Patterns of initial management of node-negative breast cancer in two Canadian provinces

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Abstract

Objective: To describe the patterns of initial management of node-negative breast cancer in Ontario and British Columbia and to compare the characteristics of the patients and tumours and of the physicians and hospitals involved in management.

Design: Retrospective, population-based, cohort study.

Participants: All 942 newly diagnosed cases of node-negative breast cancer in 1991 in British Columbia and a random sample of 938 newly diagnosed cases in Ontario in the same year.

Outcome measures: Number and proportion of patients with newly diagnosed node-negative breast cancer who received breast-conserving surgery (BCS) or mastectomy and who received radiation therapy after BCS.

Results: BCS was used in 413 cases (43.8%) in British Columbia and in 634 cases (67.6%) in Ontario ($p < 0.001$). After BCS, radiation therapy was received by 378 patients (91.5% of those who had undergone BCS) in British Columbia and 479 patients (75.6% of those who had undergone BCS) in Ontario ($p < 0.001$). In both provinces, lower patient age, smaller tumour size, a noncentral unifocal tumour, absence of extensive ductal carcinoma in situ and initial surgery by a surgeon with an academic affiliation were associated with greater use of BCS. Lower patient age and larger tumour size were associated with greater use of radiation therapy after BCS in both provinces.

Conclusion: Patient, tumour and physician factors are associated with the choice of initial management of breast cancer in these two Canadian provinces. However, the differences in management between the two provinces are only partly explained by these factors. Other possible explanations, such as the presence of provincial guidelines, differences in the organization of the health care system or differences in patient preference, require further research.

Résumé

Objectifs : Décrire les tendances du traitement initial du cancer du sein sans ganglions lymphatiques axillaires homolatéraux palpables en Ontario et en Colombie-Britannique et comparer les caractéristiques des patientes et des tumeurs ainsi que celles des médecins et des hôpitaux traitants.

Conception : Étude de cohortes rétrospective stratifiée.

Participantes : Les 942 nouveaux cas de cancer du sein sans ganglions lymphatiques axillaires homolatéraux palpables diagnostiqués en 1991 en Colombie-Britannique et un échantillon aléatoire de 938 nouveaux cas en Ontario au cours de la même année.

Mesures des résultats : Nombre et proportion des patientes chez lesquelles on venait de diagnostiquer un cancer du sein sans ganglions lymphatiques axillaires homolatéraux palpables qui ont subi une intervention chirurgicale conserva-

Evidence

Études

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trice ou une mastectomie, et qui ont reçu de la radiothérapie après l'intervention chirurgicale conservatrice.

Résultats : On a pratiqué une intervention chirurgicale conservatrice du sein dans 413 cas (43,8 %) en Colombie-Britannique et dans 634 (67,6 %) en Ontario ($p < 0,001$). Après avoir subi une intervention chirurgicale conservatrice du sein, 378 patientes (91,5 % de celles qui avaient subi une intervention chirurgicale conservatrice du sein) ont reçu des traitements de radiothérapie en Colombie-Britannique et 479 patientes (75,6 % de celles qui avaient subi une intervention chirurgicale conservatrice du sein) en ont reçu en Ontario ($p < 0,001$). Dans les deux provinces, on a établi un lien entre l'utilisation plus fréquente de l'intervention chirurgicale conservatrice du sein et l'âge moins élevé des patientes, la taille plus faible de la tumeur, la présence d'une tumeur non centrale à foyer unique, l'absence de carcinome intracanalaire non infiltrant étendu et une première intervention chirurgicale pratiquée par un chirurgien affilié à une université. On a établi un lien entre, d'une part, l'âge moins élevé des patientes et la taille plus importante de la tumeur et, d'autre part, une utilisation plus fréquente de la radiothérapie après une intervention chirurgicale conservatrice du sein dans les deux provinces.

Conclusion : On établit un lien entre des facteurs relatifs aux patientes, à la tumeur et au médecin et le choix du traitement initial du cancer du sein dans ces deux provinces du Canada. Ces facteurs n'expliquent toutefois qu'en partie seulement les différences enregistrées entre les deux provinces au niveau du traitement. Il faut toutefois pousser les recherches sur d'autres explications comme l'existence de guides provinciaux, les structures différentes des systèmes de soins de santé ou les préférences différentes des patientes.

