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Incidence and risk factors of pain following breast cancer surgery: a retrospective national inpatient sample database study

Shanlian Suo[1†], Rui Liu[1†], Xuegao Yu[2†], Jian Wang[3], Min Wang[1*], Yan Zhang[1*] and Yuqian Liu[1*]

Abstract

Background Postoperative pain (PP) is a dynamic process that reflects the complex interplay between symptoms, treatment, and patient experiences, and its intensity is reportedly primarily related to the severity of surgical trauma. However, no large-scale national database-based study has hitherto been conducted to assess the occurrence and features related to PP following breast cancer (BC) surgery.

Methods In this retrospective analysis, we screened BC surgery cases between 2015 and 2019 within the National Inpatient Sample (NIS) Database, utilizing the International Classification of Diseases (ICD) 10th edition clinical modification codes. The researchers identified patients who developed PP and compared them to those who did not. Factors associated with PP were then screened: patient demographics (age and race), hospital characteristics (type of insurance, bed size, teaching status, type of admission, location, and hospital area), length of stay (LOS), total cost during hospitalization, inpatient mortality, comorbidities, and perioperative complications. Data were analyzed using descriptive statistics. Multivariate logistic regression analysis was used to determine the independent risk factors for postoperative pain in BC surgery.

Results 39,870 BC surgery cases were identified over a five-year period from 2015 to 2019. The overall occurrence of PP following breast cancer surgery was 6.15% (2,387 cases), with a slight upward trend every year. Significant racial disparities were observed, Whites associated with a higher incidence of PP ($P < 0.001$). In addition, the incidence of elective admission was 11.96% lower (67.491% vs. 79.451%) than that of patients without PP following breast cancer surgery ($P < 0.001$). Besides, PP was related to prolonged hospitalization duration (3 vs. 2 days; $P < 0.001$), and higher total cost ($68,283 vs. $60,036; $P < 0.001$). Multivariate logistic regression identified breast cancer surgery-independent risk factors for PP, including younger age, non-elective hospital admission, rural hospitals, depression, drug abuse, metastatic cancer, psychoses, weight loss, and chronic pulmonary disease. In addition, postoperative pain for BC

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was associated with urinary retention, gastrointestinal complications, continuous invasive ventilation, deep vein thrombosis, urinary tract infection, blood transfusion, arrhythmia, and chest pain.

Conclusion Despite the low incidence of postoperative pain in BC surgery cases, it is essential to investigate factors predisposing to PP to allow optimal care management and improve the outcomes of this patient population.

Keywords Breast cancer surgery, Postoperative pain, Complications, Comorbidities

Background

Globally, breast cancer (BC) stands as a prominent contributor to cancer incidence [1], constituting 25% of reported cases and representing a leading cause of cancer in females in 2020. Its significance has been increasing worldwide, particularly in developing nations [2], representing the fifth leading cause of cancer-related mortality, accounting for 6.6% of cancer deaths worldwide [3]. The exact mechanism of breast cancer development is currently unknown. At the initiation cell level, both clonal evolutionary models and cancer stem cell models make some sense, and cancer stem cells may also evolve in a clonal fashion, further complicating the situation [4]. At the morphological level, there is a range of lesions and genetic modifications, from normal glands to cancer [5]. At the molecular level, there are many genetic mutations, hormone receptor alterations and immune crosstalk in the formation and progression of breast cancer [6]. Molecular features of breast cancer include activation of human epidermal growth factor receptor 2, activation of hormone receptor, and BRCN mutations [5, 6]. The landscape of treatment and management approaches for BC is intricate and continually progressing. Notwithstanding advancements in adjuvant treatments, surgery is still the standard of care for early and locally advanced BC [7, 8]. However, many postoperative patients develop postoperative complications [8].

According to the International Association for the Study of Pain, pain is characterized as an "unpleasant emotional and sensory experiences associated with, or described by, potential or actual tissue damage" [9]. Current evidence suggests that the type and extent of the surgery, with neurological damage and tissue damage, have the potential to induce neuropathic pain and nociceptive pain [10, 11]. Pain after breast cancer surgery has been acknowledged for decades as a major complication, initially documented as a painful sensation encompassing burning and dullness in the ipsilateral upper extremities, armpits, and chest four decades ago [11]. Besides, reports of mood disturbances, emotional distress, and decreased quality of life have been documented in this patient population [12–15]. In addition, postoperative pain can lead to a decrease in functional capacity, with about 24% of patients giving up activities due to pain [16]. Furthermore, postoperative pain is a major cause of morbidity and disability and imposes a heavy economic burden and other burdens on society [14, 15, 17].

Herein, the screening of high-risk patients prior to surgery is important to optimize postoperative outcomes and prevent complications. Various risk factors for postoperative pain, such as obesity, young age, chemotherapy, or axillary lymph node dissection, related to patients and breast cancer treatment, have been widely described [18, 19]. In addition, psychological factors, including psychological distress, preoperative anxiety, and the inability to express and recognize emotions (alexithymia), have also been shown in the literature to predispose to pain following breast cancer surgery [20, 21]. Nevertheless, there is a lack of comprehensive investigation into the occurrence and factors contributing to pain following breast cancer surgery based on data from a nationwide database.

Accordingly, it is important to investigate the factors that contribute to postoperative pain for breast cancer cases as well as identify features that increase the risk of developing postoperative pain to provide a theoretical basis for the prevention of postoperative pain. Herein, the clinical data of breast cancer surgery inpatients were retrospectively analyzed with the aim of providing an overview of the frequency of occurrence of postoperative pain events in this patient cohort and an in-depth study of potential risk factors associated with postoperative pain.

Methods

Data source

The National Inpatient Sample (NIS) database, conducted by the Healthcare Cost and Utilization Project and sponsored by the Agency for Healthcare Research and Quality, provided data for your research. In the United States, NIS is the largest database of all payers for hospitalization admissions. NIS collects stratified samples from more than 1,000 hospitals, accounting for about 20% of annual hospitalizations in the U.S [22]. Data collected from the NIS database, including hospital characteristics, type of insurance, patient demographics, length of stay (LOS), in-hospital mortality, total cost, and diagnostic and procedure codes for the International Classification of Diseases (10th Revision) Clinical Revision (ICD-10-CM). This study utilized anonymized data from public sources and is thus classified as exempt from requiring ethical approval according to established research guidelines.

