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Brief Communication

Clinicopathological and survival analysis of primary spindle cell carcinoma of the breast in Chinese patients

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Abstract: Due to the low prevalence of Spindle cell carcinoma (SpCC) of the breast, the perception of the disease was limited. The aim of our study was to analyze the clinicopathological features, survival outcomes and prognostic factors of SpCC of the breast among Chinese. Patients diagnosed with SpCC of the breast in Cancer Hospital of Chinese Academy of Medical Sciences between 2004 to 2021 were retrospectively analyzed. Additionally, we searched Chinese databases and Pubmed websites for literature on breast SpCC in Chinese patients. The clinicalpathological characteristics, survival outcomes and prognostic factors were evaluated. A total of 160 eligible cases were enrolled, including 23 patients in our center and 137 cases from the literature search. The median age was 52 years old (range, 22-88). 84.8% (101/119) cases were in the early stage (stage I and II). 15.0% (20/133) had axillary lymph node involvement. The majority of patients were HR-HER2- (85.4%, 98/137). 77.5% (79/102) patients received adjuvant chemotherapy. 36.9% (31/84) of patients received adjuvant radiation. Of 126 patients available for a median follow-up with 38 (range, 1-211) months, 58 cases (46.0%, 58/126) recurred, including 31.0% (18/58) who had local recurrence and 69.0% (40/58) who had distant metastasis. The most common distant metastatic site was the lung (41.4%, 24/58). Most patients (91.5%) had recurrence within 3 years. The Kaplan-Meier curves showed that the 3-year and 5-year disease-free survival (DFS) were 55.9% and 46.8%, and the 3-year and 5-year overall survival (OS) were 67.0% and 54.9%, respectively. T stage was an independent prognostic factor for OS (T1-2 vs T3-4, HR=0.362, 95% CI: 0.139-0.945, *P*=0.038). Although SpCC of the breast was often diagnosed in the early stage with low lymph node involvement, the prognosis was poor. T stage was an indicator of prognosis for OS. Better treatments need to be explored to prevent recurrence and improve survival.

Keywords: Spindle cell carcinoma of the breast, Chinese, clinicopathology, survival, prognostic factor

Introduction

Spindle cell carcinoma (SpCC) of the breast is a rare disease with unique features, which is grouped by the World Health Organization Classification (WHO) as one of the categories of metaplastic carcinoma and represents only 0.02%-0.3% of all invasive breast cancers [1, 2]. The criteria diagnosis of SpCC is supported by the abundance of spindle cells (more than 80%) and expression immunohistochemical of epithelial and myoepithelial markers [3]. As a consequence of the relative rarity and lack of strong evidence of standard management, SpCC of the breast was usually treated in a similar way with invasive ductal carcinomas by surgery, followed with or without chemotherapy or radiation [4-8]. Furthermore, the potential biological behavior was obscure and the survival outcomes of SpCC of the breast were variable in previous research [9-11]. In addition, existing research focusing on prognostic factors was limited, thus related analyses need to be conducted to validate.

Since the characteristics and survival of the European and American people have been reported, the aim of our study was to investi-

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gate the characteristics of SpCC in Chinese patients. We retrospectively analyzed patients with SpCC of the breast diagnosed by Cancer Hospital of Chinese Academy of Medical Sciences and reported in the public databases, aiming to better describe the clinicopathological features, survival outcomes and prognostic factors of this population.

Methods

Enrolled patients and literature search

23 patients diagnosed with SpCC of the breast in the Cancer Hospital of the Chinese Academy of Medical Sciences from 2004 to 2021 were included. Relevant literature was retrieved from the Chinese databases (China National Knowledge Infrastructure [CNKI], Wanfang and Weipu) and PubMed website, using the following keywords: "breast" and ("spindle cell" or "sarcomatoid" or "metaplasia") and ("cancer" or "neoplasm" or "tumor") and ("China" or "Chinese patients"). The inclusion criteria were as follows: 1) Chinese patients; 2) histopathologically diagnosed with SpCC of the breast according to the WHO 2003, 2012 and 2019 diagnostic criteria; and 3) available data for clinical and follow-up information. The exclusion criteria were as follows: 1) insufficient diagnostic evidence; 2) had two or more pathology types; 3) without clinical information and follow-up data; and 4) repetitive published studies. This study was approved by local ethics committees.