Current evidence suggests that either breast-conserving surgery (BCS) followed by radiation therapy or mastectomy lead to equivalent local control of cancer and survival for women with stage I or II breast cancer.[1–6] Variation in the availability and use of these procedures has been widely documented.[7–14]

Several reasons for the variation in the use of BCS and mastectomy have been suggested. Given that the survival outcomes are similar, patient and physician preferences play a major role.[15] In choosing BCS, women must trade off the cosmetic and psychological advantages with the need for follow-up radiation therapy and the possible anxiety associated with a perceived increased risk of local recurrence of breast cancer.[16] Women with families or work commitments and women who must travel a long distance for treatment may prefer mastectomy to BCS with radiation therapy because of the time and travel involved in radiation therapy.[17] The waiting time for radiation therapy has increased in some areas,[18] which may influence surgical choices.

Although variation in the use of these two treatment methods for early-stage breast cancer has previously been examined, little attention has been paid to the factors that may influence their selection. Many studies have used administrative databases that lack clinical detail or are not population based.[7–10] For example, a previous study involving two of us (V.G. and E.J.H.) that described patterns of practice in Ontario could not include factors at presentation, such as tumour size, that may have influenced treatment choice.[10] Other factors not reflected in administrative databases, such as physician characteristics, may also influence clinical management.[19]

This study describes the choice of surgical procedure and the use of radiation therapy in the initial management of early-stage breast cancer and the associated patient, tumour, physician and hospital characteristics in two Canadian provinces, British Columbia and Ontario, in 1991.

It should be noted that in 1991 British Columbia had province-wide guidelines for the treatment of breast cancer,[20] but Ontario did not. The British Columbia guidelines recommended modified radical mastectomy for patients with multifocal tumours. For other types of tumours, the guidelines did not recommend either BCS or mastectomy, and they emphasized the importance of patient choice. However, BCS was noted to be ideal for women with unifocal, noncentral tumours less than 4 cm in diameter. Radiation therapy was recommended after BCS and after modified radical mastectomy with positive surgical margins. It was considered optional for women with tumours larger than 5 cm in diameter who had undergone modified radical mastectomy.

Methods

We conducted a retrospective, population-based, cohort study by identifying cases of node-negative breast cancer newly diagnosed in 1991 in each province. The provincial

cancer registries, which have high coverage, were used to select cases.[21,22] In British Columbia, all cases that met the basic criteria were included, whereas in Ontario, because of the larger population and number of cases, a random sample was selected. Because the cancer registries do not contain detailed information on cancer stage, the records of all cases that met the basic inclusion criteria were then reviewed to assess their eligibility for the study.

The basic inclusion criterion was that nodal status was confirmed to be negative by pathologic examination. Table 1 describes the reasons for exclusion of cases and the final cohorts included from each province. The inclusion and exclusion criteria were selected to ensure that the two cohorts were as comparable as possible. Patients in whom management was more likely to be complex or who were less likely to receive standard treatments were excluded. Patients thus excluded were those over 90 years of age, those whose breast cancer was diagnosed by death certificate only or who died within 30 days of diagnosis, those with nonepithelial forms of cancer, those with previous invasive cancer or breast carcinoma in situ and those with bilateral breast cancer or carcinoma in situ. Cases in which initial treatment was provided out of province were also excluded. Upon review, we found cases in which the patients were men or the patients did not have breast cancer; these cases were also excluded. In Ontario, after data collection had commenced, one regional cancer centre (involving 272 cases) refused to participate, as did one community hospital (involving 3 cases). Although the absence of a regional cancer centre might have led to a greater proportion of cases that were not referred to a cancer centre in the Ontario cohort than in the British Columbia cohort, when we weighted the cohorts to account for this difference, the results did not change substantially. Therefore, all data are presented unweighted.

