

Original Article

An analysis of the effect of preserving the intercostobrachial nerve on reducing the incidence of postoperative pain syndrome in radical mastectomy

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Abstract: Objective: This study aimed to analyze the effect of preserving the intercostobrachial nerve (ICBN) on reducing the incidence of postoperative pain syndrome (PPS) in radical mastectomy (RM). Methods: 93 breast cancer (BC) patients admitted to our hospital from January 2018 to December 2018 were selected for a retrospective analysis and randomly divided into a control group (CG) (n=46) and an observation group (OG) (n=47). The ICBN was not preserved in the CG, but it was preserved in the OG in RM. The two groups were compared in terms of the intraoperative situation, incidence of PPS, incidence of sensory disturbance (SD), metastasis, and recurrence. Results: (1) There were no statistical differences in the operative duration, the total intraoperative blood loss, or the number of dissected lymph nodes during the operations between the two groups ($P>0.05$). (2) The patients suffering from PPS accounted for 31.91% in the OG and 56.52% in the CG ($P<0.05$). (3) The proportion of patients with light pain in the OG was higher than it was in the CG ($P<0.05$), and there were no statistical differences in the proportions of patients suffering from discomfort, horrible, or unbearable pain between the two groups ($P<0.05$). (4) The patients suffering from postoperative SD accounted for 38.30% in the OG and 69.57% in the CG ($P<0.05$). (5) There were no statistical differences in the proportions of patients suffering from SD at the specific site or in the specific type of SD between the two groups ($P>0.05$). (6) After the operations, the patients suffering from distant metastasis accounted for 4.26% in the OG and 6.52% in the CG, and those suffering from local recurrence accounted for 1.23% in the OG and 6.52% in the CG ($P>0.05$). Conclusion: The preservation of ICBN in RM did not affect the operative result or increase the incidence of postoperative tumor metastasis and recurrence, but it was conducive to reducing the incidence of PPS.

Keywords: Radical mastectomy, intercostobrachial nerve, preservation, postoperative pain syndrome

Introduction

BC is not only a female malignant tumor with a high worldwide incidence, but it is also a major cause of death of female cancer patients [1]. Over 2 million patients are diagnosed with BC every year worldwide, and more than 0.5 million patients die of BC annually worldwide [2]. In China, BC is the female malignant tumor with the highest incidence. In recent years, the incidence of BC has increased gradually in China under the influence of multiple factors, and the range of ages of patients suffering from BC is becoming broader [3].

Operations are the main treatment method for patients diagnosed with BC in the early stages,

and axillary lymph node dissection (ALND) is an important part of such operations. In the past, the long thoracic nerve and thoracodorsal nerve were preserved in ALND to avoid postoperative spasms of the latissimus dorsi muscle, but patients tended to have a variety of paresthesias after the operations, and it was difficult for them to restore their quality of life [4]. At present, due to the advances in medical and surgical techniques, surgery not only focuses on eliminating diseases, but it also emphasizes alleviating patients' postoperative paresthesia. Man [5] et al. indicated that the paresthesias included the pain and numbness of the medial upper arm and the affected armpit caused by the absence of ICBN. However, there is still a lack of clinical studies on how to alleviate these

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adverse manifestations. Although some studies have suggested that the preservation of the ICBN in ALND can reduce the incidence of paresthesias [6, 7], the research on the specific improvement effect and mechanism of the pain syndrome is not perfect. The present study was carried out with this starting point.

In this study, 93 BC patients who were admitted to our hospital from January 2018 to December 2018 were selected as objects to compare the different effects of preserving and not preserving the ICBN in RM and thus provide more useful guidance for the operations performed on BC patients.

Materials and methods

Materials

The retrospective analysis was conducted based on the clinical data of 93 BC patients who were admitted to our hospital from January 2018 to December 2018 and randomly divided into the CG (n=46) and the OG (n=47). The patients in the CG ranged in age between 42 and 62 years old, with definite diagnosis times of 0.6-3 years, and of the patients in the OG ranged in age between 43 and 64 years old, with a definite diagnosis time of 0.5-3 years. All the patients were informed of the research protocol and signed the informed consent form. This study was approved by Ethics Committee of the First Affiliated Hospital of Gannan Medical University. (1) Inclusion criteria: This study included patients who met the diagnostic criteria of BC [8] and were definitely diagnosed with BC for the first time; those who received selective RM; those in tumor stages I to IIIa; those who received no chemoradiotherapy before the operation; and those with complete case data. (2) This study excluded patients who could not complete the scheduled follow-up visit; those with a history of other cancers; those with a history of neurological disorders; those with a history of SD; those with a history of limb dysfunction; and those without complete case data.

