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Contralateral prophylactic mastectomy in women with breast cancer: Trends, predictors, and areas for future research

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Abstract

Recent studies have revealed increasing rates of contralateral prophylactic mastectomy (CPM) among women with unilateral early stage breast cancer. This trend has raised concerns, given the lack of evidence for a survival benefit from CPM and the relatively low risk of contralateral breast cancer for most women in this setting. In this article, we review available data regarding the value of CPM, predictors and outcomes related to CPM, and areas for future research and potential intervention.

Keywords

contralateral prophylactic mastectomy; breast cancer; surgery

Introduction

Rates of contralateral prophylactic mastectomy (CPM) among women treated for early stage breast cancer have increased dramatically in recent years [1-5]. This increase has been documented in several recent studies. Using Surveillance, Epidemiology, and End Results (SEER) Program data, Tuttle et al. [1] found that the proportion of mastectomy patients who underwent CPM increased from 4.2% in 1998 to 11.0% in 2003. Among DCIS patients, CPM rates rose from 6.4% in 1998 to 18.4% in 2005 [2]. Similarly, Yao et al. [3] reported an increase in CPM rates from 0.4% to 4.7% between 1998 and 2007 among all women who had breast cancer surgery in an analysis of data from the National Cancer Data Base (NCDB). This national trend has also been confirmed in smaller, single institution studies. Jones et al. [6] reported an increase in CPM rates from 6.5% in 1999 to 16.1% in 2007 at the James Cancer Hospital at The Ohio State University, and King et al. [7] documented an increase from 6.7% in 1997 to 24.2% in 2005 at Memorial Sloan-Kettering Cancer Center. Given the availability of surveillance and alternative preventive options [8,9], and the lack of clear evidence of a survival benefit in most settings [4,10-14], there is a need to evaluate this trend.

Predictors of CPM

Studies have consistently identified that women who undergo CPM are predominantly non-Hispanic white, younger in age, more educated, married, and have a family history of breast or ovarian cancer[4,7,10,15-17]. These women are also more likely to be of a higher

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socioeconomic status and be privately insured [3,5]. While early stage cancers, larger tumors, lower tumor grade, negative lymph node status, and lobular type histology have been found to be associated with CPM, most research to date suggests that patient characteristics, such as age and education status, are stronger predictors of CPM than tumor factors [1,3,7]. Planned breast reconstruction and previous efforts to perform breast conserving surgery on the affected side have also been established as determinants of likelihood to undergo CPM [7].

Increased imaging in breast cancer survivors, particularly the use of more sensitive modalities such as MRI, is another factor that has been evaluated to assess the contribution to higher rates of CPM. At present, data are conflicting in this regard. Arrington et al. [17] found no association between MRI usage and CPM among 571 patients who underwent breast cancer surgery in six Minnesota hospitals. In contrast, in a study of 177 women who underwent CPM matched with 178 women who did not, Chung et al. [12] reported that women who underwent preoperative MRI were twice as likely to choose CPM. Similarly, in a multi-institutional study of 3608 women, Sorbero et al. [18] found that 9.2% of women who underwent MRI opted for CPM, while only 4.7% of patients who did not undergo MRI chose CPM. In a large, single-institution study of almost 3,000 women who had mastectomy, King and colleagues [7] found that preoperative MRI with the indication for additional biopsy of the contralateral breast was associated with CPM.

There has also been consideration of the roles played by anxiety, misperceptions about the risks of contralateral disease and value of CPM, and/or inaccurate understanding about the systemic risks of the disease in the affected breast on the decision to undergo CPM [19,20]. A recent analysis found that worry about recurrence was significantly associated with undergoing CPM rather than unilateral mastectomy or breast conserving surgery [21]. In a recent study surveying a cohort of young women regarding their decision to undergo CPM, 95% of patients reported “desire for peace of mind” as an extremely or very important reason for choosing CPM [22]. These data suggest that women may opt for CPM for psychological rather than clinical indications. The fact that many women overestimate their risk of contralateral disease also suggests that misinformation might be influencing the decision to choose CPM [22,23].