Data elements required for the study were identified and defined before data were collected. On the basis of the framework proposed by Deber and Thompson,[23] the data were grouped into categories by demographic variables of the patient (age and region of residence), tumour characteristics (size, margins, location, lymphatic, vascular or neural [LVN] invasion, and extent of ductal carcinoma

Table 1: Exclusion criteria and cases excluded from cohorts of women with newly diagnosed node-negative breast cancer in British Columbia and Ontario, 1991

	Province; no. (and %) of patients	
Exclusion criteria	British Columbia	Ontario
Total cases registered in 1991	2317	5760
Duplicate cases registered	1 (0.0)	7 (0.1)
Age over 90 years	32 (1.4)	83 (1.4)
Diagnosis by death certificate only or death within 30 days of diagnosis	32 (1.4)	112 (1.9)
Nonepithelial forms of cancer or noncancerous conditions	27 (1.2)	23 (0.4)
Previous invasive cancer or breast carcinoma in situ	207 (8.9)	254 (4.4)
Cases randomly selected (Ontario only)	NA†	2917
Cancer centre or hospital did not participate	NA	275 (8.6)*
Bilateral invasive cancer or breast carcinoma in situ	86 (3.7)	28 (0.9)*
Breast carcinoma in situ or borderline malignant tumour	221 (9.5)	30 (0.9)*
Criteria related to cancer staging		
Chest-wall extension of tumour or metastatic cancer	105 (4.5)	149 (4.7)*
Node-positive tumour	534(23.1)	670(21.1)*
Nodal status unknown	120 (5.2)	242 (7.6)*
Treatment received out of province	10 (0.4)	5 (0.2)*
Medical record could not be located, patient was male, cancer site was not the breast, or diagnosis was not made in 1991	0	27 (0.8)*
Total excluded	1375	4822
Total included	942	938

*The sampling fraction in Ontario was 55% of cases eligible at the time of random selection. These percentages for Ontario are corrected for the sampling fraction (i.e., they represent the proportion of all registered cases).
†NA = not applicable.

in situ), physician characteristics (year of graduation from medical school and academic affiliation), hospital characteristics (teaching status and number of beds) and treatments received (type of surgery and use of radiation therapy). All information held in the cancer registries in electronic form was retrieved first, followed by centrally stored paper documents (e.g., reports from pathologic examinations) and by information from other databases (e.g., drug data and physician billings). Next, data abstractors reviewed information contained in medical records at cancer centres and larger hospitals. Finally, remaining information was sought by writing to hospital records departments or to the most responsible physician.

Information on physician characteristics was obtained through the 1991 *Canadian Medical Directory*[24] and on hospital characteristics from the 1991 *Canadian Hospital Directory*.[25] Before this information was merged with other data, names and other identifying information were removed. The patients' socioeconomic status was inferred from the Forward Sortation Area of each patient's postal code.[26] Each Forward Sortation Area takes in a population of approximately 10 000; the median family income for each area was obtained from the 1991 census.[27]

The data abstractors were certified health-records technicians, trained as a group at the start of the study. They were in regular communication throughout the study. Materials were periodically exchanged between provinces for quality assurance. Any cases with which the abstractors had difficulty were reviewed in conjunction with the investigators. Throughout the study, the anonymity of patients, physicians and hospitals was preserved. The study was approved by all relevant institutional ethics committees.

For each case, the most definitive surgical procedure performed within 6 months of diagnosis was assessed. On the basis of a review of reports from pathologic examinations and of notes from surgery, the abstractor categorized each procedure as a mastectomy or as BCS, which included any procedure less extensive than a mastectomy. Radiation therapy was defined as a course of radiation treatment begun within 12 months of diagnosis that was not for a recurrence of cancer.

Two patients were assumed to have received radiation therapy. These patients took part in a 1991 clinical trial of locoregional therapy that evaluated the use of radiation after BCS.[28] In this trial, patients were randomly assigned to receive radiation therapy (the control or standard treatment at the time) or no radiation therapy. We assumed that the two patients received the control treatment, radiation therapy. Omitting these two cases does not affect the results.

The χ^2 test was used to compare key variables between the two provinces. The Mantel–Haenszel test for heterogeneity was used to assess whether the relation between a variable and treatment differed between the provinces. Because we intend only to describe patterns of care, we do not present multivariate models in this article. Although many of the individual factors associated with choice of treatment are interrelated, descriptive data such as those presented here are valuable in planning and evaluation.

Results

Comparison of the cohorts

The final cohorts consisted of 942 cases in British Columbia and 938 cases in Ontario. Table 2 shows the characteristics of the patients, tumours, surgeons and hospitals associated with the cohorts in each province. The British Columbia cohort was significantly older than the Ontario cohort. Although the ratio of urban to rural residents among the patients in each province was similar, the proportion of patients living within 2 hours' travel time to a radiation-treatment facility was significantly lower in British Columbia. A significantly greater proportion of patients in the cohort in Ontario lived in areas with a high median family income.