Methods

In the modified radical mastectomy that was selected as the operative method, the patients were kept laying on their backs. After routine disinfection and preoperative draping, the pri-

mary tumor was resected and frozen rapidly during the operation for slicing and examination. Stewart transverse incisions were made on the affected side in the OG to separate the flap between the skin and the superficial layer of the superficial fascia. The dissociation ranged from the lower edge of the clavicle down to the upper end of rectus abdominis muscle at the position of the costal arch and from the level of the 4th rib beside the sternum outward to the front edge of the latissimus dorsi muscle, which was 5 cm away from the lower edge of the armpit. The mammary gland was resected along the surface of the pectoralis major and the fat layer of retromammary space that was tightly close to the fascia of pectoralis major was resected at the same time. The mammary gland that had been resected was turned laterally to expose the surface of the pectoralis major completely. Meanwhile, a certain tension was maintained in the pectoralis major to pull the breast tissue continuously and thus expose the retromammary space and the space between the pectoralis major and the fascia more such that the physician could perform the resection from the fascia of the pectoralis major to the armpit. In addition, the Rotter lymph nodes between the pectoralis major and the pectoralis minor were swept, and the pectoralis major and pectoralis minor were pulled continuously along the anteromedial direction. The posterior space of the axillary vein was separated to the deep surface and above, and then the axillary region was dissected to ensure that the posterior axillary vein was exposed completely. The dissection was performed from the lower edge of the axillary vein to the intersection angle between the thoracic wall and the axillary vein, and the ligation was performed on the fine lymph vessels vertical to the sub-branches of the axillary vein so as to determine and protect the starting sites of the long thoracic nerve and the thoracodorsal nerve. The lymphatic adipose tissues in front of, behind and under the axillary vein were removed thoroughly to sweep them from the lower lateral border of the pectoralis minor down to the level of the 2nd rib. Behind the pectoralis minor was the starting site of ICBN. Then, a blunt dissection was performed on the lymphatic adipose tissues along the direction of travel from this site so that the main branch of the preserved ICBN was parallel to the axillary vein and could pass through the bottom of the armpit. Then it

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Table 1. Comparison of the general data in the two groups ($\bar{x} \pm s$)/[n (%)]

Data		OG (n=47)	CG (n=46)	t/ X^2	P
Gender	Male	26 (55.32)	24 (52.17)	0.093	0.761
	Female	21 (44.68)	22 (47.83)		
Age (years old)		52.86±8.46	52.34±8.19	0.301	0.764
Disease course (year)		1.42±0.83	1.45±0.86	0.171	0.865
Weight (kg)		62.45±9.68	63.52±9.78	0.530	0.597
Pathological type	IDC	37 (78.72)	35 (76.09)	0.851	0.163
	ILC	7 (14.89)	6 (13.04)		
	Others	3 (6.38)	5 (10.87)		

was observed that the ICBN entered into the subcutaneous fat of the medial upper arm and the rest of the branches entered into the latissimus dorsi muscle and breast. The branches of ICBN entering into the breast were cut off and the ICBN was protected properly in the sweeping process of the axillary lymph nodes, which was followed by the indwelling of the axillary drainage tube, the suturing of the mammary gland incision, and the multi-band pressure bandaging. That was the end of the operation.

The CG's operative process was the same as the OG's operative process. The trunk of the ICBN was resected during the operation or after the metastatic axillary lymph nodes significantly invaded the ICBN.

Observation targets

(1) Intraoperative situation: The two groups were compared in terms of their operative duration, total intraoperative blood loss, and number of dissected lymph nodes during the operations.

(2) PPS: The incidence of PPS was evaluated based on the short-form McGill pain questionnaire (SF-MPQ) [9] in the two groups, including no pain, light pain, pain with discomfort, horrible pain, and unbearable pain.