Definition

The expression of estrogen receptor (ER), progesterone receptor (PR), human epidermal growth factor receptor 2 (HER2), Ki67 index and epithelial/myoepithelial markers in the SpCC of the breast tissues were based on immunohistochemical (IHC) staining. HER2 scores 3+ and HER2 scores 2+ with fluorescence in situ hybridization (FISH) positive were considered HER2 positive. ER and/or PR ≥1% were defined as hormone-receptor (HR) positive. Disease recurrence was verified by clinical and imaging evaluations which included magnetic resonance imaging of breast and brain, and computed tomography scans of the chest, abdomen, and pelvis areas. Disease-free survival (DFS) was calculated as the time from surgery to local recurrence or distant metastasis, or death due to breast cancer, whichever came first. Overall survival (OS) was calculated as the time from surgery to death due to any cause.

Statistical analysis

The variables collected included information on clinical characteristics, treatment modalities, and survival. Patients with stage IV were excluded from DFS analyses. Univariate analyses and survival curves were conducted by the Kaplan-Meier curves with the log-rank test. Multivariate analyses were performed using Cox proportional hazards regression models. A P value <0.05 was considered statistically significant. All data were statistically conducted by SPSS 25.0 and R (version 3.5.1).

Results

Literature search results

A total of 2306 articles were first identified for pre-selection. 534 were included after the title screening. 148 were left after excluding duplicate documents. 2 articles were translated into foreign languages. 16 articles could not be obtained for full text, and 47 articles did not meet the inclusion criteria. Finally, 35 articles were included in this study (**Figure 1**), of which 2 were from PubMed. **Table 1** shows that all included literature were published from 1999 to 2021, containing a total of 137 patients with SpCC of the breast.

Clinical and pathological characteristics

Table 2 shows the clinicopathological data of 23 patients in our center. All patients were female with a median age of 48 (range, 29-73) years old. Most patients (95.6%) were I-II stage at diagnosis. 17 (73.9%) cases were HR-HER2-. All patients received surgical treatment, of which only 2 (8.7%) patients had axillary lymph node involvement. 15 (65.2%) cases received adjuvant chemotherapy based on anthracycline, taxane and platinum. 5 (21.7%) cases received adjuvant radiotherapy. During a median follow-up time of 66 (range, 3-211) months, 8 (34.8%) cases had a recurrence, including 4 cases that had initially local recurrence (breast or chest wall) and underwent secondary surgical resection. All of them developed distant metastases, at 85, 8, 9, and 2 months after the first local recurrence. The other 4 cases had ini-