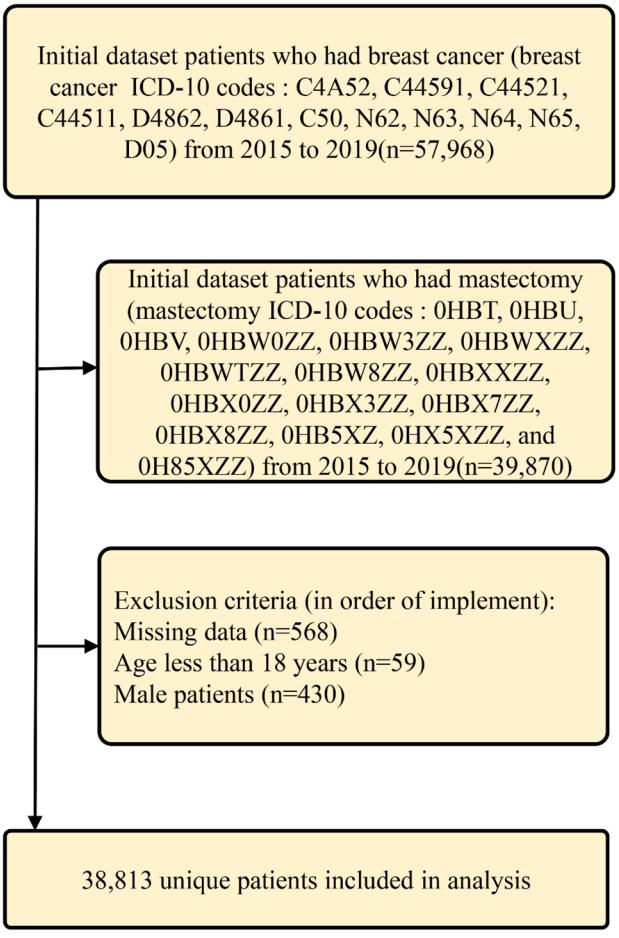

Fig. 1 Flow diagram of study selection process. ICD-10: International Classification of Diseases (Tenth Revision) Clinical Modification

Data collection

The cohort under investigation comprised individuals for whom hospitalization information was accessible in the National Inpatient Sample database spanning the years 2015 to 2019. Patients with a breast cancer diagnosis as defined by the ICD-10 codes were identified during the study (n=57,968). Patients undergoing mastectomy were then identified using the ICD-10 program codes (Fig. 1) (n=39,870). The exclusion criteria were as follows: (1) patients with missing data (n=568); (2) less than 18 years of age (n=59); (3) Male patients (n=430) (Fig. 1). Ultimately, a total of 38,813 patients meeting the specified criteria and possessing comprehensive data were identified through the screening process.

Based on postoperative pain incidence, the included cases were stratified into PP and non-postoperative pain groups. Definition of PP, acute postoperative pain (APP), chronic postoperative pain (CPP), other postoperative pain (OPP) according to ICD-10-CM diagnostic code (Supplementary Table 1).

The primary outcome of the study was PP. The ICD-10-CM diagnostic code was used to obtain preoperative underlying conditions that may be independently linked to postoperative pain and perioperative complications prior to discharge. According to the NIS database, 27 variables of comorbidities and perioperative complications before discharge are shown in Table 1.

Data analysis

All data in the present study were statistically analyzed using R software (v3.5.3). The Wilcoxon's rank-sum test and $\chi 2$ test for categorical data were used for continuous data, and the independent risk factors of postoperative pain were studied by multivariate logistic regression method. All data provided by the NIS, including demographics, hospital characteristics, payer type, and comorbidities, were incorporated for regression analysis (Table 1). Univariate and multivariate logistic regression (LR) models were generated for an assessment of the correlation between other comorbidities or perioperative complications and postoperative pain. Given the substantial study population size, statistical significance was set to a P-value $\leq$ 0.001.

Table 1 Variables used in binary logistic regression analysis

Variables categories	Specific variables
Patient demographics	Age (≤ 59 years and ≥ 60 years), race (White, Black, Hispanic, Asian or Pacific Islander, Native American and Other)
Hospital characteristics	Type of insurance (Medicare, Medicaid, private insurance, self-pay, no charge, other), bed size of hospital (small, medium, large), teaching status of hospital (nonteaching, teaching), type of admission (non-elective, elective), location of hospital (rural, urban), location of the hospital (northeast, Midwest or north central, south, west)
Comorbidities	Chronic blood loss anemia, depression, deficiency anemia, valvular disease, congestive heart failure, hypertension, lymphoma, drug abuse, diabetes, liver disease, fluid and electrolyte disorders, coagulopathy, metastatic cancer, other neurological disorders, peripheral vascular disorders, paralysis, obesity, psychoses, weight loss, solid tumor without metastasis, pulmonary circulation disorders, alcohol abuse, rheumatoid arthritis, hypothyroidism, renal failure, peptic ulcer disease, chronic pulmonary disease
Complications	Urinary retention, gastrointestinal complications, continuous invasive Ventilation, pneumonia, deep vein thrombosis (DVT), urinary tract infection, blood transfusion, postoperative delirium (POD), arrhythmia, chest pain, nerve injury, wound rupture without healing, wound infection, hemorrhage

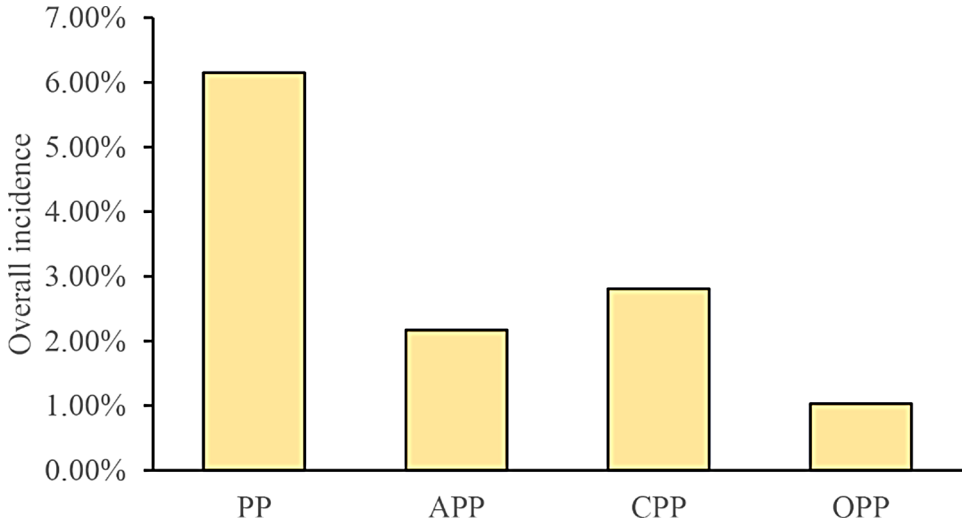

Fig. 2 Overall incidences of PP, APP, CPP, and OPP in patients undergoing breast cancer surgery. PP: Postoperative pain, APP: Acute postoperative pain, CPP: Chronic postoperative pain, OPP: Other postoperative pain

