: human epidermal growth factor receptor 2; ER: estrogen receptor; PR: progesterone receptor

of delayed screening during the pandemic would be a subsequent increase in mastectomy rates in the setting of higher numbers of palpable advanced stage cancers, for which breast conservation is not an option. Although other studies have shown an impact on surgery (28, 29), we did not observe that impact.

It should be noted, however, that the findings of this study do not negate or refute the established data on the mortality reduction seen with established screening mammography protocols. Our data reflects short-term mammography cessation of three months and supports the need for quick resumption of screening to prevent longer delays in cancer detection. Even a short period of screening stoppage can result in a longer delay to presentation due to patient hesitance. Studies that look at longer interruptions in screening showed significantly worse alterations in both stage and surgical treatment (30). Concerns about the need for a proactive approach by radiology to ensure timely screening resumption are well documented (31).

This study reflects a single institution's experience with breast cancer and the moratorium against screening imaging during the initial phases of the COVID-19 pandemic. As a result, the single institution design limits generalizability and small numbers preclude discrete statistical analysis.

Despite these limitations, our study adds important information and raises points for discussion. It may be appropriate to revisit the recommendation to avoid self-examination, as it can be a very valuable tool to detect new breast cancer, especially when routine screening is not available. Our study contributes valuable data to evaluate the impact of short interruptions to breast cancer radiology screening on stage at diagnosis. We did not see any difference between lumpectomy and mastectomy rates or axillary management when comparing Early or Late phase by years or by yearly totals themselves. At the time of manuscript preparation, there was no published literature specifically evaluating the impact of the pandemic on breast conservation rates or axillary management with such a short interval of screening deferment; thus, this paper is additive to available information. The implications of these findings are still unclear. Distinct differences in cancer presentation during the initial pandemic phase were observed, but these did not appear to be associated with clinically significant differences in treatment. Additional long-term follow-up is necessary to determine the impact of this screening moratorium and the resulting treatment delays on breast cancer recurrence and survival.

In conclusion, patients who presented with breast cancer during the COVID-19 pandemic in the absence of screening mammography were more likely to be younger, have a higher BMI, present with HER2 positive cancers, be node positive, and receive neoadjuvant treatment most commonly with endocrine therapy. Despite these differences, ultimate surgical management was not impacted by pandemic-related screening cessation.

Ethics Committee Approval: No ethical approval was obtained because this study did not involve a prospective evaluation, did not involve laboratory animals and only involved non-invasive procedures (e.g. faecal samples, voided urine etc).

Informed Consent: Retrospective study.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: H.M., D.J.; Conception: H.M., A.K.F., D.J.; Design: H.M., D.J., A.P.C.; Data Collection: H.M., D.J., S.N.; Analysis or Interpretation: J.C., H.M., D.J., S.N., A.P.C.; Literature Search: H.M., S.N., D.J.; Writing: H.M., D.J., J.C., S.N.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

