

Ipsilateral Intravenous Catheter Placement in Breast Cancer Surgery Patients

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BACKGROUND: There is a continued perception that intravenous line (IV) placement is contraindicated in the arm ipsilateral to prior breast cancer surgery to avoid breast cancer–related lymphedema (BCRL). The aim of this retrospective study was to determine the risk for development of BCRL in ipsilateral arm IV placement compared to contralateral arm IV placement to prior breast cancer surgery.

METHODS: We performed a retrospective review, via our Integrated Clinical Systems and Epic Electronic Health Record of IV placement for anesthesia and surgery in patients with a prior history of breast cancer surgery with or without axillary lymph node dissection. Complication rates were compared for IVs placed in the ipsilateral and contralateral arms. We identified 3724 patients undergoing 7896 IV placements between January 1, 2015, and May 5, 2018, with a prior history of breast cancer surgery via their index anesthesia and surgical procedures.

RESULTS: The median time from breast cancer surgery to IV placement was 1.5 years (range, 1 day to 17.8 years). Of 2743 IVs placed in the arm contralateral to prior breast cancer surgery, 2 had a complication, corresponding to an incidence of 7.3 per 10,000 (95% confidence interval [CI], 0.9–26.3 per 10,000). Of 5153 IVs placed in the arm ipsilateral to prior breast cancer surgery, 2 IVs had a complication, for an incidence of 3.9 per 10,000 (95% CI, 0.5–14.0 per 10,000). The frequency of complications was not found to differ significantly between the groups ($P = .91$), and the 95% CI for the risk difference (ipsilateral minus contralateral) was –23 to +8 complications per 10,000. The complication rate is similar when only the first IV placed following breast cancer surgery is considered (overall 5.4 per 10,000 [95% CI, 0.7–19.4] per 10,000; contralateral 7.0 [95% CI, 0.2–39.0] per 10,000, ipsilateral 4.4 [95% CI, 0.1–24.2] per 10,000; $P = 1.00$; 95% CI for risk difference [ipsilateral minus contralateral], –41 to +22 per 10,000).

CONCLUSIONS: We found very few complications in patients who had an IV placed for surgery following a previous breast cancer surgery and no complications in those patients with IV placement ipsilateral with axillary node dissection. Avoidance of IV placement in the arm ipsilateral to breast cancer surgery is not necessary. (*Anesth Analg* 2021;133:707–12)

KEY POINTS

- **Question:** What is the safety of ipsilateral intravenous line (IV) placement following breast cancer surgery as determined by a retrospective study?
- **Findings:** Out of 7896 IV placements in 3724 patients, 4 were associated with complications, and of the 2354 IVs placed in the arm ipsilateral to prior breast cancer surgery that did have axillary nodes removed, there were no complications.
- **Meaning:** Total avoidance of IV catheters on the arm ipsilateral to breast cancer surgery is not needed.

GLOSSARY

BCRL = breast cancer–related lymphedema; **BMI** = body mass index; **CI** = confidence interval; **HCCA** = Health Care Compliance Association; **ICD-9-CM** = *International Classification of Diseases, 9th Revision, Clinical Modification*; **ICD-10-CM** = *International Classification of Diseases, 10th Revision, Clinical Modification*; **IRB** = institutional review board; **IV** = intravenous line; **MICS** = Mayo Integrated Clinical Systems Chart; **NOS** = not otherwise specified; **SD** = standard deviation

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Accepted for publication March 31, 2021.

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DOI: 10.1213/ANE.0000000000005597

Funding: Support was provided solely from institutional and/or departmental sources.

The authors declare no conflicts of interest.

Reprints will not be available from the authors.