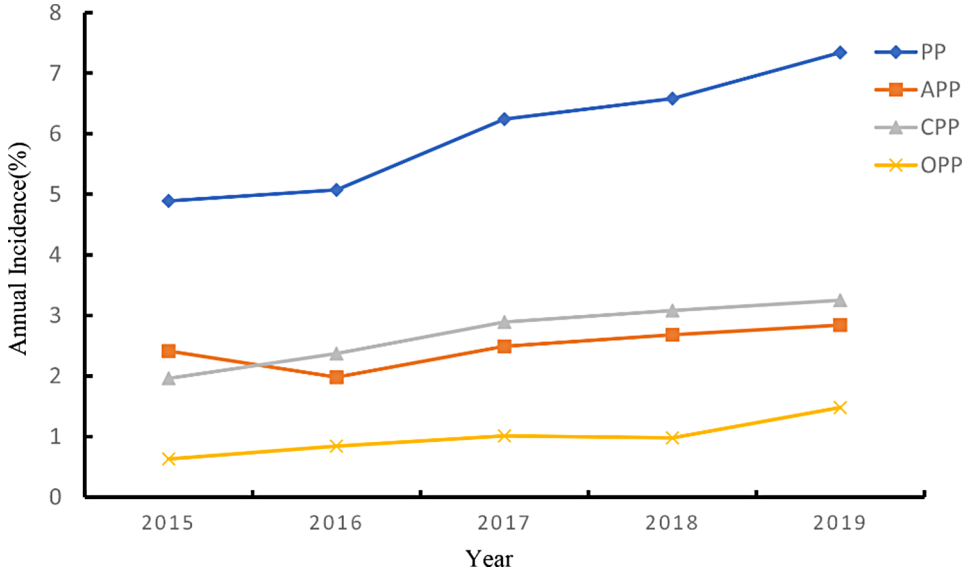

Fig. 3 Annual incidences of PP, APP, CPP, and OPP in patients undergoing breast cancer surgery. PP: Postoperative pain, APP: Acute postoperative pain, CPP: Chronic postoperative pain, OPP: Other postoperative pain

Results

Occurrence of PP after breast cancer surgery

39,870 breast cancer surgeries were screened from the National Inpatient Sample database from 2015 to 2019 (Fig. 1). Across this cohort, PP was observed in 2387 patients, with an incidence of 6.15%, including 958 patients with APP (Overall incidence: 2.47%), 1089 patients with CPP (Overall incidence: 2.81%), 401 patients with OPP (Overall incidence: 1.03%) (Fig. 2). Figure 3 presents the increasing incidence of PP, APP, CPP, and OPP over the years.

Patient demographics

The age distribution of PP cases was comparable for both study cohorts (Table 2). There was a statistically significant racial difference in patients with postoperative pain. White ethnicity was significantly predominant in the postoperative pain cohort ($P<0.001$) (Table 2).

Hospital characteristics

Individuals who experienced PP following breast cancer surgery were 11.96% less likely to undergo elective admission in comparison to cases with no postoperative pain (67.491% vs. 79.451%, $P<0.001$) (Table 2). Regarding hospital location, in-hospital PP was 2.081% lower in the urban (93.925% vs. 96.006%, $P<0.001$) (Table 2). In terms

Table 2 Patient characteristics and outcomes after breast cancer surgery (2015–2019) Continue

Characteristics	Postoperative pain	No postoperative pain	P
Total (n = count)	2,387	36,426	
Total incidence (%)	6.15		
Age (median, years)	56 (47, 66)	56 (47, 66)	0.192
Age group (%)			
18–24	0.461	0.530	0.473
25–39	9.845	9.329	
40–54	36.657	35.584	
≥ 55	53.037	54.557	
Race (%)			
White	61.416	63.175	< 0.001
Black	17.930	14.528	
Hispanic	9.803	10.512	
Asian or Pacific Islander	3.310	4.587	
Native American	0.587	0.318	
Other	6.954	6.880	
Number of Comorbidity (%)			
0	6.368	9.172	< 0.001
1	17.763	28.988	
2	20.402	24.919	
≥ 3	55.467	36.921	
LOS (median, d)	3 (2–5)	2 (1–3)	< 0.001
TOTCHG (median, $)	68,283 (40,599-1,180,56)	60,036.00 (35,854.25-98,744.50)	< 0.001
Type of insure (%)			
Medicare	34.395	29.012	< 0.001
Medicaid	18.559	12.766	
Private insurance	40.553	53.193	
Self-pay	3.016	2.550	
No charge	0.335	0.222	
Other	3.142	2.257	
Bed size of hospital (%)			
Small	18.224	19.148	0.005
Medium	24.633	27.047	
Large	57.143	53.805	
Type of hospital (teaching %)	76.414	77.475	0.230
Location of hospital (urban, %)	93.925	96.006	< 0.001
Region of hospital (%)			
Northeast	18.601	28.869	< 0.001
Midwest or North Central	19.313	16.420	
South	37.453	34.657	
West	24.633	20.054	
Elective admission (%)	67.491	79.451	< 0.001
Died (%)	0.545	0.253	0.008
Smoking	31.127	23.288	< 0.001

LOS: Length of stay, TOTCHE: Total charge

of the region of hospital, the incidence of PP was less than 10.268% in the Northeast compared with patients who did not develop PP (18.601% vs. 28.869%, $P<0.001$), and in the Midwest or North-Central, South, and West, the incidence of post-hospitalization pain was increased, respectively 2.893% (19.313% vs. 16.420%), 2.796% (37.453% vs. 34.657%), 4.579% (24.633% vs. 20.054%) ($P<0.001$) (Table 2). However, there were no significant differences in hospital bed capacity or teaching hospital status (Table 2).