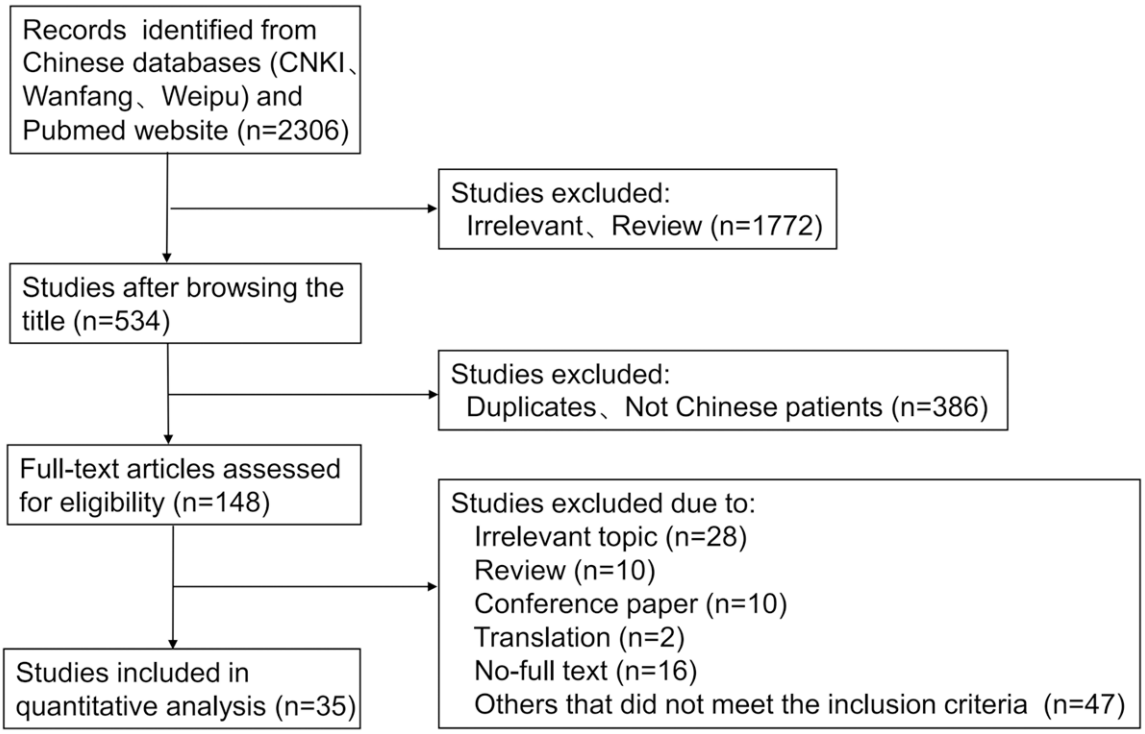

Figure 1. Flow chart of literature selection (n: number of literature).

tially distant metastases, including 3 lung metastases and 1 brain metastasis.

Table 3 shows the clinicopathological features of 160 patients in the whole group. All were female, with a median age of 52 years old (range, 22-88). TNM stage was available for 119 cases, and 101 (84.8%) cases were stage I and II. Lymph node status was available in 133 cases, and 20 (15.0%) cases had axillary lymph node metastasis. ER, PR, and HER2 expression status were available in 137 patients, and 98 (85.4%) were HR-HER2- and 3 (2.2%) were HER2 positive (HR-HER2+/HR+ HER2+).

Table 4 summarizes the IHC expression features of 160 cases. The most frequent markers were broad-spectrum cytokeratin CK (AE1/AE3) (81.0%, 94/116) and Vimentin (83.0%, 39/47), followed by P63 (61.6%, 53/86), EMA (55.2%, 37/67) and SMA (52.9%, 45/85).

Treatment and survival

All patients underwent surgical treatment, of which 112 (72.7%) cases accepted total mastectomy surgery, 42 (26.9%) cases accepted breast-conserving surgery, and 6 cases had unknown surgical methods. 79 (77.5%, 79/102) cases received adjuvant chemotherapy. 31 (36.9%, 31/84) cases received adjuvant radiotherapy. Of 126 patients available for a median follow-up with 38 (range, 1-211) months, 58 (46.0%) cases recurred and 43 (34.1%) died. Among the recurrence cases, 31.0% (18/58) had local recurrence and 69.0% (40/58) had distant metastasis as the first event. Lung, bone, liver, and brain metastasis rates were 41.4%, 13.8%, 5.2%, and 3.4%, respectively (**Figure 2**). The proportions of patients with recurrence events at 1-, 2-, 3-, 4-, and 5-year were 50.0%, 23.5%, 17.6%, 5.9%, and 2.6%, respectively. The K-M curves showed that the DFS rates at 3- and 5-year were 55.9% and 46.8%, respectively (**Figure 3A**). The OS rates at 3- and 5-year were 67.0% and 54.9%, respectively (**Figure 3B**).

Prognostic factors

Two patients with stage IV were excluded from the DFS analysis. In univariate analyses, T stage (P=0.042) and HR expression (P=0.023) were associated with DFS (**Figure 4A** and **4B**), but had no significant differences in multivari-

Table 1. Summary of 35 published articles about SpCC of the breast included in this study