(3) SD: The two groups were compared in their incidences of SD 1 week after the operations, the specific site of the SD (affected upper arm, affected armpit, or operative site) and the type of SD (sensitivity, slowness, numbness, ant line feeling, or hypesthesia).

(4) Metastasis and recurrence: The 1-year post-operative follow-up visits were conducted in the

two groups to compare the local recurrence and distant metastasis rates during their follow-up visits.

Statistical methods

SPSS 22.0 was used for the statistical analysis. The measurement data were represented as the mean \pm standard deviation, and the results between groups were compared using independent-samples *t* tests. The enumeration data were represented by [n (%)],

and the results in the groups were compared using X^2 tests. The multi-point comparisons in groups were performed using ANVOA and *F* tests. $P < 0.05$ meant that the difference had statistical significance.

Results

Comparison of the general data in the two groups

There were no significant differences in terms of gender ratio, average age, average disease course, average weight, or pathological type between the two groups ($P > 0.05$) (**Table 1**).

Comparison of the intraoperative situation between the two groups

There was no statistical difference in the operative duration, total intraoperative blood loss, or number of dissected lymph nodes during the operations in the two groups ($P > 0.05$) (**Table 2**).

Comparison of the incidences of PPS in the two groups

Among the 47 patients in the OG, 15 suffered from PPS, accounting for 31.91%, and among the 46 patients in the CG, 26 suffered from PPS, accounting for 56.52%. The incidence of PPS in the OG was much lower than it was in the CG, an indication that the difference was statistically significant ($P < 0.05$) (**Table 3**).

Comparison of the specific degrees of PPS in the two groups

There were 15 patients with PPS in the OG, including, 6 suffering from light pain, 4 suffering from discomfort, 3 suffering from horrible

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Table 2. Comparison of the intraoperative situations in the two groups ($\bar{x} \pm s$)

Group	Number of cases	Operative duration (min)	Total intraoperative blood loss (ml)	Number of dissected lymph nodes during operation (pieces)
OG	47	160.58±35.49	102.13±10.45	17.54±1.16
CG	46	158.43±32.92	103.38±10.19	17.81±1.20
t		0.303	0.584	1.512
P		0.763	0.561	0.134

Table 3. Comparison of the incidences of PPS in the two groups [n (%)]

Group	Number of cases	Occurrence	Non-occurrence
OG	47	15 (31.91)	32 (68.09)
CG	46	26 (56.52)	20 (43.48)
χ^2			5.710
P			0.017

Table 4. Comparison of the incidences of postoperative SD in the two groups [n (%)]

Group	Number of cases	Occurrence	Non-occurrence
OG	47	18 (38.30)	(61.70)
CG	46	32 (69.57)	(30.43)
χ^2			9.143
P			0.002

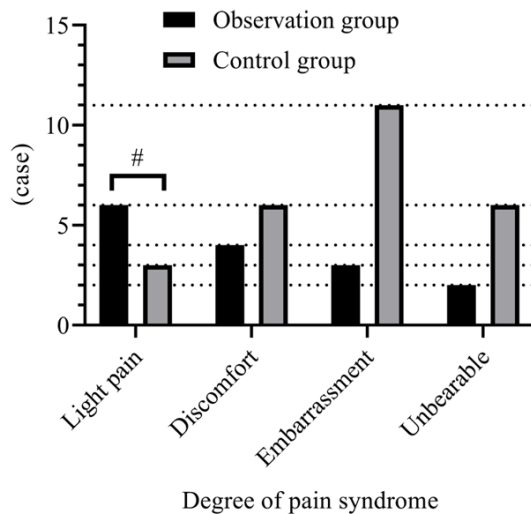


Figure 1. Comparison of the degrees of pain in the two groups. Compared with the control group, the proportion of patients suffering from light pain was significantly higher in the observation group ($P < 0.05$). There was little difference in the proportion of patients suffering from pain with discomfort, horrible pain, and unbearable pain in the two groups ($P > 0.05$). #means $P < 0.05$ in the comparison between the two groups.

pain, and 2 suffering from unbearable pain. There were 26 patients with PPS in the CG, including 3 suffering from light pain, 6 suffering from discomfort, 11 suffering from horrible pain, and 6 suffering from unbearable pain. The proportion of patients suffering from light pain in the OG was much higher than it was in the CG ($P < 0.05$), and the proportion of patients suffer-

ing from discomfort, horrible pain, and unbearable pain in OG was lower than it was in the CG, but the differences had no statistical significance ($P > 0.05$) (**Figure 1**).