References

1. CDC. Museum Covid-19 Timeline. *Centers for Disease Control and Prevention.* Centers for Disease Control and Prevention. 2021. [Crossref]
2. First Presumptive Positive Case of COVID-19 Identified by Massachusetts State Public Health Laboratory. *Mass.gov,* Commonwealth of Massachusetts. 2020. [Crossref]
3. Plevritis SK, Munoz D, Kurian AW, Stout NK, Alagoz O, Near AM, et al. Association of Screening and Treatment With Breast Cancer Mortality by Molecular Subtype in US Women, 2000-2012. JAMA 2018; 319: 154-164. Erratum in: JAMA 2018; 319: 724. (PMID: 29318276) [Crossref]
4. Provencher L, Hogue JC, Desbiens C, Poirier B, Poirier E, Boudreau D, et al. Is clinical breast examination important for breast cancer detection? Curr Oncol 2016; 23: e332-e339. (PMID: 27536182) [Crossref]
5. Oeffinger KC, Fontham ET, Etzioni R, Herzig A, Michaelson JS, Shih YC, et al. Breast Cancer Screening for Women at Average Risk: 2015 Guideline Update From the American Cancer Society. JAMA 2015; 314: 1599-1614. Erratum in: JAMA 2016; 315: 1406. (PMID: 26501536) [Crossref]
6. Kösters JP, Gøtzsche PC. Regular self-examination or clinical examination for early detection of breast cancer. Cochrane Database Syst Rev 2003; 2003: CD003373. (PMID: 12804462) [Crossref]
7. Yong JH, Mainprize JG, Yaffe MJ, Ruan Y, Poirier AE, Coldman A, et al. The impact of episodic screening interruption: COVID-19 and population-based cancer screening in Canada. J Med Screen 2021; 28: 100-107. (PMID: 33241760) [Crossref]
8. Maringe C, Spicer J, Morris M, Purushotham A, Nolte E, Sullivan R, et al. The impact of the COVID-19 pandemic on cancer deaths due to delays in diagnosis in England, UK: a national, population-based, modelling study. Lancet Oncol 2020; 21: 1023-1034. Erratum in: Lancet Oncol 2021; 22: e5. (PMID: 32702310) [Crossref]
9. Alagoz O, Lowry KP, Kurian AW, Mandelblatt JS, Ergun MA, Huang H, et al. Impact of the COVID-19 Pandemic on Breast Cancer Mortality in the US: Estimates From Collaborative Simulation Modeling. J Natl Cancer Inst 2021; 113: 1484-1494. (PMID: 34258611) [Crossref]
10. Duffy SW, Seedat F, Kearins O, Press M, Walton J, Myles J, et al. The projected impact of the COVID-19 lockdown on breast cancer deaths in England due to cessation of population screening: a national estimation. Br J Cancer 2022; 126: 1355-1361. (PMID: 35110696) [Crossref]
11. Dietz JR, Moran MS, Isakoff SJ, Kurtzman SH, Willey SC, Burstein HJ, et al. Recommendations for prioritization, treatment, and triage of breast cancer patients during the COVID-19 pandemic. the COVID-19 pandemic breast cancer consortium. Breast Cancer Res Treat 2020; 181: 487-497. (PMID: 32333293) [Crossref]
12. Al-Shamsi HO, Alhazzani W, Alhuraiji A, Coomes EA, Chemaly RF, Almuhanna M, et al. A Practical Approach to the Management of Cancer Patients During the Novel Coronavirus Disease 2019 (COVID-19) Pandemic: An International Collaborative Group. Oncologist 2020; 25: e936-e945. (PMID: 32243668) [Crossref]
13. Curigliano G, Cardoso MJ, Poortmans P, Gentilini O, Pravettoni G, Mazzocco K, et al. Recommendations for triage, prioritization and

treatment of breast cancer patients during the COVID-19 pandemic. Breast 2020; 52: 8-16. (PMID: 32334323) [Crossref]