No.	Year	Author	Publication Information	Number of cases
1	1995	Zhao et al.	Chinese Journal of Diagnostic Pathology	1
2	2001	Yang et al.	Chinese Journal of Clinical and Experimental Pathology	1
3	2005	Ding et al.	Chinese Journal of Diagnostic Pathology	3
4	2005	Shi et al.	Chinese Journal of Clinical and Experimental Pathology	1
5	2005	Zhang et al.	Chinese Journal of Clinical and Experimental Pathology	3
6	2005	Tang et al.	Chinese Journal of Pathology	1
7	2006	Ding et al.	Chinese Journal of Pathology	5
8	2007	Cai et al.	China Oncology	6
9	2009	Shi et al.	Chinese Journal of Cancer Prevention and Treatment	15
10	2009	Li et al.	Journal of Jining Medical University	1
11	2010	Fu et al.	Chinese Journal of Clinical and Experimental Pathology	15
12	2010	Wang et al.	Guangdong Medical Journal	5
13	2010	Zhang et al.	Chinese Journal of Surgical Oncology	2
14	2011	Zhang et al.	Chinese Journal of Diagnositic Pathology	2
15	2013	Wang et al.	Journal of Basic and Clinical Oncology	1
16	2014	Li et al.	Journal of Kunming Medical University	1
17	2014	Zhu et al.	Asia-Pacific Journal of Clinical Oncology	19
18	2015	Guang et al.	Chinese Journal of Clinical and Experimental Pathology	3
19	2015	Liang et al.	Chinese Journal of Oncology	20
20	2016	Su et al.	Chinese Journal of Diagnostic Pathology	7
21	2016	Yu et al.	Chinese Journal of Endocrine Surgery	5
22	2016	Zhou et al.	Oncotarget	1
23	2017	Li et al.	Chinese Journal of Endocrine Surgery	1
24	2018	Ren et al.	Chinese Journal of Clinical and Experimental Pathology	1
25	2018	Wang et al.	Journal of Youjiang Medical University for Nationalities	1
26	2018	Wang et al.	Clinical Medicine	1
27	2019	Wang et al.	Chinese Journal of Clinical and Experimental Pathology	2
28	2019	Liu et al.	Journal of Southwest Medical University	4
29	2019	Yuan et al.	Chinese Journal of Clinical and Experimental Pathology	1
30	2019	Qin et al.	Chinese Journal of Diagnostic Pathology	3
31	2020	Yao et al.	Chinese Journal of Pathology	1
32	2021	Feng et al.	Clinical Research and Practice	1
33	2021	Yang et al.	Chinese Journal of Laboratory Diagnosis	1
34	2021	Quan et al.	Guizhou Medical Journal	1
35	2021	Li et al.	Journal of Hubei Minzu University	1

Abbreviation: SpCC: Spindle cell carcinoma.

ate cox regression analysis (P=0.292, P=0.077). T stage (P=0.016) and HR expression (P=0.040) were associated with OS (**Figure 4C** and **4D**) in univariate analyses, with T stage to be an independent prognostic factor in multivariate cox regression analysis (T1-2 vs T3-4, HR=0.362, 95% CI: 0.139-0.945, P=0.038). Age, lymph node status, type of surgery, adjuvant chemotherapy and adjuvant radiotherapy showed no significant association with DFS and OS (P>0.05, **Table 5**).

Discussion

Due to the low incidence of SpCC of the breast, large-scale cohort investigations were difficult to perform, which limits our understanding of this disease. In this study, we retrospectively analyzed 160 Chinese patients with SpCC of the breast, which included 23 cases in our center and 137 cases enrolled from the literature search. To our best knowledge, this is the largest study describing the clinicalpathological

Table 2. Clinicopathological features and survival outcomes of 23 patients with SpCC of the breast in Cancer Hospital of Chinese Academy of Medical Sciences