In a study by Montgomery and colleagues [24], women surveyed about their reasons for choosing CPM indicated that recommendation from a doctor was a main factor associated with the decision. Other important factors included apprehension about a second breast cancer diagnosis, a family history of breast cancer, and cosmetic symmetry [24]. It is important to note that there are other options for symmetry aside from CPM, such as mastopexy, augmentation, and reduction mammoplasty [25]. Some data also suggest that patients of female surgeons are more likely to undergo CPM [17] although this has not been confirmed in other studies [26]. Issues related to surveillance of the unaffected breast, having a multi-centric primary tumor, and having a tumor that was originally missed on mammography have also all been found to be associated with CPM [15,27].

Decision-making, outcomes and satisfaction with CPM

There are a number of factors that a woman and her providers should consider in the decision to undergo CPM (see Figure 1). Beyond cosmetic and emotional concerns as noted above, women should ideally have an understanding of the risk of developing contralateral breast cancer (CBC) and the efficacy of the procedure in preventing a contralateral event. Consideration of the competing risk of recurrence that a woman faces, both loco-regionally and systemically, from the breast cancer she has already developed is necessary. Understanding the risk of the procedure itself from a medical and psychosocial standpoint is

also essential. For the average breast cancer survivor, the risk of developing a second primary tumor in the contralateral breast is low: 0.5% to 1% per year over the first five years following diagnosis [28]. Population based data from Sweden demonstrated a lifetime cumulative risk of 13.3% for women under 50-years-old at first diagnosis and 3.5% for women older than 50[29]. Because of the relatively low likelihood of developing CBC, the efficacy of CPM is put under greater scrutiny. While CPM is associated with a 90- 97% risk reduction of CBC [1,10] for most women, this corresponds, on average, to an absolute risk reduction of 2.0%. Further, the competing risk of metastasis from a history of having had primary breast cancer needs be considered in the balance and is generally far greater than the risk of a CBC.

Less controversy surrounds the decision to undergo CPM for women with markedly increased risk of contralateral disease including those with a potential hereditary predisposition to breast cancer, known BRCA1 or BRCA2 carriers or rare hereditary breast-cancer predisposing syndromes, or history of therapeutic chest irradiation. Women with a personal and strong family history of breast cancer have a 35% risk of developing CBC within 16 years of initial diagnosis [30]. Similarly, women who are known BRCA1 or BRCA2 carriers have a 20% [31] and 12% risk [32], respectively, of developing CBC within five years of initial diagnosis. In premenopausal women, the use of CPM can reduce the risk of CBC by 94.4% and in post-menopausal women by 96.0% [33]. However, even in this setting Graves et al. [34] reported in 2007 that only 18% of women with unilateral breast cancer elected to undergo CPM after testing positive for a BRCA mutation. Despite the potential risk reduction benefits for BRCA1 and BRCA2 carriers, Arrington and colleagues [35] found that only 7.9% of CPM patients underwent BRCA testing prior to surgery. King et al. [7] reported that 29% of patients undergoing CPM had had genetic testing, with a mutation rate of 31% among those tested. These studies suggest that while the risk of developing CBC is considerably higher for women who are mutation carriers, the recent rise in use of CPM cannot be attributed primarily to these choices among these high risk women. In fact, in a recent SEER analysis, 70% of women who had CPM did not appear to be at an elevated risk of developing cancer in their unaffected breast [36].

While there is little dispute about the risk reduction offered by CPM, the gold standard for most cancer treatments is whether it provides a survival benefit. Data are mixed with regard to the benefits of CPM with the majority of studies suggesting no survival advantage (see Table 1). Herrinton et al. [10] reported a 47% and 40% reduced risk of breast cancer and all-cause mortality, respectively, associated with CPM. More recently, Bedrosian et al.[11] reported better 5-year survival associated with CPM in patients younger than 50 with early-stage, ER-negative disease. In a study by Peralta et al. [4] CPM was associated with better disease-free survival, however there was no statistically significant difference in overall survival between women who had CPM and those who did not; similarly, there was no difference in survival between women who had CPM and those undergoing unilateral mastectomy in a study by Chung et al.[12]. A recent systematic review also concluded that CPM does not offer a survival benefit[14]. Among high-risk women, some recent studies suggest a survival benefit [37,38], however this has not been found in other studies [13]. Because there have been no randomized trials of CPM, consideration of the biases inherent in these studies is warranted. Women who choose and are counseled to undergo CPM may be healthier than non-CPM patients, with less co-morbidity and less aggressive primary disease.

