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GYNECOLOGY

Impact of race, socioeconomic status, and the health care system on the treatment of advanced-stage ovarian cancer in California

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OBJECTIVE: We sought to investigate the impact of race, socioeconomic status (SES), and health care system characteristics on receipt of specific components of National Comprehensive Cancer Network guideline care for stage IIIC/IV ovarian cancer.

STUDY DESIGN: Patients diagnosed with stage IIIC/IV epithelial ovarian cancer between Jan. 1, 1996, through Dec. 31, 2006, were identified from the California Cancer Registry. Multivariate logistic regression analyses evaluated differences in surgery, chemotherapy, and treatment sequence according to race, increasing SES (SES-1 to SES-5), and provider annual case volume.

RESULTS: A total of 11,865 patients were identified. Median age at diagnosis was 65.0 years. The overall median cancer-specific survival was 28.2 months. African American race (odds ratio [OR], 2.04; 95% confidence interval [CI], 1.45–2.87) and care by a low-volume physician (OR, 19.72; 95% CI, 11.87–32.77) predicted an increased risk of not undergoing surgery. Patients with SES-1 (OR, 0.71; 95% CI,

0.60–0.85) and those treated at low-volume hospitals (OR, 0.88; 95% CI, 0.77–0.99) or by low-volume physicians (OR, 0.80; 95% CI, 0.70–0.92) were less likely to undergo debulking surgery. African American race (OR, 1.55; 95% CI, 1.24–1.93) and SES-1 (OR, 1.80; 95% CI, 1.35–2.39) were both significant predictors of not receiving chemotherapy. African American patients were also more likely than whites to receive no treatment (OR, 2.08; 95% CI, 1.45–2.99) or only chemotherapy (OR, 1.55; 95% CI, 1.10–2.18). Patients with low SES were more likely to receive no treatment (OR, 1.95; 95% CI, 1.44–2.64) or surgery without chemotherapy (OR, 1.67; 95% CI, 1.38–2.03).

CONCLUSION: Among patients with advanced-stage ovarian cancer, African American race, low SES, and treatment by low-volume providers are significant and independent predictors of receiving no surgery, no debulking surgery, no chemotherapy, and nonstandard treatment sequences.

Key words: disparities, ovarian cancer, race, socioeconomic status

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Ovarian cancer is the second most common gynecologic cancer in the United States, with >22,000 cases diagnosed each year.¹ Because most patients present with advanced disease, >14,000 deaths are attributed to ovarian cancer annually. Significant survival gains have followed the widespread adoption of cytoreductive surgery and

combined chemotherapy regimens, but improvements have not been distributed equally among races or socioeconomic categories. While 5-year survival in white women with ovarian cancer increased from 37–45% from 1975 through 2006, 5-year survival among African American patients decreased from 43–37% over the same time period.² Although biologic,

socioeconomic, and cultural differences have been cited as reasons for this disparity, the widening survival gap suggests that African American patients have not benefited from recent improvements in ovarian cancer care, and it highlights treatment factors as important contributors to the survival disparity. Previous studies have found that African American patients with ovarian cancer are less likely to receive primary cytoreductive surgery, appropriate chemotherapy, and National Comprehensive Cancer Network (NCCN) guideline-adherent care.^{3,4} However, the specific deviations from recommended treatment programs have not been well defined. The objective of this study was to examine disparities in the quality of ovarian cancer care across a large, statewide population, as well as to identify specific treatment components that contribute to the receipt of

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nonstandard therapy in patients with advanced-stage ovarian cancer.

MATERIALS AND METHODS

This was a retrospective population-based case study of primary invasive epithelial ovarian cancers reported to the California Cancer Registry from Jan. 1, 1996, through Dec. 31, 2006. The study received exempt status from the Institutional Review Board of the University of California, Irvine (Human Subjects#2011-8317). The California Cancer Registry is a standardized, quality-controlled population-based cancer surveillance registry that has collected information about tumor characteristics, patient characteristics, diagnosis, and treatment for all cancers diagnosed in California since 1988. Case reporting in the state is estimated to be 99%, and follow-up completion rates are >95%.^{2,4-7} *International Classification of Diseases for Oncology, Second Edition* was used to identify tumor location and histology. Cases were identified using the ovarian Surveillance, Epidemiology, and End Results Program (SEER) primary site code (C569).⁸