Most tumour characteristics, such as size and laterality (side that the tumour was on), were similar in the two provincial cohorts. There were differences between the two provinces in the reporting of tumour characteristics for which the interpretation was subjective or which were important in decision-making under the British Columbia guidelines. For example, central and multifocal tumours were reported more often in British Columbia than in Ontario. The grade of tumour and any LVN invasion was less likely to be included in reports of pathologic examinations in Ontario than in British Columbia. However, when these characteristics were reported, their frequency was similar in the two provinces.

Although a similar proportion of the operations in each province was performed by a surgeon with an academic affiliation, a smaller proportion of operations in British Columbia than in Ontario was performed in a teaching hospital, and this difference was statistically significant.

Initial surgery

Breast-conserving surgery was the most definitive procedure in 43.8% of cases in British Columbia and in 67.6% of those in Ontario ($p < 0.001$).

Table 3 shows the distribution of factors that may predict the use of BCS. Lower age was associated with greater likelihood of such surgery in British Columbia and Ontario, and this result was statistically significant. However, this association was not as strong in Ontario as

Table 2: Characteristics of patients, tumours, surgeons and hospitals for newly diagnosed cases of node-negative breast cancer in British Columbia and Ontario in 1991

Characteristic	Province; no. (and %) of cases* British Columbia *n = 942*	Ontario *n = 938*	*p* value†
Patient			
Age, yr			< 0.001
≤ 49	196 (20.8)	234 (25.0)	
50–59	158 (16.8)	207 (21.8)	
60–69	280 (29.7)	260 (27.7)	
≥ 70	308 (32.7)	240 (25.6)	
Rural residence	145 (15.4)	138 (14.7)	0.680
More than 2 hours' travel time to radiation-therapy facility	300 (31.9)	56 (6.0)	< 0.001
Median family income of > $50 000	246 (26.1)	318 (33.9)	< 0.001
Tumour			
Size, cm diameter			0.885‡
≤ 2.00	663 (70.4)	647 (69.9)	
2.01–3.00	172 (18.3)	171 (18.2)	
3.01–4.00	65 (6.9)	73 (7.8)	
≥ 4.01	39 (4.2)	37 (3.9)	
Unknown	3 (0.3)	10 (1.1)	
Location			< 0.001‡
Central	96 (10.2)	53 (5.7)	
Multifocal	110 (11.7)	73 (7.8)	
Other	736 (78.1)	779 (83.1)	
Unknown	0	33 (3.5)	
Resection margins			0.159‡
Negative	845 (89.7)	901 (96.1)	
Positive	42 (4.5)	32 (3.4)	
Unknown	55 (5.8)	5 (0.5)	
Grade			0.005‡
Well differentiated	106 (11.3)	102 (10.9)	
Moderate	391 (41.5)	308 (32.8)	
Poor	317 (33.7)	186 (19.8)	
Unknown	128 (13.6)	342 (36.5)	
Lymph, vascular or neural invasion			0.003‡
Absent	648 (68.8)	232 (24.7)	
Present	200 (21.2)	109 (11.6)	
Unknown	94 (10.0)	597 (63.7)	
Extent of ductal carcinoma in situ			< 0.001
Invasive only	261 (27.7)	490 (52.2)	
Invasive plus ductal carcinoma in situ	506 (53.7)	316 (33.7)	
Invasive plus extensive ductal carcinoma in situ	175 (18.6)	132 (14.1)	
Surgeon			
Year of graduation			< 0.001
1959 or earlier	246 (26.1)	319 (34.0)	
1960–69	333 (35.4)	277 (29.5)	
1970 or later	363 (38.5)	342 (36.5)	
Academic affiliation	249 (26.4)	290 (30.9)	0.032
Hospital			
Operation performed in a teaching hospital	122 (13.0)	292 (31.1)	< 0.001

*Percentages may not sum to 100 because of rounding.
†χ^2 test for difference between provinces.
‡*p* values apply to known values only.

in British Columbia. In Ontario there was significantly greater use of BCS within each age group than in British Columbia. Rural residence was significantly associated with a lower likelihood of BCS in British Columbia, but not in Ontario. Travel time to a radiation-therapy facility was inversely associated with use of BCS in both provinces, but this association was not statistically significant in Ontario. Patients who lived in areas with lower median incomes had a lower likelihood of receiving BCS in both provinces, although this result was statistically significant only in British Columbia, where the association was much stronger.

