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Barriers to timely surgery for breast cancer in Rwanda

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ABSTRACT

Background: Ensuring timely and high-quality surgery must be a key element of breast cancer control efforts in sub-Saharan Africa. We investigated delays in preoperative care and the impact of on-site versus off-site operation on time to operative treatment of patients with breast cancer at Butaro Cancer Center of Excellence in Rwanda.

Methods: We used a standardized data abstraction form to collect demographic data, clinical characteristics, treatments received, and disease status as of November 2017 for all patients diagnosed with breast cancer at Butaro Cancer Center of Excellence in 2014 to 2015.

Results: From 2014 to 2015, 89 patients were diagnosed with stage I to III breast cancer and treated with curative intent. Of those, 68 (76%) underwent curative breast operations, 12 (14%) were lost to follow-up, 7 (8%) progressed, and 2 declined the recommended operation. Only 32% of patients who underwent operative treatment had the operation within 60 days from diagnosis or last neoadjuvant chemotherapy. Median time to operation was 122 days from biopsy if no neoadjuvant treatments were given and 51 days from last cycle of neoadjuvant chemotherapy. Patients who received no neoadjuvant chemotherapy experienced greater median times to operation at Butaro Cancer Center of Excellence (180 days) than at a referral hospital in Kigali (93 days, $P = .04$). Most patients (60%) experienced a disruption in preoperative care, frequently at the point of surgical referral. Documented reasons for disruptions and delays included patient factors, clinically indicated treatment modifications, and system factors.

Conclusion: We observed frequent delays to operative treatment, disruptions in preoperative care, and loss to follow-up, particularly at the point of surgical referral. There are opportunities to improve breast cancer survival in Rwanda and other low- and middle-income countries through interventions that facilitate more timely surgical care.

Introduction

Breast cancer is an increasingly important cause of morbidity and mortality in sub-Saharan Africa, where most patients present with advanced disease and outcomes are inferior to high-income countries.[1] In recognition of this growing burden, more and more sub-Saharan African countries are developing national control plans to address treatment of breast cancer.[2]

Surgery is the primary treatment for non-metastatic breast cancer. To treat breast cancer effectively, surgical care must be delivered through an integrated, multidisciplinary approach with other treatments as indicated, including chemotherapy, hormonal

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therapy, targeted therapy, and radiation therapy.[3] Given the central role of surgery in the treatment of potentially curable disease, ensuring access to timely, high-quality breast cancer surgery must be a core component of any national strategy for addressing the treatment of breast cancer treatment.[4]

Several studies in low- and middle-income countries (LMICs) have described delays in breast cancer diagnosis, barriers to accessing its care,[5–12] and catastrophic expenses for patients associated with cancer surgery.[13] Despite this problem, there are no studies that specifically examine delays to breast surgery or identify specific challenges in delivering timely, high-quality breast cancer surgery in low-income regions, including sub-Saharan Africa.

Rwanda is a low-income country of 12 million people in East African.[14] Seventy percent of the population live in rural areas, with a heavy reliance on subsistence agriculture.[15] In 2012, the Rwanda Ministry of Health collaborated with the nongovernmental organization Partners In Health, Brigham and Women's Hospital, and Dana-Farber Cancer Institute to open Butaro Cancer Center of Excellence (BCCOE), a dedicated cancer center located within a rural public hospital and Rwanda's first public cancer facility. Breast cancer is the most common malignancy diagnosed and treated at BCCOE. From July 2012 through April 2018, 1,076 patients with breast cancer were treated at BCCOE.

Previously, we assessed treatment quality for patients diagnosed with breast cancer at BCCOE within the first 2 years of the program opening (2012–2013). We found that only 35% of patients diagnosed with potentially curable breast cancer (ie, early-stage or locally advanced disease) underwent operative therapy within 60 days of diagnosis or the end of neoadjuvant chemotherapy.[16] These findings highlighted the need to examine why and when patients in the process of surgical referral experienced delays to the needed operative intervention. We were particularly interested in understanding whether referring patients to other facilities led to more delays because centralization of the operative care of cancer is a strategy implemented across high-income countries and is being advocated for cancer control in LMICs.[4]

We studied the timing and types of operations received by patients diagnosed with breast cancer at BCCOE in 2014 to 2015. We sought to quantify delays to appropriate operative therapy among this cohort, characterize the pathways taken by patients when trying to receive the appropriate operative therapy, identify where on this pathway the disruptions occurred, and determine whether the operation occurred on-site versus off-site and how this affected delays. Understanding barriers to timely surgical care at Rwanda's first public cancer referral facility can guide strategies to improve care in Rwanda and identify challenges that must be addressed to facilitate access to safe, timely, and effective breast cancer surgery in the region.