The study population consisted of women at least 18 years of age who were diagnosed with primary advanced-stage epithelial ovarian cancer from Jan. 1, 1996, through Dec. 31, 2006. There were 21,044 incident ovarian cancer cases identified during the time period with follow-up continuing through January 2008. After sequentially excluding borderline tumors; germ-cell tumors; sex cord tumors; cases with missing *International Classification of Diseases for Oncology, Second Edition* morphology codes; cases prepared solely from autopsy or death certificates; and cases with unknown or incomplete surgery, chemotherapy, or hospital information, 18,327 cases of all stages remained. As this study included only patients with stage IIIC or IV ovarian cancer, a total of 11,865 cases were finally analyzed.

Explanatory variables included patient, tumor, and health care provider characteristics. Race/ethnicity was categorized into 4 groups: white, African American, Hispanic, and Asian/Pacific Island. Patient insurance type was

grouped into 4 categories: private insurance (managed care, health maintenance organization, preferred provider organization, or other private insurance), Medicaid, Medicare, or other insurance type. Socioeconomic status (SES) was classified into 5 categories: lowest, lower-middle, middle, higher-middle, and highest SES based on quintiles of Yost's index of socioeconomic status (YOSTSCL) score.⁹ Age at diagnosis was used as either a continuous variable or categorical variable with groups including those age <45, 45-54, 55-69, and ≥70 years.

Hospital volume was derived based on the average number of ovarian cancer cases treated at each hospital annually. Hospitals with ≥20 cases per year were classified as high-volume hospitals; hospitals with <20 cases per year were low volume. Physician volume was derived from the average number of cases treated annually by each physician (surgeon, medical oncologist, or attending physician). Physicians involved in ≥10 cases per year were considered high volume.

Outcome variables included the concordance of surgery type, chemotherapy type, and treatment sequence with NCCN treatment guidelines.¹⁰⁻¹⁴ Surgery type was classified as follows: no surgery, oophorectomy with or without hysterectomy, oophorectomy with omentectomy, and/or debulking surgery. Chemotherapy type was categorized into 4 groups including multiple-agent chemotherapy, single-agent chemotherapy, no chemotherapy despite recommendation, and no chemotherapy for other reason. Treatment sequence had 6 categories: surgery and adjuvant chemotherapy, neo-adjuvant chemotherapy and surgery, surgery and chemotherapy in unknown sequence, surgery only, chemotherapy only, and no surgery or chemotherapy.

Differences among treatment groups (surgery, chemotherapy, and treatment sequence) were analyzed with χ^2 or Fisher exact test. A multinomial logistic regression model was used to perform multivariate analysis for outcomes with >2 categories. The guideline-adherent treatment category was used as the

referent for each outcome variable, and binary logistic regression was performed for this outcome. Race and SES were interpreted as independent variables, as interaction terms for these variables were not significant.

RESULTS

Population characteristics

Patient, tumor, and provider characteristics are shown in Table 1. Overall, 11,865 patients were included. A total of 7272 patients (61.3%) had stage IIIC disease, while 4593 (38.7%) had stage IV disease. White patients accounted for 71.7% of cases, followed in frequency by Hispanics (15.3%), Asian/Pacific Islanders (8.3%), and African American (4.7%). Despite a small percentage of minority patients, sample sizes were sufficient for analysis. Median age at diagnosis was 65.0 years (18-104 years). Private insurance was the most common payer category (47.7%), while 32.5% of patients had Medicare. Patient distribution across socioeconomic quintiles was relatively even. SES-1 was slightly underrepresented, accounting for only 13.0% of the study population. Most patients were treated at low-volume hospitals (82.1%) and by low-volume providers (61.9%). The median cancer-specific survival for all patients was 28.2 months.

Surgery

Table 2 presents patient, tumor, and provider characteristics stratified by surgery type. Overall, 25% of patients received no surgery for advanced-stage ovarian cancer, although African American race was associated with an increased likelihood of not undergoing surgery. Among African American patients, 37.3% did not undergo surgery compared to 23.8% for whites, 25.4% for Hispanics, and 26.0% for Asian/Pacific Islanders. Multinomial logistic regression analysis revealed that African American patients experienced a 2-fold increase in the risk of no surgery (odds ratio [OR], 2.04; 95% confidence interval [CI], 1.45–2.87) and were 50% more likely than whites to undergo only resection of the primary tumor with or without hysterectomy (OR, 1.49; 95%

CI, 1.02–2.18). Patients in the lowest SES category (SES-1) received no surgery in 30.4% of cases compared to 19.4% for patients in the highest SES category (SES-5), although these values were not statistically significant. SES-1 patients were significantly less likely than SES-5 patients to receive debulking surgery (OR, 0.71; 95% CI, 0.60–0.85).