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Breast cancer is the most common cancer in women.¹ Treatment of breast cancer patients relies on pathologic information from axillary surgical staging. The original operation for breast cancer, radical mastectomy, and extensive axillary lymph nodes resection have been replaced by less invasive surgeries, including lumpectomy, sentinel node biopsy, and selective omission of axillary staging. Axillary lymph node dissection and sentinel lymph node biopsy are still required in some patients. Breast cancer surgery including axillary lymph node dissection and adjuvant therapies such as radiation therapy and taxane-based chemotherapy are associated with breast cancer–related lymphedema (BCRL) in up to 21% of breast cancer survivors.^{1,2} BCRL is an abnormal accumulation of protein-rich interstitial fluid, resulting in swelling of the upper limb or trunk. BCRL is a feared complication of breast and axillary operations.³

There is controversy as to whether placement of intravenous line (IV) in the ipsilateral surgical arm is associated with BCRL.^{4–8} The American Society of Breast Surgeons Expert Panel recommendations state that the use of ipsilateral arm for IVs or blood pressure measurements is not contraindicated.⁹ In spite of an accumulation of data stating otherwise, this historical stance is difficult to change, and the majority of breast cancer surgery patients are instructed to avoid venipuncture and IV placement on the ipsilateral arm of surgery for the rest of their lives.

We hypothesize that, in the absence of symptoms of BCRL, an IV placement in the arm ipsilateral to a prior breast cancer surgery is not associated with increased patient complications compared to an IV placement in the contralateral arm. We aimed to test this hypothesis through a retrospective study of the initial safety of IV placement in the ipsilateral arm of prior breast cancer surgery patients compared to the contralateral arm.

METHODS

Study Design

After institutional review board (IRB) approval, we performed a retrospective review, via Mayo Integrated Clinical Systems Chart+ (MICS Chart+) and Epic Electronic Health Record, of IV placement for anesthesia and surgery in patients with a prior history of breast cancer surgery. Retrospective studies do not require written informed consent; therefore, this requirement was waived by the IRB. We compared complication rates in the ipsilateral versus the contralateral arm. Complications within 14 days of IV placement within the hospital were determined using the following codes: 729.71 *International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM)* nontraumatic compartment syndrome of upper

extremity; 729.79 *ICD-9-CM* nontraumatic compartment of other sites; 729.73 *ICD-9-CM* nontraumatic compartment of abdomen; 729.72 *ICD-9-CM* nontraumatic compartment syndrome of lower extremity; 729.7 *ICD-9-CM* nontraumatic compartment syndrome; 958.90 *ICD-9-CM* compartment syndrome traumatic not otherwise specified (NOS); T79.A0XS *International Classification of Diseases, 10th Revision, Clinical Modification (ICD-10-CM)* Compartment syndrome, unspecified, sequel; T79.A0XD A0XS *ICD-10-CM* compartment syndrome, unspecified, subsequent encounter; T79.A0XA *ICD-10-CM* compartment syndrome, unspecified, initial encounter (HCCA); M79.A11 *ICD-10-CM* nontraumatic compartment syndrome of right upper extremity; M79.A12 *ICD-10-CM* nontraumatic compartment syndrome of left upper extremity; M79.A19 *ICD-10-CM* nontraumatic compartment syndrome of unspecified upper extremity; 682.3 *ICD-9-CM* cellulitis and abscess of upper arm and forearm; 682.4 *ICD-9-CM* cellulitis and abscess of hand, except fingers and thumb; L03.111 *ICD-10-CM* cellulitis of right axilla; L03.112 *ICD-10-CM* cellulitis of left axilla; L03.113 *ICD-10-CM* cellulitis arm recurrent right; L03.119 *ICD-10-CM* cellulitis of unspecified part of limb; L03.818 *ICD-10-CM* cellulitis of other sites; L03.90, B95.62 *ICD-10-CM* cellulitis methicillin-resistant *Staphylococcus aureus*; 782.3 *ICD-9-CM* edema leg multifactorial; R60.0 *ICD-10-CM* edema leg multifactorial; and 457.1 *ICD-9-CM* lymphedema with personal history of breast cancer. We identified 134 patients who had 1 of the above codes and reviewed their charts.

Setting

This was a single-center retrospective study of an academic medical center.

Patient Population

All adult patients (>18 years) who had IV placements between January 1, 2015, and May 5, 2018, who required anesthesia and surgery and had a prior history of breast cancer surgery were included.