Methods

Setting and treatment protocols

Breast cancer treatment at BCCOE is provided according to standardized, nationally approved protocols developed collaboratively by international breast cancer experts, BCCOE clinicians, and the Rwanda Ministry of Health.[17] Available systemic treatments include chemotherapy (doxorubicin, cyclophosphamide, and paclitaxel) and hormonal therapy (tamoxifen and letrozole). Targeted therapy for HER2 is not yet available. Before 2018, there was no radiation therapy in Rwanda. In addition, access remains limited for patients with breast cancer. Owing to the advanced presentation of disease and lack of routinely available radiation therapy, the protocols developed in Rwanda recommend that most breast cancer patients undergo modified radical mastectomy, including axillary lymph node dissection.

Surgical capacity at BCCOE is limited by staffing, materials, and infrastructure. During some periods since the opening of BCCOE in 2012, there was no surgeon on staff. Even when a surgeon is on staff, the sole general surgeon is responsible for all general surgical care at this busy district hospital with only one operating room dedicated to general surgery. Surgical services are affected routinely by drug stock-outs, water outages, and other infrastructural limitations. As a result, patients are frequently referred for surgery at Rwanda Military Hospital (RMH), a public referral hospital in Kigali, which has 2 general surgeons in addition to other surgical specialties (eg, orthopedics, gynecology). Partners In Health employs a full-time nurse in Kigali who assists patients referred from BCCOE to RMH with obtaining appointments and managing logistics.

Patient population

We used electronic medical record at BCCOE to identify all patients who received a pathologic diagnosis of breast cancer at BCCOE between January 1, 2014 and December 31, 2015. We excluded patients who had previously received a pathologic diagnosis of or treatment for breast cancer elsewhere.

Data collection

We used a standardized data abstraction form to collect information from paper and electronic medical records at BCCOE. Data were abstracted by 2 co-investigators (L.S. and A.N.). The form gathered patient demographic and clinical characteristics, dates of all visits and types of treatments received, and disease status or loss to follow-up as of November 2017.

Key variables

Main outcomes

Delays to appropriate operative treatment. Limited evidence from high-income settings suggests a survival advantage if operative treatment is performed within 60 days of biopsy when no neoadjuvant treatment is given.[18] If neoadjuvant chemotherapy (NAC) is given, the likelihood of survival may decrease if operative treatment occurs >8 weeks after the end of NAC.[19] No studies to our knowledge have assessed the survival impact of overall time from diagnosis to operative treatment among patients receiving NAC.

There is no consensus regarding the optimal duration of neoadjuvant endocrine treatment (NET) and timing of operative treatment when NET is given.[20] The BCCOE protocol stipulates neoadjuvant tamoxifen may be used as an alternative to neoadjuvant chemotherapy in select patients and recommends an initial trial of 8 weeks, continuing up to 4 months based on tumor response.

Based on the available evidence, we defined delays in operative care as >60 days from the date of biopsy for patients who received no neoadjuvant treatment or from the last cycle of NAC if NAC was received. Owing to limited evidence, we did not define a threshold for delay to operative treatment for patients who received NET.

Disruptions in care. We defined disruptions in care as events resulting in a >7 day delay in receipt of scheduled NAC, a >7 day delay in the date of scheduled operation, or a >30 day delay in a scheduled visit for NET (endocrine therapy is typically only provided to patients at scheduled follow-up visits). We also considered as disruptions in care any missed visit for surgical evaluation or operation and changes in clinical status other than progression (eg,

pregnancy), which require modifications to the treatment plan. Reasons for treatment disruptions were collected where available; however, these were not documented consistently in the medical record.