The frequency of debulking surgery was also correlated with race and SES. African American patients underwent debulking surgery in just 38.7% of cases compared to 51.1% of cases for whites, 43.7% for Hispanics, and 44.7% for Asian/Pacific Islanders. Among patients in the highest SES category (SES-5), 55.6% underwent cytoreductive surgery. In the lowest SES category (SES-1), just 39.7% underwent debulking (OR, 0.71; 95% CI, 0.60–0.85). Hispanics (OR, 0.86; 95% CI, 0.74–0.99) and Asian/Pacific Islanders (OR, 0.79; 95% CI, 0.66–0.94) were also significantly less likely to undergo debulking surgery.

Both low-volume hospitals (OR, 0.88; 95% CI, 0.77–0.99) and low-volume physicians (OR, 0.80; 95% CI, 0.70–0.92) were significantly associated with lower rates of debulking surgery. The likelihood of receiving no surgery was also increased almost 20-fold for low-volume physicians (OR, 19.72; 95% CI, 11.87–32.77). Patient insurance status was not associated with the likelihood of receiving surgery.

Chemotherapy

When compared to whites, African American patients were significantly more likely to receive no chemotherapy (OR, 1.55; 95% CI, 1.24–1.93) or single-agent chemotherapy (OR, 1.42; 95% CI, 1.04–1.93). Of African American patients, 28% were found to have received no chemotherapy with “other” reason supplied, while only 4.6% of African American patients (compared to 6.7% of whites and 7.2% of Asian/Pacific Islanders) did not receive chemotherapy despite practitioner recommendation (Table 3).

There was a statistically significant inverse linear relationship between SES quintile and nonreceipt of chemotherapy. SES-1 had the highest risk of

TABLE 1
Population characteristics

Characteristic	n	%
Total	11,865	100
Race		
White	8509	71.7
African American	561	4.7
Hispanic	1813	15.3
Asian/Pacific Islander	982	8.3
Insurance		
Private	5660	47.7
Medicaid	986	8.3
Medicare	3853	32.5
Other	1366	11.5
SES		
Lowest	1545	13
Lower-middle	2156	18.2
Middle	2508	21.1
Higher-middle	2769	23.3
Highest	2887	24.3
Age, y		
<45	1043	8.8
45–54	2083	17.6
55–69	4214	35.5
≥70	4525	38.1
Stage		
IIIC	7272	61.3
IV	4593	38.7
Grade		
I	348	2.9
II	1573	13.3
III	5028	42.4
IV	1249	10.5
Not stated	3667	30.9
Histology		
Serous	5789	48.8
Mucinous	419	3.5
Endometrioid	644	5.4
Clear cell	322	2.7
Adenocarcinoma, NOS	1988	16.8
Other	2703	22.8

Long. NCCN guideline deviations in ovarian cancer treatment. Am J Obstet Gynecol 2015.

(continued)

TABLE 1
Population characteristics (continued)

Characteristic	n	%
Tumor size		
≤5 cm	1286	10.8
5–10 cm	2136	18
>10 cm	2010	16.9
Unknown	6433	54.2
Hospital volume		
High	2119	17.9
Low	9746	82.1
Physician volume		
High	1791	15.1
Low	7341	61.9
Unknown	2733	23
Surgery type		
No surgery	2950	24.9
Removal of ovary ± hysterectomy	805	6.8
Oophorectomy with omentectomy	2314	19.5
Debulking	5796	48.9
Chemotherapy type		
No chemotherapy—other	2482	20.9
No chemotherapy despite recommendation	757	6.4
Single-agent chemotherapy	1010	8.5
Multiple-agent chemotherapy	7616	64.2
Treatment sequence		
No treatment	1281	10.8
Surgery only	1937	16.3
Chemotherapy only	1418	12
Surgery and chemotherapy, sequence unknown	193	1.6
Neoadjuvant chemotherapy and surgery	5913	49.8
Surgery and adjuvant chemotherapy	1123	9.5

NOS, not otherwise specified; SES, socioeconomic status.