Women with smaller tumours were more likely to receive BCS in both provinces, and this likelihood was statistically significant. Within each tumour-size category (i.e., less than 2 cm in diameter, 2 to 3 cm, 3 to 4 cm and 4 cm or more), the rates of BCS were greater in Ontario than in British Columbia. Tumour location and extent of ductal carcinoma in situ (as indicated on reports of pathologic examinations) were associated with selection of cases for BCS within each category. In both provinces women were more likely to receive BCS if they had been seen by a surgeon affiliated with a teaching hospital and holding an academic appointment, and these likelihoods were sta-

Table 3: Use of breast-conserving surgery (BCS) by characteristics of patients, tumours, surgeons and hospitals in newly diagnosed cases of node-negative breast cancer in British Columbia and Ontario, 1991

Characteristic	Province; no. (and %) of cases treated with BCS*				*p* value†
	British Columbia *n = 942*		Ontario *n = 938*		
Total cases in which BCS was used	413/942	(43.8)	634/938	(67.6)	
Patient					
Age, yr	$p < 0.001$		$p = 0.300$		0.011
< 40	30/47	(63.8)	35/58	(60.3)	
40–49	71/149	(47.7)	115/176	(65.3)	
50–59	81/158	(51.3)	144/204	(70.6)	
60–69	127/280	(45.4)	179/260	(68.9)	
70–79	84/240	(35.0)	134/192	(69.8)	
≥ 80	20/68	(29.4)	27/48	(56.3)	
Residence	$p = 0.003$		$p = 0.519$		0.102
Urban	366/797	(45.9)	544/800	(68.0)	
Rural	47/145	(32.4)	90/138	(65.2)	
Travel time to radiation-therapy facility, h	$p < 0.001$		$p = 0.085$		0.746
< 2	310/642	(48.3)	602/882	(68.3)	
> 2	103/300	(34.3)	32/56	(57.1)	
Median family income, $	$p < 0.001$		$p = 0.162$		0.124
≤ 35 000	33/122	(27.1)	75/123	(61.0)	
35 001–50 000	251/574	(43.7)	335/497	(67.4)	
> 50 000	129/246	(52.4)	224/318	(70.4)	
Tumour					
Size, cm diameter	$p < 0.001$‡		$p < 0.001$‡		0.608‡
≤ 1.00	148/290	(51.0)	201/261	(77.0)	
1.01–2.00	180/373	(48.3)	286/386	(74.1)	
2.01–3.00	62/172	(36.1)	99/171	(57.9)	
3.01–4.00	16/65	(24.6)	34/73	(46.6)	
4.01–5.00	6/27	(22.2)	4/19	(21.1)	
> 5.00	1/12	(8.3)	5/18	(27.8)	
Unknown	0/3		5/10	(50.0)	

*p values from χ^2 test for difference among subcategories of the variable within the province.
†Mantel–Haenszel test for heterogeneity for difference between provinces.
‡Comparison for known values only.

tistically significant. In British Columbia there was a statistically significant likelihood that patients had received BCS if they were seen by a surgeon who had graduated from medical school recently.

Use of radiation therapy

Three of the 21 patients in British Columbia and 6 of the 23 patients in Ontario with tumours larger than 5 cm in diameter who had a modified radical mastectomy received radiation therapy. Nine of the 12 patients in British Columbia and both of the 2 patients in Ontario who had positive surgical margins after a complete mastectomy received radiation therapy. Among all women who had a mastectomy, radiation therapy was received by 6.9% of patients in Ontario and 3.2% of those in British Columbia.

Among women who underwent BCS, in British Columbia 95.4% were seen at a cancer clinic and 91.5% received radiation therapy; in Ontario 83.0% were seen at a cancer clinic and 75.6% received radiation therapy. The difference between the two provinces in the proportion of women who received radiation therapy after BCS was statistically significant ($p < 0.001$). Table 4 lists the possible factors predicting the use of radiation therapy after BCS,