Adverse outcomes of PP after breast cancer surgery

Longer hospitalization was associated with PP (3 days), compared to those with no postoperative pain (2 days)

($P<0.001$) (Table 2), accounting for increased medical spending. In this respect, the total hospitalization expenses were raised significantly by $8,247 with PP ($68,283 vs. $60,036 $P<0.001$) (Table 2). Regarding the type of insurance, the proportion of individuals with private insurance in the PP group was lower by 12.64% (40.553% vs. 53.194%, $P<0.001$) (Table 2). Cases experiencing PP had more comorbidities (55.467% vs. 36.921%, $P<0.001$) (Table 2).

Factors predisposing to postoperative pain

LR analysis revealed that features predisposing to PP (Figs. 4 and 5) included patients older than 60 years (OR=0.638; CI=0.567–0.718), urban hospital (OR=0.694; CI=0.565–0.851), private insurance (OR=0.688; CI=0.605–0.784), elective admission (OR=0.797; CI=0.719–0.884), depression (OR=1.688; CI=1.500–1.900), drug abuse (OR=2.515; CI=1.862–3.397), metastatic cancer (OR=1.293; CI=1.159–1.442), psychoses (OR=1.501; CI=1.204–1.873), weight loss (OR=1.701; CI=1.392–2.079), solid tumor without metastasis (OR=0.675; CI=0.608–0.749), and Chronic pulmonary disease (OR=1.340; CI=193-1.505) (Supplementary Tables 2–3).

Additional complications associated with PP after breast cancer surgery

Univariate analysis showed that PP cases experienced more perioperative complications during hospital stay, encompassing urinary retention, gastrointestinal complications, continuous invasive ventilation, pneumonia, deep vein thrombosis, urinary tract infection, blood transfusion, arrhythmia, and chest pain ($P<0.001$) (Table 3). Multivariate analysis revealed that PP was associated with urinary retention (OR=1.797; CI=1.308–2.467), gastrointestinal complications