Variables

The following patient data were extracted from the medical records: demographics such as age at time of surgery, gender, and date of birth; comorbidities¹⁰ and total score as measured by the Charlson comorbidity index; time in days from breast cancer surgery to placement of peripheral IV; BCRL-related complications that were present before IV placement; and complications that occurred 14 days following the IV placement date in the patient's medical record.

Statistical Analysis. Analysis was performed to determine the incidence of IV-related complications

including venous thrombosis, cellulitis, and/or BCRL. Analyses were performed using only the first IV placed in the patient with a prior history of breast cancer surgery and using all IVs placed in the patient during the study period. Incidence rates were calculated overall and according to IV location (ipsilateral versus contralateral arm in relation to prior breast cancer surgery). The rate of complications was compared between IV locations (ipsilateral versus contralateral) using a continuity-adjusted χ^2 test. Additional summaries are presented for subgroups of patients with and without a history of BCRL before IV placement. In all cases, rates are expressed as the number of complications per 10,000 IV placements and are summarized using point estimates and exact binomial 95% confidence intervals (CIs).

Study Size

No a priori power analysis was conducted.

RESULTS

We identified 3724 patients who underwent 7896 IV placements between January 1, 2015, and May 5, 2018, and had a prior history breast cancer surgery. The demographic characteristics are shown in Table 1. The patients with IVs placed in the arm contralateral to their prior breast cancer surgery were significantly older and had higher Charlson scores than

the ipsilateral arm IV placement patients (both P s < .001)¹⁰ (#2929). Furthermore, most patients with ipsilateral arm IV placement had undergone a prior bilateral breast cancer surgery (P < .001). The median time from breast cancer surgery to IV placement was 1.5 years (range, 1 day to 17.8 years).

Of all 7896 IV placements, there were 4 that had complications, corresponding to an incidence rate of 5.1 per 10,000 (95% CI, 1.4–13.0 per 10,000) (Table 2). Of 2743 IVs placed in the arm contralateral to prior breast cancer surgery, 2 had a complication, corresponding to an incidence of 7.3 per 10,000 (95% CI, 0.9–26.3 per 10,000). Of 5153 IVs placed in the arm ipsilateral to prior breast cancer surgery, 2 IVs had a complication, 3.9 per 10,000 (95% CI, 0.5–14.0 per 10,000). The frequency of complications was not found to differ significantly between the groups (P = .91), and the 95% CI for the risk difference (ipsilateral minus contralateral) was –23 to +8 complications per 10,000. The complication rate is similar when only the first IV placed following breast cancer surgery is considered (overall 5.4 [95% CI, 0.7–19.4] per 10,000; contralateral 7.0 [95% CI, 0.2–39.0] per 10,000, ipsilateral 4.4 [95% CI, 0.1–24.2] per 10,000; P = 1.00; 95% CI for risk difference [ipsilateral minus contralateral], –41 to +22 per 10,000) (Table 2).

Of 2743 IVs placed in the arm contralateral to prior breast cancer surgery, 2 had a complication, 7.3 per 10,000 (0.9–26.3 per 10,000). The first patient was a 30-year-old woman who underwent a left mastectomy and lymph node dissection with immediate expander reconstruction and subsequent chemotherapy. She subsequently developed left-arm lymphedema treated with physical therapy and an arm sleeve and glove. She subsequently underwent a left silicone gel implant insertion, nipple reconstruction, and port-A-catheter removal via right-arm IV. She developed transient aggravation of her left-arm lymphedema. The second patient was a 36-year-old woman with a history of breast cancer treated with right mastectomy, adjuvant chemotherapy, and radiotherapy who presented with a progressively worsening cough and left lower lobe mass-like infiltrate. She underwent a bronchoscopy with an IV in the left arm. She was noted to have right-arm lymphedema 3 days later, which spontaneously resolved and required no treatment.