No.	Age (y)	TNM stage		Intrinsic subtype	Adjuvant chemotherapy	Adjuvant radiotherapy	Metastasis site	DFS (m)	Treatment	OS (m)
1	46	pT1N0M0	IA	HR-HER2-	TC	Yes	No	57	No	57 (alive)
2	42	pT2N0M0	IIA	HR+HER2-	AT	No	No	137	No	137 (alive)
3	47	pT1N0M0	IA	HR-HER2-	ECF	No	No	96	No	96 (alive)
4	36	pT1N0M0	IA	HR-HER2-	No	Yes	No	211	No	211 (alive)
5	36	pT2N0M0	IIA	HR-HER2-	No	No	Breast	13	Surgery, chemotherapy (AC)	125 (die)
6	73	pT2N0M0	IIA	HR-HER2-	TC	No	Lung	9	Chemotherapy (GP, AC+apatinib)	24 (die)
7	43	pT2N0M0	IIA	HR-HER2-	TCb	No	Chest wall	2	Surgery and radiotherapy	16 (die)
8	49	pT2N0M0	IIA	HR-HER2-	No	No	Breast	12	Surgery, radiotherapy and Chemotherapy (TCb, AC)	24 (die)
9	40	pT2N0M0	IIA	HR-HER2-	No	No	Chest wall	3	Surgery and chemotherapy (AT+apatinib, GP)	13 (die)
10	48	pT1bN0M0	IA	HR-HER2-	No	Yes	No	55	No	55 (alive)
11	56	pT2N0M0	IIA	HR-HER2-	TC	No	No	82	No	82 (alive)
12	29	pT2N1M0	IIB	HR+HER2-	EC-TCb	No	No	93	No	93 (alive)
13	36	ypT2N1aM0	IIB	HR+HER2-	AT-TC	No	No	66	No	66 (alive)
14	49	pT4N0M0	IIIB	HR-HER2-	AT	No	No	95	No	95 (alive)
15	70	pT2N0M0	IIA	HR-HER2-	AC	No	Lung	6	Palliative Care	7 (die)
16	61	pT2N0M0	IIA	HR+HER2-	AC-T	No	No	41	No	41 (alive)
17	46	pT2N0M0	IIA	HR+HER2-	No	No	No	34	No	34 (alive)
18	54	pT2N0M0	IIA	HR-HER2-	TCb	No	Lung	2	Palliative Care	3 (die)
19	60	pT2N0M0	IIA	HR-HER2-	No	Yes	No	17	No	17 (alive)
20	59	pT1cN0M0	IA	HR-HER2-	TC	No	No	7	No	7 (alive)
21	64	pT2N0M0	IIA	HR+HER2-	TC	No	No	8	No	8 (alive)
22	31	pT2N0M0	IIA	HR-HER2-	No	No	Brain	20	Surgery and chemotherapy (TCb)	22 (alive)
23	70	pT2N0M0	IIA	HR-HER2-	TCb	Yes	No	5	No	5 (alive)

Abbreviations: SpCC: Spindle cell carcinoma; HR: hormone receptor; HER2: human epidermal growth factor receptor 2; TC: taxane+cyclophosphamide; AT: anthracycline and taxane; ECF: anthracycline+cyclophosphamide+fluorouracil; TCb: taxane and carboplatin; AC: anthracycline+cyclophosphamide; GP: gemcitabine+platinum.

Table 3. Clinicopathological features of 160 Chinese patients with SpCC of the breast

Characteristic	N	%*	%#
Age (Years)	52 (22-88)		
<50	46	28.8	44.7
≥50	57	35.6	55.3
Data unstratified	57	35.6	--
T			
T1	14	8.8	11.6
T2	88	55.0	73.9
T3	12	7.5	10.1
T4	5	3.1	4.2
NM	41	25.6	--
N			
N0	113	70.6	85.0
N1	10	6.3	7.5
N2	1	6.3	7.5
N3	0	0.0	0.0
NM	27	16.9	--
TNM Stage			
I	13	8.1	10.9
II	88	55.0	73.9
III	16	10.0	13.4
IV	2	1.3	1.7
NM	41	25.6	--
Hormone receptor status			
Positive	15	9.3	10.8
Negative	124	77.5	89.2
NM	21	13.1	--
HER2 status			
Positive	3	1.9	2.2
Negative	134	83.8	97.8
NM	23	14.4	--
Ki67			
≤30%	36	22.5	55.4
>30%	29	18.1	44.6
NM	95	59.4	--
Subtype			
HR+HER2-	17	10.6	12.4
HR-HER2+/HR+HER2+	3	1.9	2.2
HR-HER2-	117	73.1	85.4
NM	23	14.4	--
Type of surgery			
Breast-conserving surgery	42	26.3	26.9
Total mastectomy surgery	112	70.0	72.7
NM	6	3.8	--
Adjuvant Chemotherapy			
Yes	79	49.4	77.5
No	23	14.4	22.5
NM	58	36.3	--
Adjuvant Radiotherapy			
Yes	31	19.4	36.9
No	53	33.1	63.1
NM	76	47.5	--

*Proportions of the total population (160 cases); #Proportions of the known population. Abbreviations: SpCC: Spindle cell carcinoma; T: tumor size; N: lymph node status; HR: hormone receptor; HER2: human epidermal growth factor receptor 2; NM: not mentioned.

Table 4. Immunohistochemical results of epithelium and myoepithelium markers of SpCC of the breast

Antibody	% (No.) Positive
Vimentin	83.0% (39/47)
CK (AE1/AE3)	81.0% (94/116)
P63	61.6% (53/86)
EMA	55.2% (37/67)
SMA	52.9% (45/85)
CK34βE12	52.5% (31/59)
CK5/6	55.1% (43/78)
CD10	45.5% (15/33)
CK7	37.0% (17/27)
CK14	34.0% (16/47)
CK8	29.3% (12/41)
S100	29.0% (20/69)

Abbreviation: SpCC: Spindle cell carcinoma.