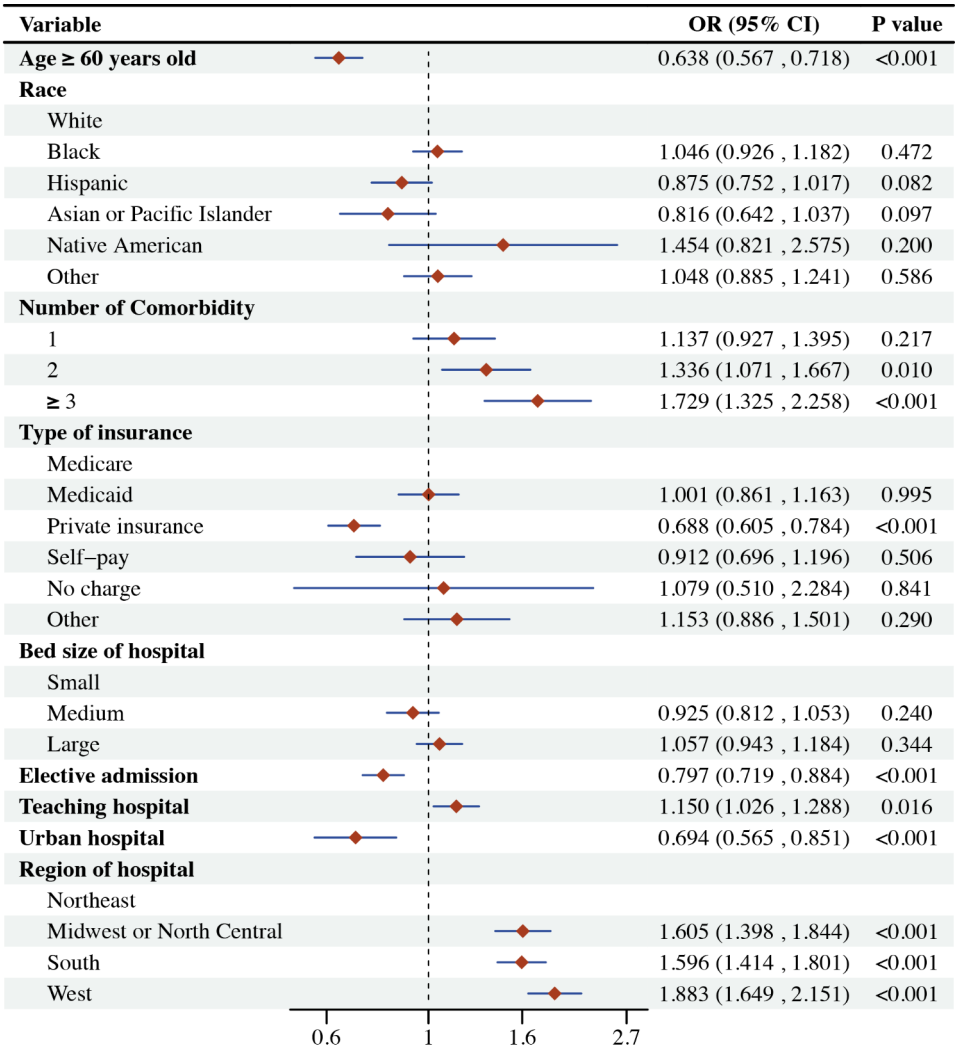

Fig. 4 Risk factors associated with PP after breast cancer surgery

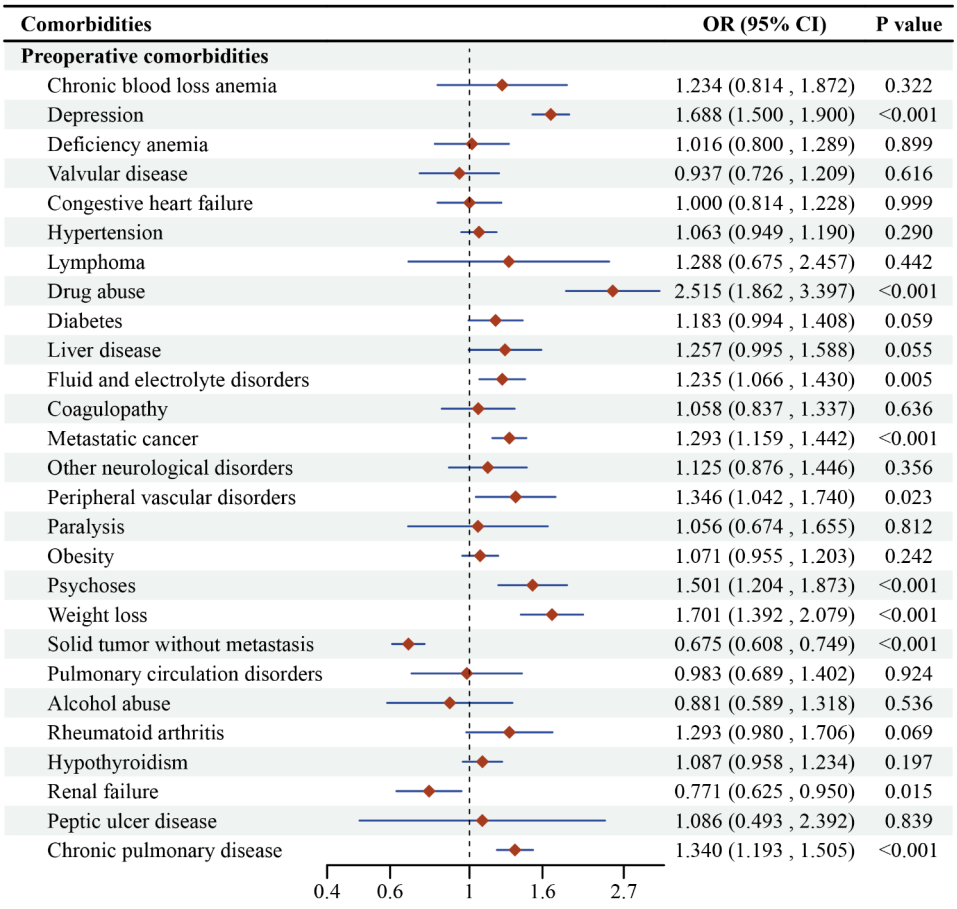

Fig. 5 Preoperative comorbidities associated with PP after breast cancer surgery

Table 3 Relationship between PP and postoperative complications

Complications	Univariate analysis			Multivariate logistic regression		
	Postoperative pain	No postoperative pain	P	OR	95% CI	P
Medical complications						
Urinary retention	46 (1.927%)	351 (0.964%)	<0.001	1.797	1.308–2.467	<0.001
Gastrointestinal complications	13 (0.545%)	27 (0.074%)	<0.001	6.197	3.120–12.310	<0.001
Continuous invasive Ventilation	32 (1.341%)	188 (0.516%)	<0.001	2.006	1.357–2.966	<0.001
Pneumonia	58 (2.430%)	409 (1.123%)	<0.001	1.475	1.093–1.992	0.011
Deep vein thrombosis	37(1.550%)	182 (0.500%)	<0.001	2.172	1.478–3.192	<0.001
Urinary tract infection	103 (4.315%)	725(1.990%)	<0.001	1.533	1.216–1.932	<0.001
Blood transfusion	161 (6.745%)	1,353 (3.714%)	<0.001	1.541	1.288–1.844	<0.001
POD	16 (0.670%)	132 (0.362%)	0.018	1.180	0.689–2.022	0.547
Arrhythmia	14 (0.587%)	57 (0.156%)	<0.001	3.614	1.997–6.538	<0.001
Chest pain	54 (2.262%)	174 (0.478%)	<0.001	4.347	3.177–5.948	<0.001
Surgical complications						
Nerve injury	1 (0.042%)	2 (0.005%)	0.156	2.741	0.138–54.457	0.509
Wound rupture without healing	29 (1.215%)	263 (0.722%)	0.007	1.519	1.019–2.262	0.040
Wound infection	38 (1.592%)	413 (1.134%)	0.043	1.218	0.859–1.726	0.268
Hemorrhage	86 (3.603%)	1,163 (3.193%)	0.271	1.012	0.806–1.272	0.916

POD: Postoperative delirium, OR: Odds ratio, CI: Confidence interval

(OR=6.197; CI=3.120–12.310), continuous invasive Ventilation (OR=2.006; CI=1.357–2.966), deep vein thrombosis (OR=2.172; CI=1.478–3.192), urinary tract infection (OR=1.533; CI=1.216–1.932), blood transfusion (OR=1.541; CI=1.288–1.844), arrhythmia (OR=3.614; CI=1.997–6.538), chest pain (OR=4.347; CI=3.177–5.948).

Discussion

This study includes a comprehensive examination of PP after breast cancer surgery, with a focus on the associated health economic impacts. Our study conducted the first nationwide survey of the incidence of PP after breast cancer surgery. Our study revealed an overall occurrence of 6.15% PP following breast cancer surgery, significantly lower than the rates reported in the literature, which ranged from 11 to 57%. Discrepancies in reported rates are contingent upon the adopted definition of PP, characteristics of the study population, and the methodology employed for assessment [20, 23, 24]. The observed variance may be attributed, in part, to limitations inherent in the National Inpatient Sample database. Notably, the database's restriction to postoperative pain during hospitalization confers high specificity (low false-positive rate) but exhibits low sensitivity (high false-negative rate), potentially leading to an underestimation of actual rates [25]. Secondly, differences in study design interpretation and diagnostic criteria could potentially account for the disparities in incidence observed [26].

This investigation presents an extensive health-economic analysis of PP following breast cancer surgery. Over the period spanning 2015 to 2019, the incidence of PP exhibited an upward trend, rising from approximately 4.89–7.34%. The comparatively low rates observed in 2015 may be attributed to the implementation of the ICD-10-CM coding system. The increase in PP incidence could be attributed to enhanced awareness of the medical staff [14, 27]. Alternatively, this phenomenon might be influenced by the widespread adoption of mammograms, leading to enhanced detection of asymptomatic diseases and, consequently, an enhanced identification of breast cancer cases. The subsequent rise in breast cancer surgeries may contribute to heightened patient expectations regarding pain management, as perceptions evolve [28, 29].