It is important to note that studies have demonstrated that satisfaction with CPM is generally high among women who have had the procedure. Geiger et al. [39] found 86.5% of CPM patients were satisfied with their decision to undergo CPM. Nekhlyudov et al. [16] reported that women who reported active roles in their decision-making process (defined as the

woman deciding alone or deciding after hearing her physician's opinion) were twice as likely to be satisfied with their decision to undergo CPM compared to women who reported passive roles. Similarly, Montgomery et al. [24] found that only 6% of CPM patients reported regrets. In this study, the main issues of regret among women who underwent CPM were poor cosmetic outcomes (from either CPM or reconstruction), lessened feelings of sexuality, and a lack of knowledge about different modes of screening for the other breast [24]. Not surprisingly, however, in a study by Rolnick et al. [40], only 58% of women who had been diagnosed with breast cancer and underwent CPM wished they had been given more information prior to their surgery in contrast to 79% of women without a history of breast cancer undergoing bilateral prophylactic mastectomy who wished they had been given more information. Further, satisfaction with CPM has been found to be even higher among women with both a family and personal history of breast cancer [41].

Data are mixed regarding the impact of CPM on psychological outcomes. While Unokovych et al. [42] found that CPM was not associated with any negative long-term psychological outcomes, Tuli et al. [43] reported a high prevalence of depression among women who had CPM. Medical outcomes should also be considered. One study detected higher rates of adverse events following surgery, including higher post-surgical infection rates and greater likelihood of additional surgical intervention among CPM patients, compared to unilateral mastectomy patients [44].

Limitations and Future Directions

Despite the recent surge in research about the rates and efficacy of contralateral prophylactic mastectomy, the data available remain limited. Most studies reviewed were retrospective database or medical record reviews. While these studies have provided valuable information about the risk reduction associated with CPM, it is difficult to discern what truly drives women to undergo CPM without prospective data. Research to date has shown that there are many factors associated with CPM and future research is warranted to see if and how such factors influence the decision-making processes. There are also limitations with many of the larger database studies based on patient information collected many decades earlier. Older, less effective treatments led to a higher rate of metastasis and poorer survival, as well as lower rates of CBC. Therapeutic advances for current breast cancer patients has improved survival [45], however this will also likely result in an increased incidence of CBC in an aging survivor population.

Additional data is needed to better understand the role of cost in relation to the decision to undergo CPM. Interestingly, a recent decision analysis [46] found CPM to be more cost-effective when compared to regular surveillance among women under the age of 70. There is also a need for prospective data about why women choose CPM and how this choice affects both health and psychosocial outcomes. Data collected both prior to and after surgery would allow for the assessment of how patients' thoughts and emotions change throughout their treatment. For example, if CPM resulted in reduced levels of anxiety in women, this could potentially change how providers counsel patients about this topic. Similarly, prospective data related to satisfaction with cosmetic outcome and symmetry is also needed. Without prospective data, it is difficult to accurately measure any changes that a woman experiences throughout the course of her treatment and into the survivorship period.

It would also be valuable to examine patients of different aged cohorts. Young women undergo CPM at higher rates than older patients [6,7,10,15-17,20]. Younger patients are a unique population who often have younger children or are still dating, and may still be in the formative years of their career. During this phase in life, younger women might feel more driven to have their opposite breast removed as a preventive measure. Body image issues

may be more pertinent to younger women and therefore they might be more likely to choose CPM for cosmetic reasons. Furthermore, while younger women are often diagnosed with more advanced disease [47] they generally have few co-morbidities and are typically good surgical candidates. Importantly, younger patients are also more likely to suffer from post-mastectomy pain syndrome than their older counterparts [48].

Finally, it is likely that some women who undergo CPM have misperceptions about the actual risks and values of the surgery. Improved education and counseling is likely to help and decision aids may be particularly useful in this setting to assure that patients are making choices that are consistent with their preferences and values and should be studied [49-51]. For some women, when weighing all of the pros and cons, CPM may be the right choice. In order for caregivers to provide quality care to their patients and inform this decision, and for patients to achieve optimal medical and psychosocial outcomes, further research to determine both the short and long term risks and benefits associated with CPM is warranted.