Comparison of the incidence of postoperative SD in the two groups

Among the 47 patients in the OG, 18 had postoperative SD, accounting for 38.30%, and among the 46 patients in the CG, 32 had postoperative SD, accounting for 69.57%. The incidence of postoperative SD in the OG was much lower than it was in the CG, an indication that the difference had statistical significance ($P < 0.05$) (**Table 4**).

Comparison of the specific SD sites in the two groups

In the 18 patients with postoperative SD in the OG, there were 4 suffering from it with affected upper arms accounting for 22.22%, 6 suffering from it with affected armpits accounting for 33.33%, and 8 suffering from it at the operative sites, accounting for 44.44%. Among the 32 patients with postoperative SD in the CG, there were 9 suffering from it with affected upper arms, accounting for 28.13%, 12 suffering from it with affected armpits, accounting for 37.50% and 11 suffering from it at the operative sites, accounting for 34.38%. There was no statistical difference in the specific sites of the SD between the two groups ($P > 0.05$) (**Figure 2**).

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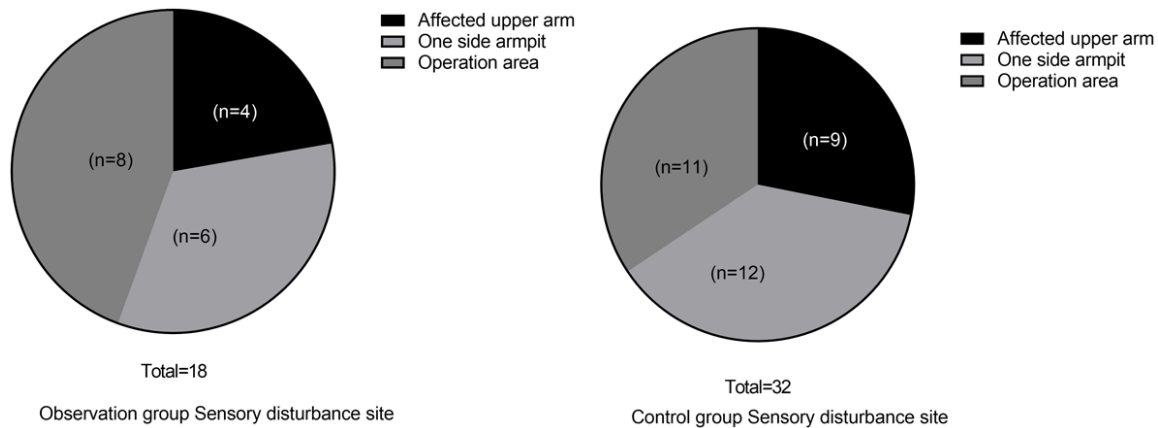


Figure 2. Comparison on specific site of SD between two groups. There was little difference in the proportion of patients suffering from SD in the affected upper arm, affected armpit, and the operative site in the two groups ($P>0.05$).