Patient and treatment characteristics

Stage and treatment intent. Patients were staged with physical exam and either chest x-ray and abdominal ultrasonography or computed tomography) according to the staging manual of the American Joint Committee on Cancer, seventh edition.[21] Initial treatment intent was determined by the treatment plan established at the first visit after diagnosis.

Type of operative treatment. We were unable to consistently verify the type of breast operation received and whether axillary lymph node dissection was performed because operative reports from other hospitals were not accessible for data abstraction; however, surgical pathology reports were reviewed to determine whether axillary lymph nodes were present in the specimen and examined.

Surgical facility. We identified whether the operations were performed at BCCOE, RMH, or another facility.

Data Analysis

We characterized the sequence of treatments received by each patient and grouped patients into the following 4 trajectories of preoperative care: no neoadjuvant treatment, NAC only, NET only, and NET then NAC in sequence. We identified when disruptions in preoperative care occurred and classified documented reasons for disruptions in care as related to patient factors, system factors, and clinical indications.

Time to operation was analyzed using descriptive statistics to determine the proportion of patients who experienced clinically important delays. We compared median days to operation for patients whose operations were performed at BCCOE versus RMH using Wilcoxon rank-sum tests.

Ethics statement

This study was approved by the Rwanda National Ethics Committee and the Institutional Review Board of Partners HealthCare.

Results

Patients and clinical presentation

Between 2014 to 2015, 151 patients were diagnosed with breast cancer at BCCOE. Of these, 97 patients (64%) had stage I to III disease, 45 (30%) were metastatic on presentation, and 9 (6%) had unknown stage (Table I).

Of the 146 patients with known estrogen receptor status, 101 (69%) were estrogen receptor- positive. Of the 98 patients with known HER2 status, 39 (40%) had HER-positive disease (Table I). Progesterone receptor status was not assessed routinely.

Treatments received

Of the 151 patients diagnosed with breast cancer, 92 (61%) were treated initially with curative intent, including 2 patients with stage IV breast cancer and one with unknown stage who had incomplete staging at the time of initiation of treatment. Forty-three patients (28%) were treated initially with palliative intent, including 7 patients with inoperable stage III breast cancer. Sixteen patients (11%) did not return after undergoing biopsy, including 1 with stage III cancer (Table I).

Table I
Patient and tumor characteristics and breast cancer treatments received

Patient characteristic	*n*	%
Sex		
Female	144	95%
Male	7	5%
Age		
Median (range)	54 (27–84)	
Clinical stage		
I	3	2%
II	37	25%
III	57	38%
IV	45	30%
Unknown	9	6%
Receptor status		
Estrogen receptor status known	146	97%
Positive	101	69%
Negative	45	31%
HER2 receptor status known	98	65%
Positive	39	40%
Equivocal	6	6%
Negative	53	54%
Initial treatment intent		
Curative*	92	61%
Palliative	43	28%
Not specified (did not return after biopsy)	16	11%
Breast surgery among patients with stages I–III breast cancer treated with curative intent ($n = 89$)		
Breast surgery received	68	76%
Operative therapy recommended but declined by patient	2	2%
Lost to follow-up before operation	12	13%
Disease progression before operation	7	8%
Neoadjuvant and adjuvant systemic treatment among patients who received breast surgery with curative intent ($n = 68$)†		
Neoadjuvant endocrine therapy	29	43%
Neoadjuvant chemotherapy	23	34%
No neoadjuvant therapy	24	35%
Adjuvant endocrine therapy	46	68%
Adjuvant chemotherapy	42	62%
No adjuvant therapy	11	16%

* Includes 2 patients with unknown stage, and 1 patient with stage IV disease who initiated treatment before completing staging.

† Some patients had more than one neoadjuvant or adjuvant treatment modality.

A majority of the 89 patients with stages I to III disease who were treated with initial curative intent received some neoadjuvant treatment—either tamoxifen alone (33%), chemotherapy alone (28%), or both in sequence (10%; Fig 1). Ultimately, 68 patients (76%) underwent curative breast operations. Of the 21 patients initially eligible for curative treatment who did not undergo definitive breast surgery, 2 refused the recommended operative treatment, 12 were lost to follow-up, and 7 had documented progression of the disease (Table I).