Table 3, continued

Characteristic	Province; no. (and %) of cases treated with BCS*		
	British Columbia *n = 942*	Ontario *n = 938*	*p* value
Tumour			
Location	$p < 0.001$	$p < 0.001$‡	0.534‡
Central	25/96 (26.0)	25/53 (47.2)	
Multifocal	24/110 (21.8)	37/73 (50.7)	
Other	364/736 (49.5)†	553/779 (71.0)	
Unknown		19/33 (57.6)	
Extent of ductal carcinoma in situ	$p = 0.001$	$p < 0.001$	0.071
Invasive only	100/261 (38.3)	340/490 (69.4)	
Invasive plus ductal carcinoma in situ	251/506 (49.6)	225/316 (71.2)	
Invasive plus extensive ductal carcinoma in situ	62/175 (35.4)	69/132 (52.3)	
Surgeon			
Year of graduation	$p = 0.006$	$p = 0.419$	0.089
1950 or earlier	6/18 (33.3)	55/71 (77.5)	
1950–1959	103/228 (45.2)	169/248 (68.2)	
1960–1969	123/333 (36.9)	182/277 (65.7)	
1970–1979	143/296 (48.3)	170/257 (66.2)	
1980 or later	38/67 (56.7)	58/85 (68.2)	
Academic affiliation	$p = 0.027$	$p = 0.035$	0.999
Yes	124/249 (49.8)	210/290 (72.4)	
No	289/693 (41.7)	424/648 (65.4)	
Hospital			
Type of hospital where operation was performed	$p > 0.040$	$p = 0.028$	0.819
Teaching	64/122 (52.5)	212/292 (72.6)	
Community	349/820 (42.6)	422/646 (65.3)	

which is the major indication for such therapy in patients with breast cancer. In British Columbia a high proportion of patients in every age group, except those over 80 years of age, received radiation therapy, whereas in Ontario the rate dropped with increasing age. Urban residence was significantly associated with greater use of radiation therapy after BCS in British Columbia but not in Ontario. Although travel time of more than 2 hours to a radiation-therapy facility was associated with a lower likelihood of radiation therapy after BCS in both provinces, the rela-

Table 4: Use of radiation therapy after BCS by characteristics of patients, tumours, surgeons and hospitals in newly diagnosed cases of node-negative breast cancer in British Columbia and Ontario, 1991

Characteristic	Province; no. (and %) of cases in which radiation therapy was used after BCS*				*p* value†
	British Columbia *n = 942*		Ontario *n = 938*		
Patient seen by radiation oncologist	398/413	(96.4)	522/634	(82.3)	
Total cases in which radiation therapy was used	378/413	(91.5)	479/634	(75.6)	
Patient					
Age, yr	*p* = 0.008		*p* < 0.001		0.287
< 40	29/30	(96.7)	31/35	(88.6)	
40–49	68/71	(95.8)	98/115	(85.2)	
50–59	76/81	(93.8)	127/144	(88.2)	
60–69	116/127	(91.3)	144/179	(80.5)	
70–79	75/84	(89.3)	73/134	(54.5)	
≥ 80	14/20	(70.0)	6/27	(22.2)	
Residence	*p* < 0.001		*p* = 0.999		0.008
Urban	341/366	(93.2)	411/544	(75.6)	
Rural	37/44	(78.7)	68/90	(75.6)	
Travel time to radiation-therapy facility, h	*p* = 0.182		*p* = 0.029		0.570
< 2	287/310	(92.6)	460/602	(76.4)	
> 2	91/103	(88.4)	19/32	(59.4)	
Median family income, $	*p* = 0.023		*p* = 0.576		0.222
≤ 35 000	26/33	(78.8)	53/75	(70.7)	
35 001–50 000	233/251	(92.8)	255/335	(76.1)	
> 50 000	119/129	(92.3)	171/224	(76.3)	
Tumour					
Size, cm diameter	*p* = 0.129		*p* = 0.448‡		0.599‡
≤ 1	130/148	(87.8)	145/201	(72.1)	
1.01–2.00	164/180	(91.1)	223/286	(78.0)	
2.01–3.00	61/62	(98.4)	76/99	(76.8)	
3.01–4.00	16/16	(100.0)	23/34	(67.7)	
4.01–5.00	6/6	(100.0)	4/4	(100.0)	
> 5.00	1/1	(100.0)	4/5	(80.0)	
Unknown	0/0		4/5	(80.0)	
Location	*p* = 0.600		*p* = 0.370‡		0.258‡
Central	22/25	(88.0)	22/25	(88.0)	
Multifocal	21/24	(87.5)	30/37	(81.1)	
Other	335/364	(92.0)	425/553	(76.9)	
Unknown	0/0		2/19	(10.5)	

*p values from χ^2 test for difference among subcategories of the variable within the province.
†Mantel–Haenszel test for heterogeneity for difference between provinces.
‡Comparison for known values only.

tion was stronger and statistically significant in Ontario. In contrast, residence in an area with a lower family income was associated with a lower likelihood of radiation therapy after BCS in both provinces, but had a stronger and statistically significant effect in British Columbia.