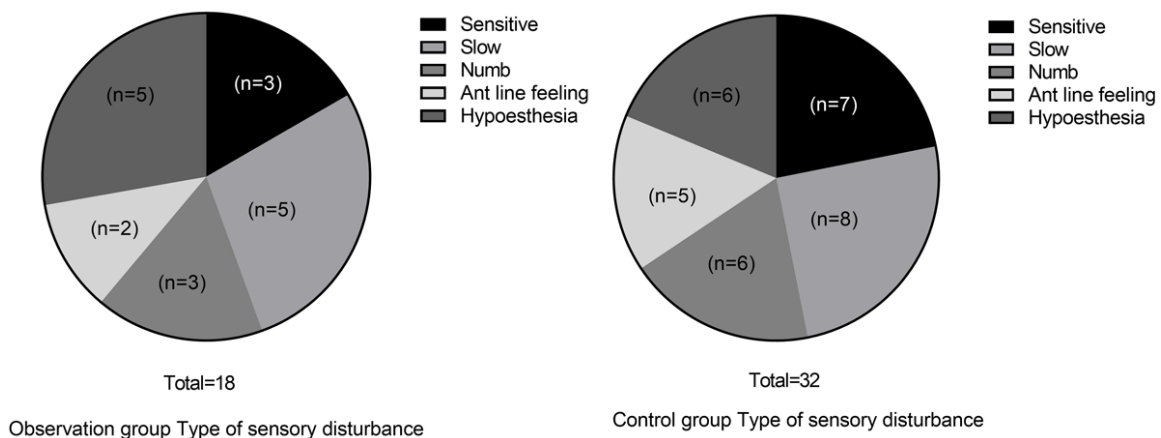


Figure 3. Comparison on type of SD between two groups. There was little difference in the proportion of patients with sensitivity, slowness, numbness, ant line feeling, and hypesthesia in the two groups ($P>0.05$).

Comparison of the type of SD between the two groups

Among the 18 patients suffering from postoperative SD in the OG, there were 3 with sensitivity, accounting for 16.67%, 5 with slowness, accounting for 27.78%, 3 with numbness, accounting for 16.67%, 2 with ant line feeling, accounting for 11.11%, and 5 with hypesthesia, accounting for 27.78%. Among the 32 patients suffering from postoperative SD in the CG, there were 7 with sensitivity, accounting for 21.88%, 8 with slowness, accounting for 25.00%, 6 with numbness, accounting for 18.75%, 5 with ant line feeling, accounting for 15.63%, and 6 with hypesthesia, accounting for 18.75%. There was no statistical difference

in the specific types of SD between the two groups ($P>0.05$) (Figure 3).

Comparison of the metastasis and recurrence rates in the two groups

During the 1-year postoperative follow-up visits, 2 patients suffered from distant metastasis in the OG, accounting for 4.26%, and 1 patient suffered from local recurrence, accounting for 1.23%. Also, 3 patients suffered from distant metastasis in the CG, accounting for 6.52%, and 3 patients suffered from local recurrence, accounting for 6.52%. There was no statistical difference in the distant metastasis and local recurrence rates in the two groups at the 1-year postoperative follow-up visit ($P>0.05$) (Figure 4).

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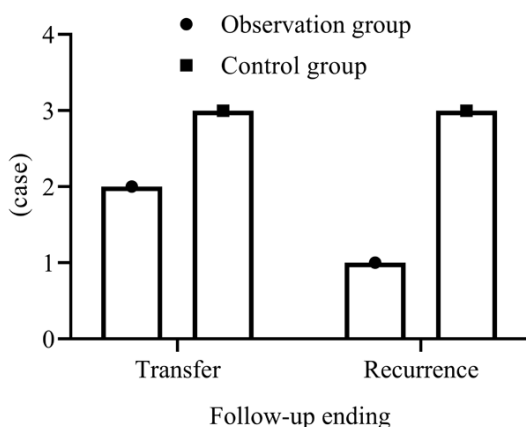


Figure 4. Comparison of the postoperative metastasis and recurrence in the two groups. There was little difference in the distant metastasis and local recurrence rates in the two groups at the 1-year postoperative follow-up visits ($P>0.05$).

Discussion

Operations are always the main method of treating patients with early breast cancer (EBC). But now, the comprehensive therapeutic schedule will be selected according to the specific disease stage and the patients' states, with the specific methods including chemotherapy, radiotherapy, endocrinotherapy, and molecular targeted therapy [10, 11]. With the continuous improvement of operative techniques and concepts, the operative method of RM has been changed continuously. Currently, the modified radical operation (MRO) is gradually substituting the extended radical operation, which reduces injury and promotes postoperative rehabilitation [12, 13]. However, Huang et al. [14] found in a statistical investigation that the incidence of chronic pain after RM exceeded 20%, which greatly affected the patients' postoperative rehabilitation. Coufal et al. [15] proposed that the proportion of BC patients who suffered from pain syndrome after ALND was much higher than the proportion of BC patients who were not treated with ALND, so the incidence of PPS was correlative with ALND. Later, Kim et al. [16] indicated that the incidence of PPS could be reduced by preserving the ICBN in ALND.