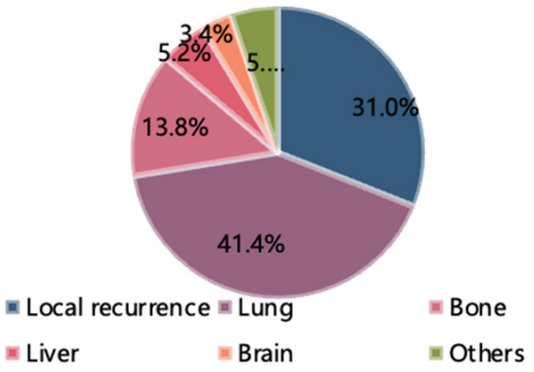

Figure 2. The pie charts indicating the first site of cancer recurrence and metastasis among patients with Spindle cell carcinoma (SpCC) of the breast.

characteristics, survival outcomes, as well as prognostic factors in Chinese patients with SpCC of the breast.

SpCC of the breast was often diagnosed in the early stage and was characterized by low axi llary lymph node involvement. The frequency of

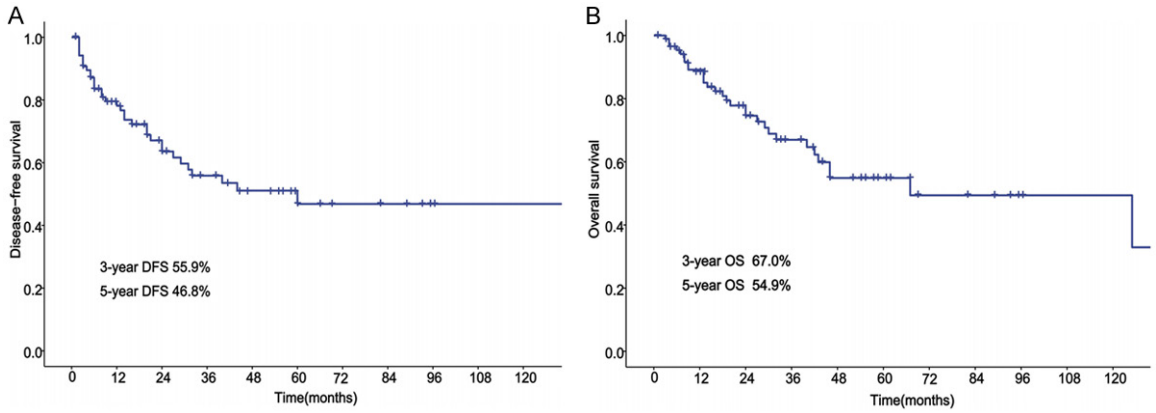

Figure 3. Kaplan-Meier curve showing disease-free survival (DFS) and overall survival (OS) of patients with spindle cell carcinoma (SpCC) of the breast in the total population. A. Survival curves of DFS in total population; B. Survival curves of OS in total population.