Postoperatively, of the 68 patients who underwent operations, 31 (46%) received adjuvant chemotherapy followed by endocrine therapy (tamoxifen and/or letrozole), 15 (22%) received adjuvant endocrine therapy alone, 11 (16%) received adjuvant chemotherapy alone, and 11 (16%) received no adjuvant therapy (Table I).

Surgical care

Surgical facility

A minority of operations ($n = 24$, 35%) were performed on-site at BCCOE. Most patients ($n = 42$, 62%) received their operative treatment of the breast cancer at RMH; the remaining 2 patients underwent operation at the University Teaching Hospital in Kigali and the Kisoro Hospital in Uganda.

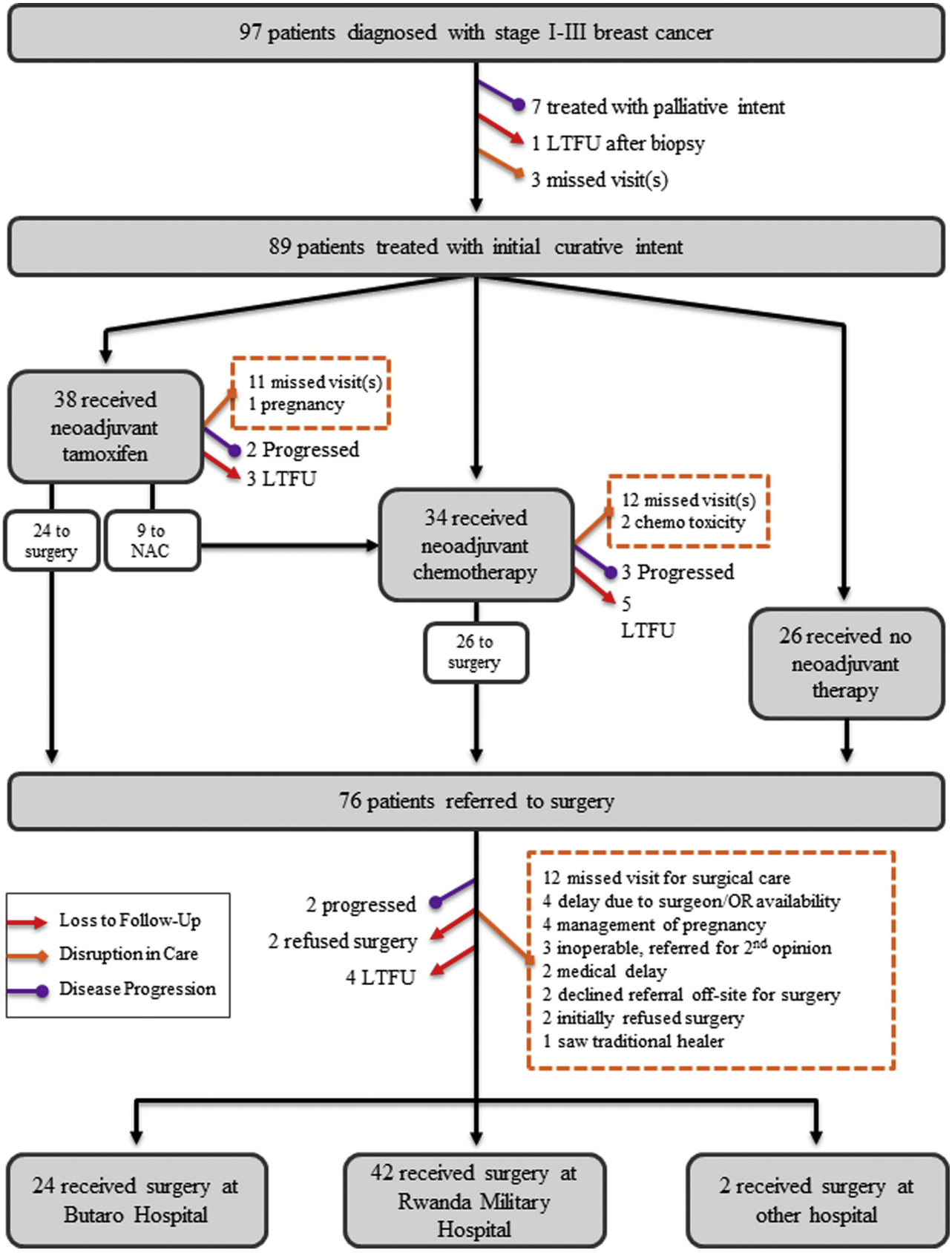

Fig 1. Timing of interruption, progression and LTFU during preoperative trajectory of care. *LTFU*, lost to follow-up; *NAC*, neoadjuvant chemotherapy.