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References

1. Tuttle TM, Habermann EB, Grund EH, Morris TJ, Virnig BA. Increasing use of contralateral prophylactic mastectomy for breast cancer patients: a trend toward more aggressive surgical treatment. *J Clin Oncol*. 2007; 25(33):5203–5209. [PubMed: 17954711]
2. Tuttle TM, Jarosek S, Habermann EB, Arrington A, Abraham A, Morris TJ, Virnig BA. Increasing rates of contralateral prophylactic mastectomy among patients with ductal carcinoma in situ. *J Clin Oncol*. 2009; 27(9):1362–1367. [PubMed: 19224844]
3. Yao K, Stewart AK, Winchester DJ, Winchester DP. Trends in contralateral prophylactic mastectomy for unilateral cancer: a report from the National Cancer Data Base, 1998-2007. *Ann Surg Oncol*. 2010; 17(10):2554–2562. [PubMed: 20461470]
4. Peralta EA, Ellenhorn JD, Wagman LD, Dagis A, Andersen JS, Chu DZ. Contralateral prophylactic mastectomy improves the outcome of selected patients undergoing mastectomy for breast cancer. *Am J Surg*. 2000; 180(6):439–445. [PubMed: 11182394]
5. McLaughlin CC, Lillquist PP, Edge SB. Surveillance of prophylactic mastectomy: trends in use from 1995 through 2005. *Cancer*. 2009; 115(23):5404–5412. [PubMed: 19787635]
6. Jones NB, Wilson J, Kotur L, Stephens J, Farrar WB, Agnese DM. Contralateral prophylactic mastectomy for unilateral breast cancer: an increasing trend at a single institution. *Ann Surg Oncol*. 2009; 16(10):2691–2696. [PubMed: 19506956]
7. King TA, Sakr R, Patil S, Gurevich I, Stempel M, Sampson M, Morrow M. Clinical management factors contribute to the decision for contralateral prophylactic mastectomy. *J Clin Oncol*. 2011; 29(16):2158–2164. [PubMed: 21464413]
8. Tamoxifen for early breast cancer: an overview of the randomised trials. Early Breast Cancer Trialists' Collaborative Group. *Lancet*. 1998; 351(9114):1451–1467. [PubMed: 9605801]
9. Polychemotherapy for early breast cancer: an overview of the randomised trials. Early Breast Cancer Trialists' Collaborative Group. *Lancet*. 1998; 352(9132):930–942. [PubMed: 9752815]
10. Herrinton LJ, Barlow WE, Yu O, Geiger AM, Elmore JG, Barton MB, Harris EL, Rolnick S, Pardee R, Husson G, Macedo A, Fletcher SW. Efficacy of prophylactic mastectomy in women with unilateral breast cancer: a cancer research network project. *J Clin Oncol*. 2005; 23(19):4275–4286. [PubMed: 15795415]
11. Bedrosian I, Hu CY, Chang GJ. Population-based study of contralateral prophylactic mastectomy and survival outcomes of breast cancer patients. *J Natl Cancer Inst*. 2010; 102(6):401–409. [PubMed: 20185801]