Of 2799 IVs placed in the arm ipsilateral to prior breast cancer surgery in patients who that did not have axillary nodes removed, 2 patients had IVs associated complication, corresponding to a rate of 7.1 per 10,000 (95% CI, 0.9–25.8 per 10,000). The first patient identified with an IV-associated complication was a 92-year-old woman with a history of moderate coronary atherosclerosis; paroxysmal atrial fibrillation who was status post prior ablation and on Coumadin;

Table 1. Patient Characteristics at the Time of Breast Cancer Surgery (N = 3724)

Characteristics	Side of first subsequent IV placement			P value ^b
	Overall (N = 3724)	Contralateral (N = 1427)	Ipsilateral ^a (N = 2297)	
Age, y				
Mean ± SD	53 ± 13	57 ± 13	51 ± 13	<.001
Median (25th–75th)	52 (45–62)	56 (47–66)	50 (43–60)	
Sex, n (%)				
Female	3647 (97.9)	1405 (98.5)	2242 (97.6)	.075
Male	77 (2.1)	22 (1.5)	55 (2.4)	
Charlson score				
Mean ± SD	4.1 ± 2.4	4.5 ± 2.4	3.8 ± 2.4	<.001
Median (25th–75th)	4 (3, 5)	4 (3, 6)	3 (2, 5)	
Breast surgery side, n (%)				
Left	852 (22.9)	662 (46.4)	189 (8.2)	<.001
Right	1080 (29.0)	765 (53.6)	316 (13.8)	
Bilateral	1792 (48.1)	0 (0.0)	1792 (78.0)	
Nodes removed, n (%) ^c				
No	2011 (54.0)	785 (55.0)	1226 (53.4)	.330
Yes	1713 (46.0)	642 (45.0)	1071 (46.6)	

Abbreviations: IV, intravenous line; SD, standard deviation.

^aIncludes single breast cancer surgery ipsilateral arm and bilateral breast cancer surgery.

^bAge and Charlson score are compared between the groups using the rank-sum test. Sex, breast cancer surgery side, and node removal are compared between the groups using the χ^2 test.

^cFor patients undergoing unilateral breast cancer surgery, 814/1932 (42.1%) had nodes removed, and for patients undergoing bilateral breast cancer surgery, 899/1792 (50.1%) had nodes removed.

Table 2. Complications Associated With IV Placement After Breast Cancer Surgery^a

Characteristic	First IV only (N = 3724)			All IVs (N = 7896)		
	Number of IVs placed	Complications		Number of IVs placed	Complications	
		No.	Rate per 10,000 Estimate (95% CI)		No.	Rate per 10,000 Estimate (95% CI)
Overall	3724	2	5.4 (0.7–19.4)	7896	4	5.1 (1.4, 13.0)
Side of IV placement						
Breast surgery contralateral arm	1427	1	7.0 (0.2–39.0)	2743	2	7.3 (0.9–26.3)
Breast surgery ipsilateral arm ^b	2297	1	4.4 (0.1–24.2)	5153	2	3.9 (0.5–14.0)
Without nodes removed	1226	1	8.2 (0.2–45.4)	2799	2	7.1 (0.9–25.8)
With nodes removed	1071	0	0.0 (0.0–34.4)	2354	0	0.0 (0.0–15.7)

Abbreviation: CI, confidence interval; IV, intravenous line.

^aThere were a total of 7896 IVs placed in 3724 patients.

^bIncludes single breast cancer surgery ipsilateral arm and bilateral breast cancer surgery.

hypertension; hyperlipidemia; type 2 diabetes mellitus and bilateral mastectomy. Nine years after her mastectomies, she had a traumatic fall and required a closed reduction and internal fixation of a right hip fracture. IVs were placed in the right arm. On postoperative day 5, she was noted to have 3 mm of pitting edema over her left elbow and pitting edema in both legs, right greater than left. The edema was treated with physical therapy. The second patient was a 71-year-old woman with a past history of bilateral mastectomy, adjuvant radiotherapy, adjuvant chemotherapy with Taxotere and Cytoxan, and a history of upper and lower extremity lymphedema right worse than left, who underwent L2-L5 laminectomy 2 years after her mastectomies. An IV and arterial line were placed in her left arm for the laminectomy surgery. She developed diffuse bilateral upper and lower edema on the first postoperative day that resolved spontaneously.