Table II
Time to the recommended breast operation by surgical facility for patients diagnosed at BCCOE

Time interval	Treatment received prior to surgery	Facility	*n*	Days to surgery median (interquartile range)	Percentage ≤60 days	Percentage ≤90 days	Percentage ≤120 days	*P* value*
Biopsy to operation	None	All	24	122 (76–178)	8%	38%	50 %	
		BCCOE	7	180 (147–224)	14%	14%	14%	.04
		RMH	16	93 (76–132)	6%	50%	69%	
End of NAC to operation	NAC ± NET	All	23	51 (30–88)	57%	74%	83%	
		BCCOE	9	35 (31–69)	67%	89%	89%	.41
		RMH	14	67 (28–102)	50%	64%	79%	

* Wilcoxon rank-sum tests comparing days to operation among patients who had their operation at BCCOE versus RMH.

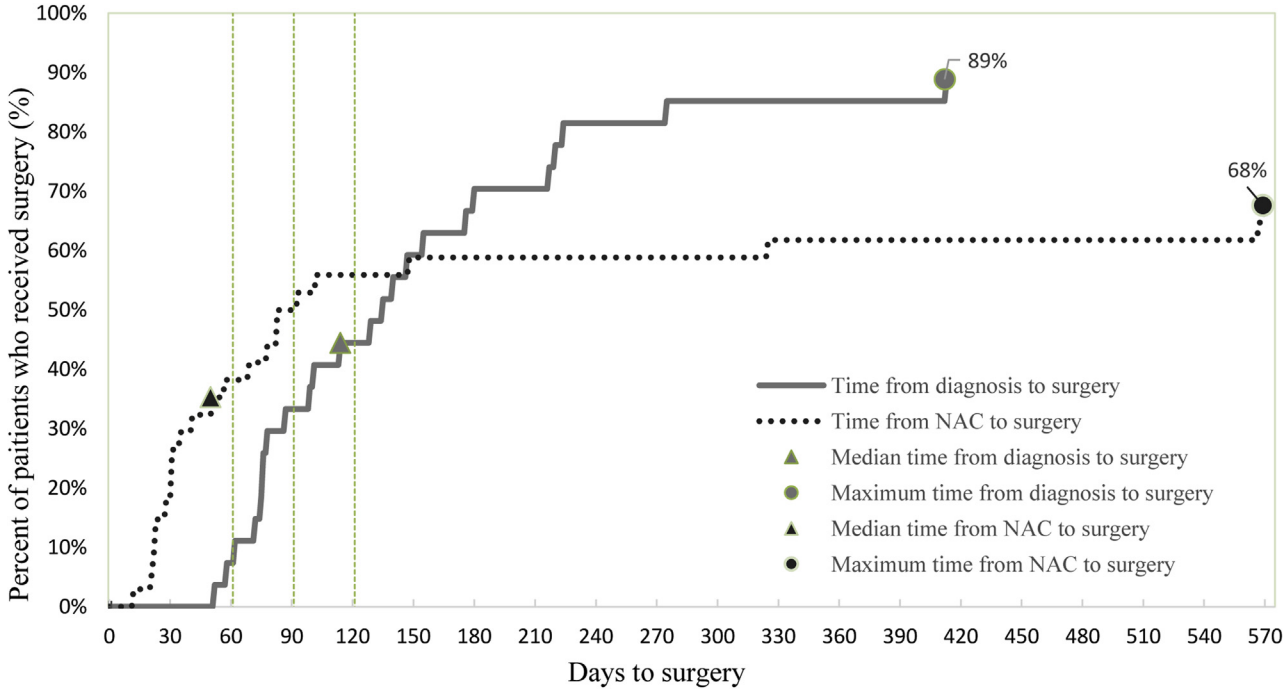

Fig 2. Time from biopsy to operation among patients treated with curative intent who received no neoadjuvant therapy ($n = 26$) or from last cycle of NAC among patients who received NAC ($n = 35$). *NAC*, neoadjuvant chemotherapy.