12. Chung A, Huynh K, Lawrence C, Sim MS, Giuliano A. Comparison of patient characteristics and outcomes of contralateral prophylactic mastectomy and unilateral total mastectomy in breast cancer patients. *Ann Surg Oncol*. 2012; 19(8):2600–2606. [PubMed: 22396004]
13. van Sprundel TC, Schmidt MK, Rookus MA, Brohet R, van Asperen CJ, Rutgers EJ, Van't Veer LJ, Tollenaar RA. Risk reduction of contralateral breast cancer and survival after contralateral prophylactic mastectomy in BRCA1 or BRCA2 mutation carriers. *Br J Cancer*. 2005; 93(3):287–292. [PubMed: 16052221]
14. Lostumbo L, Carbine NE, Wallace J. Prophylactic mastectomy for the prevention of breast cancer. *Cochrane Database Syst Rev*. 2010; (11):CD002748. [PubMed: 21069671]
15. Yi M, Hunt KK, Arun BK, Bedrosian I, Barrera AG, Do KA, Kuerer HM, Babiera GV, Mittendorf EA, Ready K, Litton J, Meric-Bernstam F. Factors affecting the decision of breast cancer patients to undergo contralateral prophylactic mastectomy. *Cancer Prev Res (Phila)*. 2010; 3(8):1026–1034. [PubMed: 20647335]
16. Nekhlyudov L, Bower M, Herrinton LJ, Altschuler A, Greene SM, Rolnick S, Elmore JG, Harris EL, Liu A, Emmons KM, Fletcher SW, Geiger AM. Women's decision-making roles regarding contralateral prophylactic mastectomy. *J Natl Cancer Inst Monogr*. 2005; (35):55–60. [PubMed: 16287886]
17. Arrington AK, Jarosek SL, Virnig BA, Habermann EB, Tuttle TM. Patient and surgeon characteristics associated with increased use of contralateral prophylactic mastectomy in patients with breast cancer. *Ann Surg Oncol*. 2009; 16(10):2697–2704. [PubMed: 19653045]
18. Sorbero ME, Dick AW, Beckjord EB, Ahrendt G. Diagnostic breast magnetic resonance imaging and contralateral prophylactic mastectomy. *Ann Surg Oncol*. 2009; 16(6):1597–1605. [PubMed: 19330381]
19. Kwong A, Chu AT. What made her give up her breasts: a qualitative study on decisional considerations for contralateral prophylactic mastectomy among breast cancer survivors undergoing BRCA1/2 genetic testing. *Asian Pac J Cancer Prev*. 2012; 13(5):2241–2247. [PubMed: 22901201]
20. Fisher CS, Martin-Dunlap T, Ruppel MB, Gao F, Atkins J, Margenthaler JA. Fear of recurrence and perceived survival benefit are primary motivators for choosing mastectomy over breast-conservation therapy regardless of age. *Ann Surg Oncol*. 2012; 19(10):3246–3250. [PubMed: 22833001]
21. Hawley ST, Jagsi R, Morrow M, Katz SJ. Correlates of contralateral prophylactic mastectomy in a population-based sample. *J Clin Oncol*. 2011; 29(suppl) abstr 6010.
22. Rosenberg SM, Tracy M, Meyer ME, Sepucha K, Gelber S, Hirshfield-Bartek J, Troyan S, Morrow M, Schapira L, Come SE, Winer EP, Partridge AH. Perceptions, knowledge, and satisfaction with contralateral prophylactic mastectomy among young women with breast cancer: A cross-sectional survey. *Ann Intern Med*. 2013 (in press).
23. Abbott A, Rueth N, Pappas-Varco S, Kuntz K, Kerr E, Tuttle T. Perceptions of contralateral breast cancer: an overestimation of risk. *Ann Surg Oncol*. 2011; 18(11):3129–3136. [PubMed: 21947590]
24. Montgomery LL, Tran KN, Heelan MC, Van Zee KJ, Massie MJ, Payne DK, Borgen PI. Issues of regret in women with contralateral prophylactic mastectomies. *Ann Surg Oncol*. 1999; 6(6):546–552. [PubMed: 10493622]
25. Losken A, Carlson GW, Bostwick J 3rd, Jones GE, Culbertson JH, Schoemann M. Trends in unilateral breast reconstruction and management of the contralateral breast: the Emory experience. *Plast Reconstr Surg*. 2002; 110(1):89–97. [PubMed: 12087236]
26. Musiello T, Bornhammar E, Saunders C. Breast surgeons' perceptions and attitudes towards contralateral prophylactic mastectomy. *ANZ J Surg*. 2012
27. Gershenwald JE, Hunt KK, Kroll SS, Ross MI, Baldwin BJ, Feig BW, Ames FC, Schusterman MA, Singletary SE. Synchronous elective contralateral mastectomy and immediate bilateral breast reconstruction in women with early-stage breast cancer. *Ann Surg Oncol*. 1998; 5(6):529–538. [PubMed: 9754762]