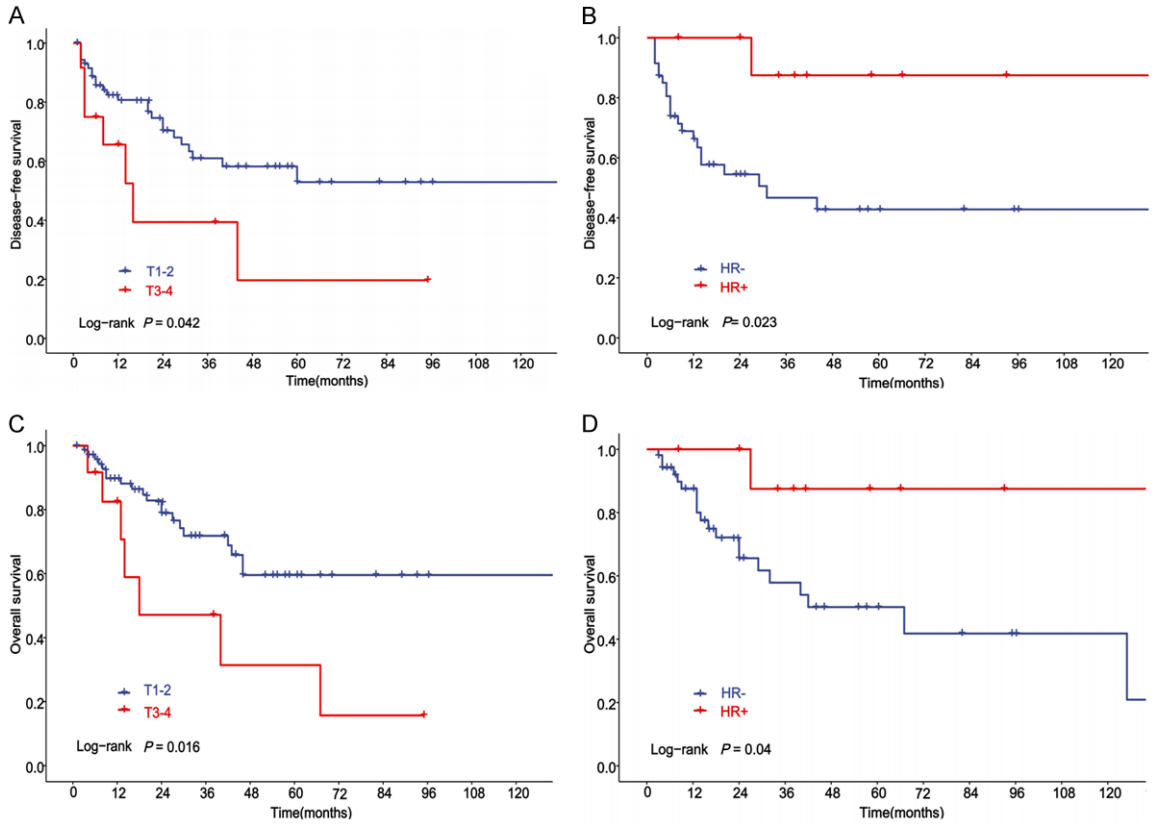

Figure 4. Kaplan-Meier curve showing disease-free survival (DFS) and overall survival (OS) of patients with spindle cell carcinoma (SpCC) of the breast according to tumor size (T) and hormone receptor (HR) status. A. Survival curves of DFS for patients with T1-2 and T3-4; B. Survival curves of DFS for patients with HR- and HR+; C. Survival curves of OS for patients with T1-2 and T3-4; D. Survival curves of OS for patients with HR- and HR+.

axillary lymph node involvement varied from 5% to 30% across previous research, which was lower compared with invasive ductal breast cancer. Moten AS et al. revealed that 9% of patients had axillary lymph node involvement [2], while in Ishizuka Y's cohort, 30% of patients harbored axillary lymph node metastasis [11].

It was generally accepted that SpCC of the breast originates from epithelium and/or myo-

Table 5. Analysis of predictive factors of DFS and OS of SpCC of the breast

	DFS			OS		
	Univariate analyses	Multivariate analyses		Univariate analyses	Multivariate analyses	
	Log-rank *P*	HR (95% CI)	*P*	Log-rank *P*	HR (95% CI)	*P*
Age (<50 vs ≥50)	0.831			0.772		
T (T1-2 vs T3-4)	0.042	0.579 (0.210-1.598)	0.292	0.016	0.362 (0.139-0.945)	0.038
N (N0 vs N1-3)	0.371			0.206		
HR (negative vs positive)	0.023	6.188 (0.823-46.549)	0.077	0.040	4.812 (0.633-36.598)	0.129
Surgery (Breast-conserving vs Total mastectomy)	0.248			0.591		
Adjuvant Chemotherapy (yes vs no)	0.100			0.602		
Adjuvant Radiotherapy (yes vs no)	0.689			0.415		

Abbreviation: SpCC: Spindle cell carcinoma; T: tumor size; N: lymph node status; HR: hormone receptor; DFS: Disease-free survival; OS: Overall survival.

epithelium. Two clues were helping to correctly diagnose the disease [12-14]. On the one hand, the presence of epithelial atypia or ductal carcinoma in situ around spindle cell tumor was proposed to be preferable for differential diagnosis. On the other hand, IHC expression of epithelium markers (CK, EMA, CK34βE12, CK5/6, CK8, etc.) and/or myoepithelium markers (SMA, P63, CD10, S100, etc.), contributed to the diagnosis of SpCC of the breast. Koker and colleagues showed that P63 was a specific and sensitive marker to distinguish spindle cell carcinomas from other mesenchymal neoplasms [14]. In our study, CK, P63, EMA, SMA, CK-34βE12 and CK5/6, showed high-frequency positivity.