In terms of demographic characteristics, there was no significant age difference in patients with PP compared to those without PP. In addition, from the perspective of age distribution, clinical observations show that the proportion of middle-aged and elderly patients in the PP group is higher. However, logistic regression analysis identified an independent risk factor for PP as age less than 60 years. While the specific cause of postoperative pain associated with younger age remains unknown, its significance as a risk factor is well-established, widely thought to be due to the greater risk of advanced histopathological tumor grade among younger cases and the necessity for adjuvant chemotherapy in this demographic [30]. Moreover, disparities in estrogen receptor status between young and old patients, as well as decreased pain receptor sensitivity in old patients, are thought to be potential risk-related mechanisms [31]. Intriguingly, younger age was previously identified as a factor predisposing for breast cancer and postoperative pain [32–34].

The present study found that whites were disproportionately represented in the PP group, which is in accordance with the literature that more patients of white ethnicity who undergo general or orthopedic surgery experience PP [35, 36]. Nonetheless, the precise nature of the association between ethnic disparities and postoperative pain is still unknown, warranting more investigation.

As expected, patients who underwent breast cancer surgery during elective surgery were associated with lower rates of postoperative pain, given that most patients admitted for elective surgery are in good health or have been adequately evaluated and prepared prior to surgery [37]. In terms of regional location, hospitals in the Midwest or North Central, South, and West regions were related to increased postoperative pain, while hospitals in the Northeast region were linked to a lower incidence of postoperative pain. These disparities may be related to economic, social, and behavioral factors, such as racial discrimination, unhealthy environments, and persistent inequalities in access to care [38, 39]. In terms of location, patients undergoing surgery in urban hospitals experienced a lower incidence of postoperative pain, although the cause is unclear and may be due to multiple factors.

The number of comorbidities was significantly higher in patients with postoperative pain. This finding is acceptable because the higher prevalence of comorbidities means relatively poor health prior to surgery, which may increase the likelihood of postoperative complications, including postoperative pain. Previous studies have shown that postoperative pain is associated with longer hospital stays and increased health care expenditures [15, 18, 40]. Our study yielded similar results, showing a 1-day extension in median hospital stay due to postoperative pain and an increase in overall hospital stay costs of $8,247, per admission. In addition, patients with postoperative pain often have agitation, impaired consciousness, and are unable to follow nursing and rehabilitation instructions [41]. Patients with postoperative pain are more often paid through Medicare than those without postoperative pain. In addition, private insurance is a protective factor for postoperative pain, underscoring the significant influence of medical insurance type in this context.

Several studies on pain after breast cancer surgery have shown that risk stratification, pre-screening, and optimal care are essential to improve prognosis [20, 42, 43]. Therefore, to prevent the occurrence of postoperative pain, emphasis should be placed on comprehending the preoperative risk factors. As expected, preoperative drug abuse resulted in the highest OR (8.35) for pain (Fig. 5), indicating that such comorbidities are strongly related to the occurrence of postoperative pain and emphasized prior to surgery. Patients with a history of other neuropsychiatric disorders, such as depression (OR=1.688) and psychoses (OR=1.501), were found to be at higher risk of developing pain following BC surgery. Other comorbidities such as metastatic cancer (OR=1.293), weight loss (OR=1.701), and chronic pulmonary disease (OR=1.340) have previosuly been documented as factors predisposing to postoperative pain [44, 45]. Interestingly, patients older than 60 years (OR=0.638), urban hospital (OR=0.694), private insurance (OR=0.688), elective admission (OR=0.797), and solid tumor without metastasis (OR=0.675) yielded a protective effect against postoperative pain, although the reasons are unknown and could be multifaceted.

Our study offers notable strengths, encompassing a substantial study population size, national representativeness, and the adoption of multivariate regression models to account for confounders. However, it is imperative to recognize inherent shortcomings associated with the use of the National Inpatient Sample database. Firstly, the collection of each case data was confined to the duration of their hospital stay, thereby omitting complications or outcomes post-discharge, including readmission rates and long-term follow-up data from this database. Since only early-stage hospitalized cases are included, this limitation may lead to an underestimation of the incidence of postoperative pain [34, 46]. Secondly, akin to any extensive administrative dataset, coding, and documentation discrepancies or misclassifications may occur [25]. In addition, the evaluation is constrained to variables documented in the NIS database. Notably, pertinent surgical and anesthetic factors that could potentially influence postoperative pain, such as surgical technique, operation duration, anesthesia duration, anesthesia mode, and the selection of anesthetic agents, were not captured in the NIS database [18, 20].

Conclusions

Postoperative pain after BC surgery is a costly complication, with an overall incidence of 6.15%, comprising APP at an incidence of 2.47%, CPP at 2.81%, and OPP at 1.03%. From 2015 to 2019, the annual incidence of PP gradually increased. This study identified several features predisposing to pain in this patient population, including depression, drug abuse, metastatic cancer, psychoses, weight loss, and chronic pulmonary disease. In addition, PP is associated with urinary retention, gastrointestinal complications, continuous invasive Ventilation, deep vein thrombosis, urinary tract infection, blood transfusion, arrhythmia, and chest pain. Patients older than 60 years, urban hospitals, private insurance, elective admissions, and solid tumors without metastasis were identified as protective factors. PP in this specific patient population is related to higher total hospitalization costs, and longer LOS.

Abbreviations

BC	Breast Cancer
PP	Postoperative pain
APP	Acute postoperative pain
CPP	Chronic postoperative pain
OPP	Other postoperative pain
NIS	National Inpatient Sample
ICD	International Classification of Diseases
LR	Logistic Regression
LOS	Length of Stay
OR	Odds ratio
CI	Confidence interval
POD	Postoperative Delirium

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12905-024-03430-3.

Supplementary Material 1

Author contributions

SS, RL and XY contributed to the study design, data acquisition and analysis, interpretation of results, and writing and revising the manuscript. MW and YZ contributed to the study design, interpretation of results, and reviewing the manuscript. JW contributed to data acquisition, data analysis, and reviewing of the manuscript. YL contributed to the study design, interpretation of results, and reviewing the manuscript. All authors read and approved the final manuscript.

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Data availability

The datasets are available at https://www.ahrq.gov/data/hcup/index.html.