Long. NCCN guideline deviations in ovarian cancer treatment. *Am J Obstet Gynecol* 2015.

not receiving chemotherapy despite provider recommendations (OR, 1.80; 95% CI, 1.35–2.39) and not receiving chemotherapy for “other” reasons (OR, 1.67; 95% CI, 1.40–1.99). Low-volume hospitals were also associated with increased likelihood of receiving no chemotherapy for “other” reason (OR, 1.77; 95% CI, 1.53–2.05), no chemotherapy despite recommendations (OR,

1.55; 95% CI, 1.23–1.96), or single-agent chemotherapy (OR, 1.49; 95% CI, 1.24–1.8). Patients treated by low-volume physicians were also more likely to receive no chemotherapy for “other” reason (OR, 1.29; 95% CI, 1.10–1.50), although there was no association with single-agent chemotherapy or nonreceipt of chemotherapy when it was recommended.

Treatment sequence

Order of treatments also differed by race and SES (Table 4). African American patients were more than twice as likely to receive no treatment (OR, 2.08; 95% CI, 1.45–2.99) compared to white patients. A treatment program consisting of only chemotherapy was significantly more likely for African American (OR, 1.55; 95% CI, 1.10–2.18) or Hispanic (OR, 1.34; 95% CI, 1.07–1.68) patients. Hispanic patients were also significantly more likely to be treated with neoadjuvant chemotherapy (OR, 1.22; 95% CI, 1.01–1.48).

There were statistically significant relationships between SES classification and treatment regimens, as well. Patients in the lowest SES quintile were almost twice as likely to undergo no treatment (OR, 1.95; 95% CI, 1.44–2.64) and 67% more likely to undergo surgery without chemotherapy (OR, 1.67; 95% CI, 1.38–2.03) compared to patients in the highest SES quintile.

Low-volume hospital status was significantly associated with all non-standard treatment sequences: no treatment (OR, 1.59; 95% CI, 1.21–2.08), only surgery (OR, 1.94; 95% CI, 1.67–2.26), only chemotherapy (OR, 1.41; 95% CI, 1.13–1.76), and neoadjuvant chemotherapy (OR, 1.42; 95% CI, 1.19–1.69). Similarly, care by a low-volume physician was associated with a 15-fold increase in the likelihood of no treatment (OR, 15.66; 95% CI, 8.34–29.41).

COMMENT

Due to aggressive surgical debulking and combined chemotherapy regimens, ovarian cancer survival in the general population has shown steady improvement over the last several decades. Conversely, multiple population-based analyses have shown a decline in survival rates for African American patients during the same time period.^{1,2} Later stage at diagnosis and other biologic factors have been studied as sources of this survival disparity; however, recent studies have shown that differences in quality of care may substantially contribute to the survival gap.^{3,4,15}