Tumour size was modestly associated with the use of radiation therapy after BCS in either province. Women with smaller tumours were somewhat less likely to receive radiation therapy after BCS than women with larger tumours. Radiation was more likely to be used in both

Table 4, continued

Characteristic	Province; no. (and %) of cases in which radiation therapy was used after BCS* British Columbia $n = 942$		Ontario $n = 938$		p value
Tumour					
Resection margins	$p = 0.326$‡		$p = 0.308$‡		0.163‡
Negative	339/369	(91.9)	450/599	(75.1)	
Positive	26/30	(86.7)	25/30	(83.3)	
Unknown	13/14	(92.9)	4/5	(80.0)	
Grade	$p = 0.23$‡		$p = 0.051$‡		0.446‡
Well differentiated	47/55	(85.5)	60/77	(77.9)	
Moderate	173/191	(90.6)	162/211	(76.8)	
Poor	136/141	(96.5)	111/127	(87.4)	
Unknown	22/26	(84.6)	146/219	(66.7)	
Lymph, vascular or neural invasion	$p = 0.156$‡		$p = 0.140$‡		0.704‡
Absent	280/307	(91.2)	128/169	(75.7)	
Present	89/93	(95.7)	68/81	(84.0)	
Unknown	*9/13*	(69.2)	283/384	(73.7)	
Extent of ductal carcinoma in situ	$p = 0.889$		$p = 0.671$		0.996
Invasive only	91/100	(91.0)	255/340	(75.0)	
Invasive plus ductal carcinoma in situ	231/251	(92.0)	174/225	(77.3)	
Invasive plus extensive ductal carcinoma in situ	56/62	(90.3)	50/69	(72.5)	
Surgeon					
Year of graduation	$p = 0.410$		$p = 0.132$		0.561
1950 or earlier	6/6	(100.0)	36/55	(65.5)	
1950–59	92/103	(89.3)	133/169	(78.7)	
1960–69	110/123	(89.4)	137/182	(75.3)	
1970–79	133/143	(93.0)	124/170	(72.9)	
1980 or later	37/38	(97.4)	49/58	(85.5)	
Academic affiliation	$p = 0.083$		$p = 0.026$		0.517
No	260/289	(90.0)	309/424	(72.9)	
Yes	118/124	(95.2)	170/210	(81.0)	
Hospital					
Type of hospital in which operation was performed	$p = 0.836$		$p = 0.012$		0.445
Teaching	59/64	(92.2)	173/212	(81.6)	
Community	319/349	(91.4)	306/422	(72.5)	

provinces when the tumour grade was "poor," but the likelihood was statistically significant only in British Columbia. There were higher rates of radiation therapy among patients with each grade of tumour in British Columbia than in Ontario, but this difference was not statistically significant. In Ontario, women who had a surgeon with an academic affiliation or who underwent surgery in a teaching hospital had a higher and statistically significant likelihood of receiving radiation therapy after BCS. For women seen by a radiation oncologist after BCS in either province, the likelihood of receiving radiation therapy did not vary according to characteristics of the radiation oncologist (data not shown).

Discussion

Patterns of care for initial management of breast cancer differed in British Columbia and Ontario in 1991. Women in Ontario were more likely to be treated with BCS than those in British Columbia. However, women in British Columbia were more likely to receive radiation therapy after BCS. In both provinces the use of these procedures was related to similar factors, such as patient age and tumour size.

Given that the 1991 British Columbia guidelines called for radiation therapy after BCS, surgeons may have offered BCS only when it was likely that the patient would accept radiation therapy, or when they believed that radiation therapy would be accessible and available.

Even after stratification by age, tumour size and location, significant differences in the utilization of BCS and radiation therapy between the two provinces remained. Among women 50 to 65 years of age who had noncentral, unifocal tumours less than 4 cm in diameter (for whom BCS is most appropriate), BCS was used in 54.0% of cases in British Columbia and 75.5% of those in Ontario ($p < 0.001$). In these cases, radiation therapy was given in 95.9% of cases in British Columbia and 84.5% of those in Ontario ($p = 0.001$). These differences persisted even if analysis was restricted to the women who also lived in urban areas less than 2 hours' travel time from a radiation-treatment facility.