Declarations

Ethics approval and consent to participate

Not applicable. Administrative permissions were required to access the raw data used in this study and the author's (Jian Wang) work unit (Division of Orthopaedic Surgery, Department of Orthopaedics, Nanfang Hospital, Southern Medical University, Guangzhou, Guangdong, 510515, China.) has already granted permission from Agency for Healthcare Research and Quality (AHRQ) to access Healthcare Cost and Utilization Project (HCUP) Nationwide Databases. However, this observational study used deidentifed publicly available data, hence there was no requirement for consent to participate and it was deemed exempt by the ethics committee. So there is no need to grant permission in the Ethics approval and consent to participate section. What is more, the data used in this study were no need anonymized before its use. All methods are carried out following relevant guidelines and regulations.

Consent for publication

Not applicable.

Competing interests
The authors declare no competing interests.

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References

1. Bray F., Ferlay J., Soerjomataram I., Siegel R.L., Torre L.A., Jemal A. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. Cancer J Clin. 2018;68(6):394–424.
2. Heer E, Harper A, Escandor N, Sung H, McCormack V, Fidler-Benaoudia MM. Global burden and trends in premenopausal and postmenopausal breast cancer: a population-based study, The Lancet. Global health. 2020;8(8):e1027–37.
3. Huang J, Chan PS, Lok V, Chen X, Ding H, Jin Y, Yuan J, Lao XQ, Zheng ZJ, Wong MC. Global incidence and mortality of breast cancer: a trend analysis. Aging. 2021;13(4):5748–803.
4. Agus HZ, Kahraman S, Arslan C, Yildirim C, Erturk M, Kalkan AK, Yildiz M. Systemic immune-inflammation index predicts mortality in infective endocarditis. J Saudi Heart Association. 2020;32(1):58–64.
5. Harbeck N, Penault-Llorca F, Cortes J, Gnant M, Houssami N, Poortmans P, Ruddy K, Tsang J, Cardoso F. Breast cancer, Nature reviews. Disease primers. 2019;5(1):66.
6. Huen MS, Sy SM, Chen J. BRCA1 and its toolbox for the maintenance of genome integrity, Nature reviews. Mol cell biology. 2010;11(2):138–48.
7. Thompson JA, Schneider BJ, Brahmer J, Achufusi A, Armand P, Berkenstock MK, Bhatia S, Budde LE, Chokshi S, Davies M, Elshoury A, Gesthalter Y, Hegde A, Jain M, Kaffenberger BH, Lechner MG, Li T, Marr A, McGettigan S, McPherson J, Medina T, Mohindra NA, Olszanski AJ, Oluwole O, Patel SP, Patil P, Reddy S, Ryder M, Santomasso B, Shofer S, Sosman JA, Wang Y, Zaha VG, Lyons M, Dwyer M, Hang L. Management of Immunotherapy-Related Toxicities, Version 1.2022, NCCN Clinical Practice Guidelines in Oncology. J Natl Compr Cancer Network: JNCCN. 2022;20(4):387–405.
8. Al-Hilli Z, Wilkerson A. Breast Surgery: Management of Postoperative Complications Following Operations for Breast Cancer. Surg Clin North Am. 2021;101(5):845–63.
9. Woolf CJ. What is this thing called pain? J Clin Investig. 2010;120(11):3742–4.
10. Kehlet H. Postoperative pain, analgesia, and recovery-bedfellows that cannot be ignored. Pain. 2018;159(Suppl 1):S11–6.
11. Jung BF, Ahrendt GM, Oaklander AL, Dworkin RH. Neuropathic pain following breast cancer surgery: proposed classification and research update. Pain. 2003;104(1–2):1–13.
12. Mustonen L, Vollert J, Rice ASC, Kalso E, Harno H. Sensory profiles in women with neuropathic pain after breast cancer surgery. Breast Cancer Res Treat. 2020;182(2):305–15.
13. Shabangu N, Thebe T, Casey M, Wesselmann U, Parker R. Chronic pain in female breast cancer survivors - prevalence, characteristics and contributing factors: a cross-sectional pilot study. BMC Womens Health. 2023;23(1):613.
14. Caffo O, Amichetti M, Ferro A, Lucenti A, Valduga F, Galligioni E. Pain and quality of life after surgery for breast cancer. Breast Cancer Res Treat. 2003;80(1):39–48.
15. Belfer I, Schreiber KL, Shaffer JR, Shnol H, Blaney K, Morando A, Englert D, Greco C, Brufsky A, Ahrendt G, Kehlet H, Edwards RR, Bovbjerg DH. Persistent postmastectomy pain in breast cancer survivors: analysis of clinical, demographic, and psychosocial factors. J pain. 2013;14(10):1185–95.
16. Gärtner R, Jensen MB, Kronborg L, Ewertz M, Kehlet H, Kroman N. Self-reported arm-lymphedema and functional impairment after breast cancer treatment–a nationwide study of prevalence and associated factors, Breast (Edinburgh. Scotland). 2010;19(6):506–15.
17. Wang L, Cohen JC, Devasenapathy N, Hong BY, Kheyson S, Lu D, Oparin Y, Kennedy SA, Romerosa B, Arora N, Kwon HY, Jackson K, Prasad M, Jayasekera D, Li A, Guarna G, Natalwalla S, Couban RJ, Reid S, Khan JS, McGillion M, Busse JW. Prevalence and intensity of persistent post-surgical pain following breast cancer surgery: a systematic review and meta-analysis of observational studies. Br J Anaesth. 2020;125(3):346–57.
18. Armstrong AD, Hassenbein SE, Black S, Hollenbeak CS. Risk Factors for Increased Postoperative Pain and Recommended Orderset for Postoperative Analgesic Usage. Clin J Pain. 2020;36(11):845–51.
19. Pogatzki-Zahn EM, Segelcke D, Schug SA. Postoperative pain-from mechanisms to treatment. Pain Rep. 2017;2(2):e588.
20. Nelson ER, Gan TJ, Urman RD. Predicting Postoperative Pain: A Complex Interplay of Multiple Factors. Anesth Analg. 2021;132(3):652–5.
21. Ji W, Sang C, Zhang X, Zhu K, Bo L. Personality, Preoperative Anxiety, and Postoperative Outcomes: A Review. Int J Environ Res Public Health 19(19) (2022).
22. Liu R, Liu N, Suo S, Yang Q, Deng Z, Fu W, Wang M. Incidence and risk factors of postoperative delirium following hepatic resection: a retrospective national inpatient sample database study. BMC Surg. 2024;24(1):151.
23. Pak LM, Pawloski KR, Sevilimedu V, Kalvin HL, Le T, Tokita HK, Tadros A, Morrow M, Van Zee KJ, Kirstein LJ, Moo TA. How Much Pain Will I Have After Surgery? A Preoperative Nomogram to Predict Acute Pain Following Mastectomy. Ann Surg Oncol. 2022;29(11):6706–13.
24. Schreiber KL, Belfer I, Miaskowski C, Schumacher M, Stacey BR, Van De Ven T. AAAPT Diagnostic Criteria for Acute Pain Following Breast Surgery. J pain. 2020;21(3–4):294–305.
25. Edigin E, Kaul S, Eseaton PO. Analysis of hidradenitis suppurativa hospitalizations: A report from the National Inpatient Sample database. J Am Acad Dermatol. 2021;85(5):1357–60.
26. Siegel RL, Miller KD, Fuchs HE, Jemal A. Cancer statistics, 2022, CA: a cancer journal for clinicians 72(1) (2022) 7–33.
27. Meissner W, Zaslansky R. A survey of postoperative pain treatments and unmet needs, Best practice & research. Clin Anaesthesiol. 2019;33(3):269–86.
28. Breen N, Gentleman JF, Schiller JS. Update on mammography trends: comparisons of rates in 2000, 2005, and 2008. Cancer. 2011;117(10):2209–18.
29. Xu Y, Gong M, Wang Y, Yang Y, Liu S, Zeng Q. Global trends and forecasts of breast cancer incidence and deaths. Sci data. 2023;10(1):334.
30. Tait RC, Zoberi K, Ferguson M, Levenhagen K, Luebbert RA, Rowland K, Salsich GB, Herndon C. Persistent Post-Mastectomy Pain: Risk Factors and Current Approaches to Treatment. J pain. 2018;19(12):1367–83.
31. Bruce J, Thornton AJ, Scott NW, Marfizo S, Powell R, Johnston M, Wells M, Heys SD, Thompson AM. Chronic preoperative pain and psychological robustness predict acute postoperative pain outcomes after surgery for breast cancer. Br J Cancer. 2012;107(6):937–46.
32. Kehlet H, Jensen TS, Woolf CJ. Persistent postsurgical pain: risk factors and prevention. Lancet (London England). 2006;367(9522):1618–25.
33. Poobalan AS, Bruce J, Smith WC, King PM, Krukowski ZH, Chambers WA. A review of chronic pain after inguinal herniorrhaphy. Clin J Pain. 2003;19(1):48–54.
34. Meijuan Y, Zhiyou P, Yuwen T, Ying F, Xinzhong C. A retrospective study of postmastectomy pain syndrome: incidence, characteristics, risk factors, and influence on quality of life. TheScientificWorldJournal. 2013;2013:159732.
35. Dehal A, Abbas A, Johna S. Racial disparities in clinical presentation, surgical treatment and in-hospital outcomes of women with breast cancer: analysis of nationwide inpatient sample database. Breast Cancer Res Treat. 2013;139(2):561–9.
36. Meyer R, Maxey C, Hamilton KM, Nasseri Y, Barnajian M, Levin G, Truong MD, Wright KN, Siedhoff MT. Associations between race and ethnicity and perioperative outcomes among women undergoing hysterectomy for adenomyosis. Fertil Steril. 2024;121(6):1053–62.
37. Jonczyk MM, Fisher CS, Babbitt R, Paulus JK, Freund KM, Czerniecki B, Margenthaler JA, Losken A, Chatterjee A. Surgical Predictive Model for Breast Cancer Patients Assessing Acute Postoperative Complications: The Breast Cancer Surgery Risk Calculator. Ann Surg Oncol. 2021;28(9):5121–31.
38. Campbell RT, Li X, Dolecek TA, Barrett RE, Weaver KE, Warnecke RB. Economic, racial and ethnic disparities in breast cancer in the US: towards a more comprehensive model. Health Place. 2009;15(3):855–64.
39. Jordan H, Roderick P, Martin D, Barnett S. Distance, rurality and the need for care: access to health services in South West England. Int J Health Geogr. 2004;3(1):21.
40. Schug SA, Bruce J. [Risk stratification for the development of chronic postsurgical pain]. Schmerz (Berlin Germany). 2018;32(6):471–6.
41. O'Gara BP, Gao L, Marcantonio ER, Subramaniam B. Sleep, Pain, and Cognition: Modifiable Targets for Optimal Perioperative Brain Health. Anesthesiology. 2021;135(6):1132–52.