14. Freedman RA, Sedrak MS, Bellon JR, Block CC, Lin NU, King TA, et al. Weathering the Storm: Managing Older Adults with Breast Cancer Amid COVID-19 and Beyond. J Natl Cancer Inst 2021; 113: 355-359. (PMID: 32449757) [Crossref]
15. Bleicher RJ, Ruth K, Sigurdson ER, Beck JR, Ross E, Wong YN, et al. Time to Surgery and Breast Cancer Survival in the United States. JAMA Oncol 2016; 2: 330-339. Erratum in: JAMA Oncol 2016; 2: 1244. (PMID: 26659430) [Crossref]
16. Degeling K, Baxter NN, Emery J, Jenkins MA, Franchini F, Gibbs P, et al. An inverse stage-shift model to estimate the excess mortality and health economic impact of delayed access to cancer services due to the COVID-19 pandemic. Asia Pac J Clin Oncol 2021; 17: 359-367. (PMID: 33567163) [Crossref]
17. Turan U, Sanal A, Irkorucu O. The reliability of breast cancer surgery in a regional pandemic hospital during the COVID-19 pandemic: Delay or Do? J BUON. 2021; 26: 1379-1385. (PMID: 34564995) [Crossref]
18. Ji C, Singh K, Luther AZ, Agrawal A. Is elective cancer surgery safe during the COVID-19 pandemic? World J Surg 2020; 44: 3207-3211. (PMID: 32766957) [Crossref]
19. Pairawan SS, Olmedo Temich L, de Armas S, Folkerts A, Solomon N, Cora C, et al. Recovery of Screening Mammogram Cancellations During COVID-19. Am Surg 2021; 87: 1651-1655. (PMID: 34628958) [Crossref]
20. Miller MM, Meneveau MO, Rochman CM, Schroen AT, Lattimore CM, Gaspard PA, et al. Impact of the COVID-19 pandemic on breast cancer screening volumes and patient screening behaviors. Breast Cancer Res Treat. 2021; 189: 237-246. (PMID: 34032985) [Crossref]
21. Amorniripanitch N, Chikarmane SA, Bay CP, Giess CS. Patients characteristics related to screening mammography cancellation and rescheduling rates during the COVID-19 pandemic. Clin Imaging 2021; 80: 205-210. (PMID: 34340204) [Crossref]
22. Vanni G, Materazzo M, Pellicciaro M, Ingallinella S, Rho M, Santori F, et al. Breast Cancer and COVID-19: The Effect of Fear on Patients' Decision-making Process. In Vivo 2020; 34(3 Suppl): 1651-1659. (PMID: 32503825) [Crossref]
23. Papautsky EL, Hamlish T. Patient-reported treatment delays in breast cancer care during the COVID-19 pandemic. Breast Cancer Res Treat 2020; 184: 249-254. (PMID: 32772225) [Crossref]
24. Tonneson JE, Hoskin TL, Day CN, Durgan DM, Dilaveri CA, Boughey JC. Impact of the COVID-19 Pandemic on Breast Cancer Stage at Diagnosis, Presentation, and Patient Management. Ann Surg Oncol 2022; 29: 2231-2239. (PMID: 34812981) [Crossref]
25. Martelli G, Miceli R, Daidone MG, Vetrella G, Cerrotta AM, Piromalli D, et al. Axillary dissection versus no axillary dissection in elderly patients with breast cancer and no palpable axillary nodes: results after 15 years of follow-up. Ann Surg Oncol 2011; 18: 125-133. (PMID: 20652755) [Crossref]
26. Sun J, Mathias BJ, Sun W, Fulp WJ, Zhou JM, Laronga C, et al. Is it Wise to Omit Sentinel Node Biopsy in Elderly Patients with Breast Cancer? Ann Surg Oncol 2021; 28: 320-329. (PMID: 32613363) [Crossref]
27. Welsh JL, Hoskin TL, Day CN, Habermann EB, Goetz MP, Boughey JC. Predicting Nodal Positivity in Women 70 Years of Age and Older with Hormone Receptor-Positive Breast Cancer to Aid Incorporation of a Society of Surgical Oncology Choosing Wisely Guideline into Clinical Practice. Ann Surg Oncol 2017; 24: 2881-2888. (PMID: 28766197) [Crossref]
28. Vanni G, Pellicciaro M, Materazzo M, Pedini D, Portarena I, Buonomo C, et al. Advanced Stages and Increased Need for Adjuvant Treatments in Breast Cancer Patients: The Effect of the One-Year COVID-19 Pandemic. Anticancer Res 2021; 41: 2689-2696. (PMID: 33952500) [Crossref]
29. Tang A, Neeman E, Vuong B, Arasu VA, Liu R, Kuehner GE, et al. Care in the time of COVID-19: impact on the diagnosis and treatment of breast cancer in a large, integrated health care system. Breast Cancer Res Treat 2022; 191: 665-675. (PMID: 34988767) [Crossref]
30. Soyder A, Güldoğan N, Isıklar A, Arıbal E, Başaran G. What Has Changed in Patients Aged 65 and over Diagnosed with Breast Cancer during the COVID-19 Pandemic: A Single-Center Experience. Breast Care (Basel) 2022; 55: 1-6. (PMID: 35528628) [Crossref]
31. Yılmaz E, Güldoğan N, Arıbal E. The effect of COVID-19 pandemic on breast imaging: a clinical observations. Diagn Interv Radiol 2020; 26: 603. (PMID: 33044174) [Crossref]