28. Fisher ER, Fisher B, Sass R, Wickerham L. Pathologic findings from the National Surgical Adjuvant Breast Project (Protocol No. 4). XI. Bilateral breast cancer. *Cancer*. 1984; 54(12):3002–3011. [PubMed: 6498774]
29. Adami HO, Bergstrom R, Hansen J. Age at first primary as a determinant of the incidence of bilateral breast cancer. Cumulative and relative risks in a population-based case-control study. *Cancer*. 1985; 55(3):643–647.
30. Harris RE, Lynch HT, Guirgis HA. Familial breast cancer: risk to the contralateral breast. *J Natl Cancer Inst*. 1978; 60(5):955–960. [PubMed: 642037]
31. Verhoog LC, Brekelmans CT, Seynaeve C, van den Bosch LM, Dahmen G, van Geel AN, Tilanus-Linthorst MM, Bartels CC, Wagner A, van den Ouweland A, Devilee P, Meijers-Heijboer EJ, Klijn JG. Survival and tumour characteristics of breast-cancer patients with germline mutations of BRCA1. *Lancet*. 1998; 351(9099):316–321. [PubMed: 9652611]
32. Verhoog LC, Brekelmans CT, Seynaeve C, Dahmen G, van Geel AN, Bartels CC, Tilanus-Linthorst MM, Wagner A, Devilee P, Halley DJ, van den Ouweland AM, Meijers-Heijboer EJ, Klijn JG. Survival in hereditary breast cancer associated with germline mutations of BRCA2. *J Clin Oncol*. 1999; 17(11):3396–3402. [PubMed: 10550133]
33. McDonnell SK, Schaid DJ, Myers JL, Grant CS, Donohue JH, Woods JE, Frost MH, Johnson JL, Sitta DL, Slezak JM, Crotty TB, Jenkins RB, Sellers TA, Hartmann LC. Efficacy of contralateral prophylactic mastectomy in women with a personal and family history of breast cancer. *J Clin Oncol*. 2001; 19(19):3938–3943. [PubMed: 11579114]
34. Graves KD, Peshkin BN, Halbert CH, DeMarco TA, Isaacs C, Schwartz MD. Predictors and outcomes of contralateral prophylactic mastectomy among breast cancer survivors. *Breast Cancer Res Treat*. 2007; 104(3):321–329. [PubMed: 17066320]
35. Arrington A, Tuttle T. Author Reply: Contralateral prophylactic mastectomy overtreatment: Expectations from personal genomics for tailored breast cancer surgery. *Ann Surg Oncol*. 2010; 17:940.
36. Hawley S, Jaggi R, Katz S. Is contralateral prophylactic mastectomy (CPM) overused? Results from a population-based study. *J Clin Oncol*. 2012; 30(suppl 34) abstr 26.
37. Evans DG, Ingham SL, Baidam A, Ross GL, Lalloo F, Buchan I, Howell A. Contralateral mastectomy improves survival in women with BRCA1/2-associated breast cancer. *Breast Cancer Res Treat*. 2013
38. Boughey JC, Hoskin TL, Degnim AC, Sellers TA, Johnson JL, Kasner MJ, Hartmann LC, Frost MH. Contralateral prophylactic mastectomy is associated with a survival advantage in high-risk women with a personal history of breast cancer. *Ann Surg Oncol*. 2010; 17(10):2702–2709. [PubMed: 20853163]
39. Geiger AM, West CN, Nekhlyudov L, Herrinton LJ, Liu IL, Altschuler A, Rolnick SJ, Harris EL, Greene SM, Elmore JG, Emmons KM, Fletcher SW. Contentment with quality of life among breast cancer survivors with and without contralateral prophylactic mastectomy. *J Clin Oncol*. 2006; 24(9):1350–1356. [PubMed: 16549829]
40. Rolnick SJ, Altschuler A, Nekhlyudov L, Elmore JG, Greene SM, Harris EL, Herrinton LJ, Barton MB, Geiger AM, Fletcher SW. What women wish they knew before prophylactic mastectomy. *Cancer Nurs*. 2007; 30(4):285–291. quiz 292–283. [PubMed: 17666977]
41. Frost MH, Slezak JM, Tran NV, Williams CI, Johnson JL, Woods JE, Petty PM, Donohue JH, Grant CS, Sloan JA, Sellers TA, Hartmann LC. Satisfaction after contralateral prophylactic mastectomy: the significance of mastectomy type, reconstructive complications, and body appearance. *J Clin Oncol*. 2005; 23(31):7849–7856. [PubMed: 16204003]
42. Unukovych D, Sandelin K, Liljegren A, Arver B, Wickman M, Johansson H, Brandberg Y. Contralateral prophylactic mastectomy in breast cancer patients with a family history: A prospective 2-years follow-up study of health related quality of life, sexuality and body image. *Eur J Cancer*. 2012; 48(17):3150–3156. [PubMed: 22695071]
43. Tuli R, Chandra RA, Sugar E, Christodouleas JP, Flynn RA, Usuki KY, Brill KL, Rosenberg AL. Patient decision making, satisfaction, and quality of life following contralateral prophylactic mastectomy. *J Clin Oncol*. 2010; 28(15):19160.