Type of operation

Surgical pathology reports were available in BCCOE records for 47 of 68 breast operations performed (69%); of the available reports, 42 (89%) reported at least one lymph node identified in the specimen.

Time to operation

Median time to operation and proportion of patients receiving timely operative therapy are presented in Table II and Figure 2. Total time from biopsy to operation for all patients is presented in Appendix A. Overall, 32% of patients underwent operations within the optimal time frame of 60 days from biopsy (if no neoadjuvant treatments were given) or last cycle of NAC.

For patients who received no neoadjuvant treatment, median time from biopsy to operation was 122 days (range 52–413); only 8% had operations within 60 days from biopsy, and 50% experienced a delay of >120 days from biopsy to appropriate operative treatment. Of note, the median time from biopsy to pathology report in this group was 23 days (0–73); 42% of patients had operations within 60 days from the date of the pathology report.

For patients who received NAC, median time from last cycle of NAC to operation was 51 days (range 12–570); 57% had operations within 60 days from last NAC, and 17% had time to operation of >120 days from last NAC.

Median time from biopsy to operation was greater among patients whose operations were performed at BCCOE (180 days) compared with RMH (93 days, $P = .04$) among patients who received no neoadjuvant treatment. In contrast, among patients who received NAC, the median time from last cycle of NAC to operation was not different for patients whose operations were performed at BCCOE (35 days) compared with RMH (67 days; $P = .4$).

Disruptions in care

Figure 1 depicts the treatments received and timing of disruptions, progression, and loss to follow-up for the 97 patients diagnosed with stages I to III cancer at BCCOE from diagnosis through operative treatment. Of the 89 stages I to III patients treated with initial curative intent, 53 (60%) experienced at least one documented disruption in care or became lost to follow-up before operative treatment. Of the 76 patients referred for operative care, 76 (37%) experienced one or more disruptions in care at the point of surgical referral. More than half of the 68 patients who ultimately underwent operations ($n = 33$, 54%) had experienced at least one documented disruption in care before operation. Seven patients initially referred to BCCOE for operative therapy were re-referred

and underwent operations at RMH after a disruption in care, and 2 patients initially referred to RMH underwent operations at BCCOE. Fourteen patients (34%) receiving NAC experienced a disruption in scheduled chemotherapy, and 12 patients (32%) receiving NET experienced a disruption in treatment with NET. Thirteen of the 89 patients in our study cohort (15%) experienced treatment disruptions at multiple time points along the preoperative trajectory of care.

Documented reasons for disruptions in care are shown in Table III. The reasons for disruptions in care are documented in the medical record in 26 patients. Patient factors were the most frequently documented reasons, including social and financial issues ($n = 9$), refusing operation ($n = 4$), and refusing referral for off-site operative treatment ($n = 2$). Only one treatment disruption was attributed to a patient seeking traditional medicine instead of operative therapy. Of the 4 patients documented as refusing operation, 2 continued to receive neoadjuvant treatments and ultimately underwent operation. Clinical indications that resulted in a disruption of care included pregnancy ($n = 5$), toxicity of the chemotherapy ($n = 3$), referral to RMH for a second opinion when the BCCOE surgeon declined to operate ($n = 3$), and other medical conditions requiring treatment (malaria, thrombocytopenia, and venous thrombosis). System delays owing to limited availability of the surgeon or operating room were documented in the medical record for 5 patients.

Table III
Documented reasons for disruptions in care* ($n = 44$†)

Patient factors ($n = 14$)	Financial/social issues	9
	Seeking traditional medicine	1
	Seeking care abroad	1
	Patient refused breast surgery	4
	Patient refused referral for off-site operative treatment	2
System factors ($n = 5$)	Surgeon/operating room availability	5
Clinical indications ($n = 13$)	Management of pregnancy	5
	Inoperable, referred for second opinion	3
	Chemotherapy toxicity	3
	Other medical delay	4
Unknown ($n = 27$)	Reason not documented	27

* Disruptions in care were defined as events causing delays of >7 days for scheduled neoadjuvant chemotherapy operation, >30 days for receipt of neoadjuvant endocrine therapy, any missed visit for surgical evaluation, or any change in clinical status other than progression requiring modification of treatment plan.
† Some patients had multiple disruptions in care or disruptions were attributable to multiple factors.