Of 2354 IVs placed in the arm ipsilateral to the prior breast cancer surgery with axillary nodes removed, none had a complication, for a rate of 0.0 per 10,000 (95% CI, 0.0–15.7 per 10,000).

All 4 patients who had prior breast cancer surgery and subsequently required an IV placement in the upper extremity for an anesthetic and developed a complication had a history of BCRL before the date of IV placement. The incidence of IV-associated complications for those with and without a history of BCRL is summarized in Table 3. The estimated rate of complications in patients with a history of BCRL was significantly higher (Fisher exact test $P < .001$) compared to that for patients without a history of BCRL (40.9 [95% CI, 11.2–104.5] per 10,000 versus 0.0 [95% CI, 0.0–5.3] per 10,000; Fisher exact test $P < .001$).

DISCUSSION

We identified very few complications of IV placement in patients with a prior history of breast cancer surgery. The patients with IV placement in the arm contralateral to their prior breast cancer surgery were older and sicker than patients with ipsilateral arm IV

placement. Most of the ipsilateral arm IV placement patients had undergone bilateral breast cancer surgery. This suggests a bias to avoid ipsilateral IV placement in patients who had prior breast cancer surgery, especially those who are older and sicker. Despite this, we found few complications in all groups.

Disruption in the lymphatic system, such as excision of lymph nodes, can be an inciting event for the accumulation of lymph in the interstitial tissues, with subsequent tissue swelling leading to lymphedema.^{3,11} The risk factors for BCRL include axillary surgery (especially axillary lymph node dissection with >5 nodes removed), regional axillary node irradiation, taxane chemotherapy, body mass index (BMI) >30 kg/m², weight gain following breast cancer surgery, edema within 3 months of surgery, edema at any time after surgery, cellulitis, and inactivity.^{1,12,13} Lymphedema typically presents as subjective tightness, heaviness, and pain in the affected tissue. The accepted treatment of acquired lymphedema is combined decongestive therapy, gradient manual lymphatic drainage, compression bandaging, therapeutic exercises, and skin care.³ Seventy percent of patients will experience BCRL within 2 years of their surgery, 90% within 3 years, and 1% per year after 3 years.¹⁴

There is a continued perception that IV placement is contraindicated in the arm ipsilateral to prior breast cancer surgery.^{9,15} A survey that revealed the most frequently identified factor (75%) perceived by breast cancer survivors to increase the chance of BCRL was blood draws or IVs on the arm ipsilateral to the surgery.¹⁶ Furthermore, the 10-year survival rate for breast cancer has increased to 83%, with many of the patients going on to need surgery and IV placement.¹⁷

The first reported case associating BCRL with needle-stick injury was a patient who developed ipsilateral arm swelling after a blood glucose needle stick 30 years following radical mastectomy.¹⁸ Brennan¹⁹ then published an article suggesting strategies to reduce the risk of BCRL, with the statement “Foremost among these precautions are the avoidance of injury to the limb (including needle puncture, lacerations and abrasions,

Table 3. Complications Associated With IV Placement After Breast Cancer Surgery in Patients With and Without a Prior History of BCRL

Characteristic	Without history of BCRL (N = 6919)			With history of BCRL (N = 977)		
	Number of IVs placed	Complications		Number of IVs placed	Complications	
		No.	Rate per 10,000 Estimate (95% CI)		No.	Rate per 10,000 Estimate (95% CI)
Overall	6919	0	0.0 (0.0–5.3)	977	4	40.9 (11.2–104.5)
Side of IV placement						
Breast surgery contralateral arm	2371	0	0.0 (0.0–15.5)	372	2	53.8 (6.5–192.8)
Breast surgery ipsilateral arm ^b	4548	0	0.0 (0.0–8.1)	605	2	33.1 (4.0–118.9)
Without nodes removed	2470	0	0.0 (0.0–14.9)	329	2	60.8 (7.4–217.9)
With nodes removed	2078	0	0.0 (0.0–17.7)	276	0	0.0 (0.0–132.8)

Abbreviations: BCRL, breast cancer-related lymphedema; CI, confidence interval; IV, intravenous line.