SpCC of the breast was characterized by HR-HER2-, accounting for 85.4% in our study, which was consistent with previous research [9, 11]. However, the standard chemotherapy regimen for SpCC of the breast has not yet been determined. In our study, 77.5% of patients received adjuvant chemotherapy. Anthracycline, taxane and platinum-based chemotherapy regimens were usually adopted as the other invasive ductal carcinomas did. Despite receiving chemotherapy regimens, a certain amount of patients recurred, suggesting that the chemotherapy regimens might not be so effective for this population. Zhou N's study showed that apatinib was effective for advanced and chemotherapy-resistant SpCC of breast patients [15]. Could antiangiogenic drugs, which are widely used in sarcomas, also provide a new and effective treatment strategy for breast SpCC? More further clinical evidence is needed to draw a clear conclusion.

In our patient cohort, SpCC of the breast had high local recurrence and lung was the most universal metastasis site. This may be possibly explained by the reasons as follows. Firstly, though the majority of patients in our cohort were early stages and most of them received total mastectomy surgery, the local recurrence was still high, which manifested that SpCC of the breast might behave biologically similar to sarcoma, which also had high local recurrence [16]. It was also a reminder of whether the topical treatment was inadequate. In addition, several previous studies indicated that breast cancer subtypes had a strong correlation with site-specific metastasis patterns, patients with HR-HER2- had the greatest tendency to metastasize to the lung than other organs [17-19].

Our study demonstrated that 58 cases (46.0%) had recurrence, which was consistent with previous studies [9, 10]. Khan et al. reported 12 (63%) of 19 cases encountered recurrence, while Carter et al. observed 46% events in their cohort. These results suggested that SpCC of the breast was a highly aggressive histological type. A report by Wargotz, one of the biggest research of SpCC to date, showed that the cumulative 5-year survival rate in 100 cases cohort of SpCC was 64% [20], which was superior to that of our study (54.9%). One of the reasons for the different outcomes may be that fibromatosis-like SpCC, featured with better behavior and less aggressive, eliminated from SpCC by the 4th WHO classification, were also excluded in our study since 2012, but not Wargotz ES's. However, the 5-year survival rate of SpCC, both in our study and Wargotz's, was inferior to those described 81.3%-90.7% of invasive ductal triple-negative breast cancer (TNBC) in previous literature of Chinese patients [21, 22].

Our study indicated that T stage was an independent prognostic factor for OS both in univariate and multivariate analysis. While T stage and HR expression were associated with DFS in univariate analysis, but had no significant differences in multivariate analyses. Wargotz's study demonstrated that patients occurred recurrence had larger tumor sizes than those who did not (P=0.033). Unfortunately, the association between T stage and OS was not analyzed further in the study [20]. Ambria S's study from the SEER database showed that patients with SpCC of the breast who received complete mastectomy had worse survival outcomes than those receiving partial mastectomy (HR= 1.96, 95% CI: 1.10-3.49), while adjuvant radiotherapy adds no survival benefit after mastectomy both in early and late stage disease [2]. However, in our study, type of surgery, adjuvant chemotherapy and adjuvant radiotherapy showed no significant association with DFS and OS (P>0.05). Further larger and prospective studies are warranted to confirm the conclusions.

Finally, our study has several limitations. Retrospective analysis cannot avoid selection bias. Besides, cases enrolled from the literature search lacked central revision of histology, which might have biased our results and the missing data in the literature did not allow us to further analyze the effective chemotherapy treatment with durable outcomes. In addition, the analysis in our study was limited to the Chinese population. A prospective study was warranted to be conducted to verify the conclusions of this study in the future.

Conclusion

In summary, our study provides insights into the clinicalpathological characteristics, survival outcomes and prognostic factors of SpCC of the breast in Chinese population. SpCC of the breast was often diagnosed in the early stage, and was characterized by HR-HER2- and low lymph node involvement. SpCC of the breast was aggressive and had poor survival outcomes. T stage may serve as an indicator of prognosis for OS. Further larger and prospective studies are warranted to be conducted to confirm the optimal treatment for the population.

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Disclosure of conflict of interest

None.

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