Discussion

This study examined barriers to timely operative care among patients diagnosed with breast cancer at the first public cancer referral center in Rwanda. We found that only 32% of patients diagnosed with stages I to III breast cancer in 2014 to 2015 received breast surgery within 60 days of biopsy or the last cycle of NAC. This delay is similar to our findings among patients diagnosed in 2012 to 2013.[16] Disruptions in preoperative care were common, and 13% of patients treated with curative intent were lost to follow-up before any operative treatment. Contrary to our hypothesis, receiving operative care on site was not associated with lesser time to operation.

We observed a large difference in rates of timely operative intervention between patients referred directly from diagnosis (of whom only 8% had operative therapy within 60 days of biopsy) versus patients referred for operative treatment after NAC (among whom 57% had their operation within 60 days of last cycle of NAC). Part of this difference reflects the turnaround time in pathology (ie, the time from biopsy to pathology report, which was a median of 23 days for this cohort). Pathology turnaround time would only contribute to the time interval to appropriate operative care among patients who received no neoadjuvant treatments. Efforts to increase pathology capacity on site since BCCOE opened in 2012 successfully reduced pathology turnaround time to 5 days for specimens examined on-site at BCCOE as of 2015.[22] In contrast, when we measured the percentage of patients without neoadjuvant treatment who underwent operative therapy within 60 days of the pathology report (excluding the contribution of turnaround times), only 42% met this threshold for timeliness compared with the proportion of patients receiving NAC who had timely operations after receiving their last cycle (57%). This persistent difference may reflect the opportunity for surgical planning, counseling, and coordination provided during NAC because surgical evaluation and scheduling may be facilitated concurrently with NAC to decrease wait time for surgery after NAC is complete. Furthermore, it suggests that decreasing pathology turnaround time is necessary, but not sufficient to eliminate delays between diagnosis and operation.

We had anticipated that receiving surgical care at the same facility where diagnosis and neoadjuvant treatments are delivered would be associated with less time to definitive operative therapy. But, in our cohort, the opposite was true for patients not receiving neoadjuvant treatment. Patients who received no neoadjuvant treatments and underwent operations at RMH in Kigali had significantly lesser time to operation than those who underwent operations at BCCOE. In contrast, among patients who received NAC, those who underwent operations at BCCOE had similar time to operation compared to those who underwent operations at RMH.

At BCCOE during our study period, surgical capacity was limited by inconsistent availability of a surgeon on site and competing priorities. At RMH, greater surgical capacity permits the team of general surgeons to meet the acute surgical needs in a timelier manner while also prioritizing scheduling of elective cancer procedures. Although referring patients to another facility for operative care poses challenges for coordination of care, our findings suggest that referring patients for definitive operative care at hospitals with greater surgical capacity may enable more timely scheduling when on-site capacity is limited. Given the substantial delays to operation that we observed, additional research is needed to assess how centralizing cancer care will impact the timeliness and quality of cancer surgery in LMICs.

Reasons for delays and disruptions in care

Among the patients for whom reasons for delays and disruptions were documented, financial and social barriers were common despite several very helpful programs that seek to minimize financial barriers to care at BCCOE; these programs include a robust national health insurance system, free cancer medications, and financial support for transportation expenses. This finding is consistent with a study from Haiti demonstrating that high out-of-pocket costs can pose a huge, often insurmountable barrier even in settings where cancer care is ostensibly free.[23]

In our study, 4 patients were documented as refusing recommended breast surgery (5% of those referred). Two of them ultimately underwent operations, suggesting that with appropriate counseling, patients who initially refuse mastectomy may reconsider. Although traditional medicine is in widespread use in Rwanda, only one patient had a delay attributed to seeking traditional medicine instead of the recommended breast surgery.

Some observed delays were attributed to clinical circumstances requiring changes in treatment protocols, including 5 pregnancies. Pregnancy-associated breast cancer and pregnancies that occur during breast cancer treatment are a particularly relevant and very

real issue in sub-Saharan Africa, where patients with breast cancer tend to be younger than in high-income countries.[1,24]

Implications for strategies to decrease delays

Our findings revealed several opportunities for improving a more timely access to breast surgery. First, increasing surgical oncology capacity by expanding general surgical capacity at centers like BCCOE or dedicating general surgery resources (eg, operating room time, surgeon and anesthesia time, and surgical beds) at referral hospitals to surgical oncology care has the potential to decrease the wait times for definitive operative care.