^aAll IVs placed after breast cancer surgery are included.

^bIncludes single breast cancer surgery ipsilateral arm and bilateral breast cancer surgery.

insect stings and bites, and solar or thermal burns) and identification of infection.” Clark et al²⁰ performed a prospective observational study of 251 patients who had surgical treatment of breast cancer. They demonstrated that hospital skin puncture, mastectomy, and BMI >26 were associated with BCRL by univariate analysis with no multivariable analysis. It is important to note that recommendations above were made when most patients underwent radical mastectomy for breast cancer therapy. This operation, with its extensive skin, muscle, and lymph node resection, is rarely performed now and has been replaced by less invasive surgeries, including lumpectomy, muscle- and skin-sparing mastectomies, sentinel node biopsy, and selective omission of axillary staging. As a result, we need to reevaluate whether these recommendations remain valid.

Multiple studies indicate that trauma to the arm ipsilateral to prior breast cancer surgery is not associated with increased risk of BCRL. Dawson et al²¹ reported on carpal tunnel surgery to the ipsilateral arm following mastectomy and found no increase in BCRL. Gunnoo et al²² noted a transient worsening of lymphedema in the affected arm that rapidly disappeared in 32 patients who had carpal tunnel surgery to the ipsilateral arm following mastectomy. In a small study, Lee et al²³ also showed no problems with hand surgery on the ipsilateral arm following prior breast cancer surgery. Baltzer et al²⁴ performed a retrospective cohort study of 103 patients who underwent elective hand surgery on the arm ipsilateral to prior breast cancer surgery and showed that 3.8% of patients had lymphedema after hand surgery.

Asdourian et al⁵ performed a review of 31 articles that examined whether lifestyle-associated risk factors increase the risk of BCRL. Infections and inflammation of the ipsilateral arm were the most clearly defined risk factors for BCRL, with no direct evidence correlating venous puncture with BCRL. Ferguson et al⁴ reported on 3041 arm volume measurements before and following mastectomy. They found no significant association between relative volume changes or

weight-adjusted change and blood draws, injections, and air travel. Kilbreath et al⁶ performed a prospective study of 539 women undergoing breast surgery for cancer for whom weekly diaries were kept for 18 months. For those with >5 nodes removed, independent risk factors for BCRL were early arm swelling, radiation therapy to the axilla, taxane-based chemotherapy, and high BMI. Showalter et al⁸ performed a subanalysis of the Physical Activity and Lymphedema trial of 295 breast cancer survivors reporting 30 different potential risk factors for BCRL. Only sauna use was associated with BCRL. Trauma and blood draws were not associated with BCRL.

Study Limitations

Our study has limitations secondary to retrospective design, in addition to the bias noted above. It is possible that IV complications were not reported in the patient record or the patient developed complications after hospital discharge that were not reported. The reported incidence of phlebitis following IV catheter placement is 30%.^{25,26} These complications are likely under-reported in our study as they are usually treated by local heat application and not recorded in the patient’s record. Lymphedema was assessed by clinical signs and symptoms and not limb volume measurements. It is known that objective measures of lymphedema, such as limb volume measurements, identify some cases in which the patient is unaware of the lymphedema.²⁷ Provider discretion directed IV placement. As such, IV placement was likely avoided on the extremity with active or a history of lymphedema. Furthermore, those patients who were adamantly against IV placement in the arm ipsilateral to prior breast surgery would certainly not have an IV placed in that limb. This would be a strong confounding factor to this study.

In conclusion, total avoidance of IV catheters on the arm ipsilateral to breast cancer surgery is not needed, especially for patients without a history of BCRL. ■

DISCLOSURES

Name: Julian Naranjo, DO.

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