42. Khajoei R, Azadeh P, ZohariAnboohi S, Ilkhani M, Nabavi FH. Breast cancer survivorship needs: a qualitative study. BMC Cancer. 2024;24(1):96.
43. Wang L, Guyatt GH, Kennedy SA, Romerosa B, Kwon HY, Kaushal A, Chang Y, Craigie S, de Almeida CPB, Couban RJ, Parascandalo SR, Izhar Z, Reid S, Khan JS, McGillion M, Busse JW. Predictors of persistent pain after breast cancer surgery: a systematic review and meta-analysis of observational studies, CMAJ: Canadian Medical Association journal = journal de l'Association medicale canadienne 188(14) (2016) E352-e361.
44. Rechenmacher AJ, Yancy WS Jr., Bolognesi MP, Ryan SP, Jiranek WA, Horn ME. Does Medically Supervised Weight Loss Prior to Total Knee Arthroplasty Improve Patient-Reported Pain and Physical Function? J Arthroplast. 2024;39(2):350–4.
45. Kunkler IH, Williams LJ, Jack WJ, Cameron DA, Dixon JM. Breast-conserving surgery with or without irradiation in women aged 65 years or older with early breast cancer (PRIME II): a randomised controlled trial, The Lancet. Oncology. 2015;16(3):266–73.
46. Pergolizzi JV Jr., LeQuang JA, Magnusson P, Varrassi G. Identifying risk factors for chronic postsurgical pain and preventive measures: a comprehensive update. Expert Rev Neurother. 2023;23(12):1297–310.

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