Second, delivery of efficient, multidisciplinary cancer care requires close communication and shared record-keeping between medical and surgical providers, regardless of where the surgical care occurs. Although our study did not capture direct communication between providers, the limited documentation in BCCOE records regarding surgical care provided outside of BCCOE, for example, to confirm the type of operation performed, limits a better understanding of surgical care provided and the challenges of local surgical capacity. Implementing a system to track patients who are referred for definitive operative therapy would help identify those who do not receive it and enable timely outreach. BCCOE is transitioning to a more extensive electronic medical record which would facilitate information-sharing and examination of the quality of care delivered in the future.

Furthermore, our findings suggest that in settings where limited operative capacity prolongs time to operation, provision of chemotherapy preoperatively rather than postoperatively can provide time for multidisciplinary coordination and facilitate timely operative care, as long as delays and disruptions in NAC provision are minimized. This strategy of altering treatment sequencing based on local resource constraints has been employed elsewhere to decrease time to the initiation of operative treatment.[25]

Third, pathology services are integral to cancer care and are often under-developed in LMICs owing to the constraints of both resources and personnel. Decreasing pathology turnaround time by increasing local pathology capacity is necessary to decrease time from diagnosis to operation, although our findings demonstrate that these efforts should be just one part of a multidimensional approach. Our ongoing evaluation of care quality at BCCOE will allow us to investigate further the degree to which further improvements in pathology turnaround times in recent years affect the timeliness of definitive operative care.

Lastly, our study suggests there may be an important role for patient navigation and psychosocial and financial support in minimizing those patients lost to follow-up and optimizing timely operative care. Peer support and survivor groups for patient education and accompaniment could be one strategy to ease concerns about mastectomy and decrease loss to follow-up.

Limitations

Our study has several limitations. First, the information available in medical records was often incomplete. Reasons for delays and disruptions were not recorded routinely. Furthermore, some treatment information was missing from medical records, in part because of care that occurred in different locations. Thirty-one percent (31%) of charts were missing surgical pathology reports, and we were unable to access operative reports for operations performed off site to verify the exact type of operation performed.

Second, our assessments of timely operative therapy were limited by the availability of evidence-based metrics. For example, we were unable to evaluate the timeliness of operation for the 21% of patients who received only NET. Although there is mounting evidence supporting use of NET, there is no consensus on the optimal duration of treatment.[20] Additional studies to determine the optimal role of NET in breast cancer care in LMICs would be beneficial. In addition, several patients were classified as having timely operations within 60 days of last NAC, but experienced long disruptions in care before and during neoadjuvant treatment.

Third, our ability to retrospectively identify reasons for observed delays was limited to the documentation available in individual patient records. Patient factors and clinical indications are more likely to be documented than system-related factors. This constraint particularly limited our understanding of the role of system and facility-related factors.

Finally, our study did not examine the impact of delays on survival. Research is underway in a larger cohort to examine the impact of the quality of care of breast cancer, including timely definitive operative therapy, on breast cancer survival at BCCOE.

We observed frequent delays to definitive operation, disruptions in care, and loss to follow-up during preoperative care, particularly at the point of surgical referral on this hospital system in Rwanda. These findings suggest there may be opportunities to improve breast cancer survival in Rwanda through increasing operative capacity and other interventions that facilitate more timely operative intervention care. Prospective studies are needed to better characterize the contribution of patient, system, and clinical factors to the observed delays in surgical care.

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Conflict of interest/Disclosure

The authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest, or nonfinancial interest in the subject matter or materials discussed in this manuscript.

Appendix A – Time from Biopsy to Surgery by Pre-Operative Treatments Received

Treatment Received Prior to Operation	n	Median Days to Operatin (Interquartile Range)
None	24	122 (76 – 178)
Neoadjuvant endocrine therapy only	21	154 (100 – 302)
Neoadjuvant chemotherapy only	15	267 (241 – 392)
Neoadjuvant endocrine therapy and chemotherapy	8	368 (232 – 551)

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