There are a lot of clinical studies on whether the ICBN can be preserved in RM. Henry [17] et al. found that there was little difference in operative duration, intraoperative blood loss, or the number of dissected lymph nodes during oper-

ations in BC patients with ICBN preserved and not preserved in MRO ($P>0.05$). In addition, Zhu [18] et al. also indicated that the preservation of ICBN had no significant influence on the operative duration, intraoperative bleeding, or other operative situations in RM. This study also showed that there was no statistical difference in the operative duration, intraoperative blood loss, or number of dissected lymph nodes among the OG patients whose ICBNs were preserved and those of the CG whose ICBNs were not preserved ($P>0.05$). However, Wijayasinghe et al. [19] came to the conclusion that the operative duration in the group preserving the ICBN was much longer than it was in the group not preserving the ICBN, but there was no difference in the intraoperative bleeding or the number of dissected lymph nodes. It was thought that the operative duration changed with the operation habits, operation methods, technical levels, and the proficiency of the various physician teams.

In this study, the incidence of PPS in the OG reached 31.91% by preserving the ICBN, which was much lower than the 56.52% in the CG. With regard to the specific degree, the proportion of patients suffering from light pain in OG was higher than it was in the CG ($P<0.05$), and the proportion of patients suffering from discomfort, horrible pain, and unbearable pain in the OG was lower than it was in the CG, but the difference had no statistical difference ($P>0.05$). It was determined that the results had no statistical significance due to the small number of objects included in this study. But the results indicated that the pain degree in the OG was slightly lower than it was in the CG, and this indicated that the preservation of ICBN in the radical operation had a certain significance to alleviating postoperative pain. What's more, the incidence of SD was 38.30% in the OG, which was much lower than the 69.57% in the CG ($P<0.05$). As for the specific site of the SD, the patients suffering from SD in the affected upper arm, affected armpit, and operative site respectively accounted for 22.22%, 33.33% and 44.44% in the OG and 28.13%, 37.50% and 34.38% in the CG ($P>0.05$). There was no statistical difference in the type of SD between the two groups, including sensitivity, slowness, numbness, ant line feeling, or hypesthesia ($P>0.05$). It was thought that this was related to the small number of objects, but on the whole, the preservation of the ICBN in the radical oper-

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ations was very important in reducing the incidence of postoperative SD and accelerating postoperative rehabilitation. Andersen et al. [20] found that the incidences of numbness, hypesthesia, and sensitivity were respectively 2%, 58% and 29% in the group preserving the ICBN and 2.5%, 67.5% and 20% in the group not preserving the ICBN, which indicated that the difference was insignificant. Orsolya et al. [21] proposed based on the follow-up visits that the operative duration was prolonged gradually, and the incidence of SD was reduced gradually in the group preserving the ICBN, which were not very different from those in the group not preserving ICBN. According to Taira et al. [22], the incidence of SD in the upper limbs of the group preserving ICBN was much lower than it was in the group not preserving ICBN within two years after the operations. As indicated by Kubala et al. [23], the incidence of paresthesias and pain on the posterior medial side of the upper arm was lower in the group preserving the ICBNs. Warriar et al. [24] found through a study that the incidence of SD in the group preserving the ICBN was much lower than it was in the group not preserving the ICBN and thought that the occurrence risk of SD would be enhanced by resecting the ICBN in RM and that the occurrence of SD was mainly caused by the loss of nerve function. It was determined that the ICBN had a dominating effect on the medial upper arm, the posterior upper arm, and the anterior upper arm, etc. and the removal of the ICBN could lead to the SD in corresponding sites, so the preservation of ICBN played a crucial role in reducing the incidence of SD [25]. In this study, the distant metastasis and local recurrence rates were respectively 4.26% and 1.23% in the OG and 6.52% and 6.52% in the CG at the 1-year postoperative follow-up visits, showing little difference ($P>0.05$). This implied that the preservation of ICBN in RM had no significant influence on postoperative metastasis, recurrence, or operative safety, so this also verified the feasibility of preserving ICBN during RM operations.

In conclusion, the preservation of the ICBN in RM can reduce the incidence of PPS and SD by ensuring the number of dissected lymph nodes and will not increase postoperative metastasis and recurrence, so it is worthy of promotion and application. However, this study was a retrospective study with few objects and fewer

analysis indexes, so it was not comprehensive. Also, the follow-up period was short, so the results were biased to a certain extent. Intensive studies with larger samples in more aspects should be conducted in the future, and the prospective studies should be emphasized to obtain more scientific and representative conclusions, thus providing more references for the operative treatment of BC patients.

Disclosure of conflict of interest

None.

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