44. Stover AC, Warren PA, Foster RD, Esserman LJ, Alvarado MD, Ewing CA, Hwang ES. Impact of Contralateral Prophylactic Mastectomy on Surgical Outcomes. *Cancer Res.* 2012; 71:PD02–01.
45. Peto R, Boreham J, Clarke M, Davies C, Beral V. UK and USA breast cancer deaths down 25% in year 2000 at ages 20–69 years. *Lancet.* 2000; 355(9217):1822. [PubMed: 10832853]
46. Zendejas B, Moriarty JP, O'Byrne J, Degnim AC, Farley DR, Boughey JC. Cost-effectiveness of contralateral prophylactic mastectomy versus routine surveillance in patients with unilateral breast cancer. *J Clin Oncol.* 2011; 29(22):2993–3000. [PubMed: 21690472]
47. Bharat A, Aft RL, Gao F, Margenthaler JA. Patient and tumor characteristics associated with increased mortality in young women (< or =40 years) with breast cancer. *J Surg Oncol.* 2009; 100(3):248–251. [PubMed: 19330813]
48. Vilholm OJ, Cold S, Rasmussen L, Sindrup SH. The postmastectomy pain syndrome: an epidemiological study on the prevalence of chronic pain after surgery for breast cancer. *Br J Cancer.* 2008; 99(4):604–610. [PubMed: 18682712]
49. Sivell S, Edwards A, Manstead AS, Reed MW, Caldon L, Collins K, Clements A, Elwyn G. Increasing readiness to decide and strengthening behavioral intentions: evaluating the impact of a web-based patient decision aid for breast cancer treatment options. *Patient Educ Couns.* 2012; 88(2):209–217. (BresDex: www.bresdex.com). [PubMed: 22541508]
50. Kurian AW, Munoz DF, Rust P, Schackmann EA, Smith M, Clarke L, Mills MA, Plevritis SK. Online tool to guide decisions for BRCA1/2 mutation carriers. *J Clin Oncol.* 2012; 30(5):497–506. [PubMed: 22231042]
51. Peate M, Meiser B, Cheah BC, Saunders C, Butow P, Thewes B, Hart R, Phillips KA, Hickey M, Friedlander M. Making hard choices easier: a prospective, multicentre study to assess the efficacy of a fertility-related decision aid in young women with early-stage breast cancer. *Br J Cancer.* 2012; 106(6):1053–1061. [PubMed: 22415294]

Figure 1.
Risks and benefits to consider when weighing the decision to undergo contralateral prophylactic mastectomy (CPM)

Table 1

Summary of studies evaluating survival outcomes among women undergoing contralateral prophylactic mastectomy

Author	Year	Study Design	Study Population	Major Outcomes
Peralta et al.[4]	2000	Retrospective cohort (Institutional series)	64 CPM 182 non-CPM	No significant differences in overall survival between CPM and non-CPM patients
Herrinton et al. [10]	2005	Retrospective cohort (HMO data from the Cancer Research Network)	1,072 CPM 317 non-CPM For mortality analysis: 908 CPM 46,368 non-CPM	CPM was associated with better overall and disease-free survival
van Sprundel et al. [13]	2005	Retrospective cohort (Institutional series)	BRCA 1/2 carriers 79 CPM 69 non-CPM	After controlling for bilateral prophylactic oophorectomy, CPM did not improve overall survival.
Bedrosian et al. [11]	2010	Retrospective cohort (SEER data)	8,902 CPM 98,204 non-CPM	CPM improved survival among women < age 50 with early-stage ER-negative tumors
Boughey et al. [38]	2010	Retrospective cohort (Institutional series)	Women with a positive family history for breast cancer 385 CPM 385 Non-CPM	CPM was associated with better disease-free and overall survival.
Chung et al.[12]	2012	Retrospective cohort (Institutional series)	177 CPM 178 non-CPM	No survival benefit associated with CPM
Evans et al. [37]	2013	Retrospective cohort (Institutional series)	BRCA 1/2 mutation carriers 105 CPM 593 non-CPM	After controlling for bilateral prophylactic oophorectomy, CPM was associated with better disease-free and overall survival.