During 1991, some Ontario physicians may have believed that not all patients would benefit from postoperative radiation therapy; in particular, they may have felt that older women with smaller tumours would not benefit. An Ontario trial conducted to assess the benefit of radiation therapy had completed accrual in 1989 but had not yet been reported in 1991.[29] In contrast, in British Columbia, the guidelines did not indicate a group of patients in whom radiation therapy could be forgone.

Of women seen by a radiation oncologist after BCS, 95.0% in British Columbia and 91.8% in Ontario received radiation therapy. The factors associated with the use of radiation therapy after BCS were similar to those associated with the likelihood of being seen by a radiation oncologist. Thus, the differences in radiation therapy practices in the two provinces are likely due to factors that influence referral to a cancer centre rather than to practices within the centres. However, the perception of the availability of radiation-therapy services at the centres or the expectation of the practices of the radiation oncologists may well have driven surgeons' referral decisions. Radiation therapy was delivered within 8 weeks for 61% of cases in British Columbia but for only 50% of cases in Ontario ($p = 0.001$). The longer waiting time for radiation therapy in Ontario may have affected referral decisions.

The use of BCS and of radiation therapy after BCS were related to patient residence factors (including whether the patient lived in an urban or rural area, travel time to a radiation-therapy facility and median family income) in British Columbia and, to a lesser extent, in Ontario. Clearly, preferences with regard to travel and inconvenience in obtaining radiation therapy affect the initial management of breast cancer. In British Columbia, a much larger proportion of women lived more than a 2-hour drive from a radiation-therapy facility and, therefore, beyond a reasonable daily commuting distance.

There are several caveats with regard to this retrospective study based on review of patient medical records and other information. Although the use of medical-record review makes this study stronger then studies that rely solely on administrative sources, it is still limited by the available information recorded or accessible. Patient preferences, for example, could not be elicited.

The procedures for assembly of the cohorts in the two provinces were slightly different, but the proportions excluded for reasons such as stage of disease were mainly similar. One exception involves carcinoma in situ, for which a different proportion of the cohort was excluded in British Columbia and in Ontario; this difference resulted from different cancer-registration practices in the two provinces. Other differences between the two provinces include the patients' ages, the incidence of breast cancer and use of axillary dissection. The older age distribution among the patients in British Columbia is explained in part by a slightly older population[27] and a higher incidence of breast cancer in British Columbia.[30] Because cases in which the nodal status of the tumour was unknown were excluded, differential patterns of axillary node dissection performed among older patients may also explain some of the age difference. In British Columbia, the surgical guidelines called for ascertainment of nodal status in all cases, whereas in Ontario surgeons may have begun to forgo axillary node dissections in older women.

Other differences in tumour characteristics between the provinces may be explained by the effects of the

guidelines. For example, the greater proportion of cases with central and multifocal tumours in British Columbia may well have been related to the fact that, under the guidelines, these types of tumours were specific selection criteria for the type of surgery. Surgeons and pathologists in British Columbia may therefore have been more likely to observe and note these factors.

Comparisons between the two provinces may be influenced by differences in the cancer care systems. In both provinces, definitive surgery is performed at a wide variety of community and academic hospitals. However, in British Columbia a single agency is responsible for cancer services for the province,[20] and, in 1991, radiation-therapy services were centralized at two centres. In contrast, in Ontario there were 2 cancer agencies and 10 centres that delivered radiation therapy.

In these two Canadian provinces, we observed differences in treatment among a relatively homogeneous group of women. These differences are attributable to specific factors such as patient age and travel time to radiation-therapy facilities, and also to some surgeon and hospital characteristics. The results show that variations in the surgical management of early breast cancer between regions persist even when tumour characteristics are examined.

The data alone cannot establish the appropriate rates of BCS or radiation therapy, nor can they indicate an acceptable degree of variation. This study does not assess the quality of care in either province; it describes patterns of practice. These retrospective data cannot shed light on how the decision to perform BCS or mastectomy was made or on the physician–patient interaction. According to current evidence, patient preference should be the most important determinant in choosing the type of breast surgery.[31]

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