TABLE 2

Patient characteristics and multinomial logistic model by surgery type

Characteristics	No surgery					Removal of ovary +/- hysterectomy					Oophorectomy with omentectomy		Debulking				
	n	%	OR	95% CI		n	%	OR	95% CI		n	%	n	%	OR	95% CI	
Total	2905	25	—	—		805	7	—	—		2314	19	5796	49	—	—	
Race																	
White	2025	23.8	1.00	—	—	539	6.3	1.00	—	—	1598	18.8	4347	51.1	1.00	—	—
African American	209	37.3	2.04	1.45	2.87	45	8.0	1.49	1.02	2.18	90	16	217	38.7	0.99	0.76	1.28
Hispanic	461	25.4	1.08	0.87	1.33	154	8.5	1.10	0.88	1.39	405	22.3	793	43.7	0.86	0.74	0.99
Asian/Pacific Islander	255	26	1.14	0.87	1.48	67	6.8	0.87	0.65	1.18	221	22.5	439	44.7	0.79	0.66	0.94
Socioeconomic status																	
Lowest SES	469	30.4	1.06	0.82	1.38	117	7.6	1.00	0.75	1.35	345	22.3	614	39.7	0.71	0.60	0.85
Low-mid SES	613	28.4	1.19	0.94	1.5	149	6.9	1.13	0.87	1.47	400	18.6	994	46.1	0.95	0.81	1.11
Middle SES	644	25.7	1.07	0.86	1.33	183	7.3	1.18	0.92	1.51	479	19.1	1202	47.9	0.90	0.78	1.05
High-mid SES	663	23.9	0.98	0.79	1.22	190	6.9	1.11	0.87	1.41	543	19.6	1373	49.6	0.89	0.77	1.02
Highest SES	561	19.4	1.00	—	—	166	5.7	1.00	—	—	5447	18.9	1613	55.9	1.00	—	—
Stage																	
IIIC	1036	14.2	1.00	—	—	539	7.4	1.00	—	—	1731	23.8	3966	54.5	1.00	—	—
IV	1914	41.7	4.02	3.46	4.67	266	5.8	1.39	1.16	1.66	583	12.7	1830	39.8	1.38	1.24	1.54
Hospital volume																	
High	309	14.6	1.00	—	—	137	6.5	1.00	—	—	428	20.2	1245	58.8	1.00	—	—
Low	2641	27.1	1.16	0.94	1.43	668	6.9	1.05	0.85	1.31	1886	19.4	4551	46.7	0.88	0.77	0.99
Physician volume																	
High	18	1.0	1.00	—	—	111	6.2	1.00	—	—	414	23.1	1248	69.7	1.00	—	—
Low	2214	30.2	19.7	11.9	32.8	517	7.0	1.30	1.02	1.65	1398	19.0	3212	43.8	0.80	0.70	0.92
Unknown	718	26.3	20.8	12.3	35.1	177	6.5	1.19	0.90	1.58	502	18.4	1336	48.9	0.94	0.80	1.10

CI, confidence interval; OR, odds ratio; SES, socioeconomic status.

Long. NCCN guideline deviations in ovarian cancer treatment. Am J Obstet Gynecol 2015.

TABLE 3

Patient characteristics and multinomial logistic model by chemotherapy type

Characteristic	No chemotherapy—"other" reason					No chemotherapy despite recommendation					Multiple agent chemotherapy				Single agent chemotherapy		
	n	%	OR	95% CI		n	%	OR	95% CI		n	%	OR	95% CI		n	%
Total	2482	21	—	—		757	6	—	—		1010	9	—	—		7616	64
Race																	
White	1748	20.5	1.00	—	—	571	6.7	1.00	—	—	741	8.7	1.00	—	—	5449	64
African American	157	28.0	1.55	1.24	1.93	26	9.8	0.76	0.50	1.17	55	9.8	1.42	1.04	1.93	323	57.6
Hispanic	386	21.3	1.02	0.88	1.18	89	7.7	0.68	0.53	0.88	139	7.7	0.95	0.77	1.17	1199	66.1
Asian/Pacific Islander	191	19.5	1.11	0.93	1.34	71	7.6	1.23	0.94	1.61	75	7.6	0.99	0.77	1.28	645	65.7
Socioeconomic status																	
Lowest SES	397	25.7	1.67	1.40	1.99	104	6.7	1.80	1.35	2.39	130	8.4	1.11	0.87	1.42	914	59.2
Low-mid SES	498	23.1	1.33	1.14	1.56	171	7.9	1.73	1.36	2.21	155	7.2	0.83	0.67	1.03	1332	61.8
Middle SES	559	22.3	1.29	1.11	1.50	158	6.3	1.35	1.06	1.72	204	8.1	0.91	0.75	1.11	1587	63.3
High-mid SES	541	19.5	1.11	0.96	1.29	187	6.8	1.41	1.11	1.78	252	9.1	0.99	0.83	1.20	1789	64.6
Highest SES	487	16.9	1.00	—	—	137	4.7	1.00	—	—	269	9.3	1.00	—	—	1994	69.1
Stage																	
IIIC	1317	18.1	1.00	—	—	462	6.4	1.00	—	—	600	8.3	1.00	—	—	4893	67.3
IV	1165	25.1	1.21	1.09	1.34	295	6.4	0.89	0.76	1.05	410	8.9	1.09	0.94	1.25	2723	59.3
Hospital volume																	
High	269	12.7	1.00	—	—	93	4.4	1.00	—	—	151	7.1	1.00	—	—	1606	75.8
Low	2213	22.7	1.77	1.53	2.05	664	6.8	1.55	1.23	1.96	859	8.8	1.49	1.24	1.80	6010	61.7
Physician volume																	
High	259	14.5	1.00	—	—	83	4.6	1.00	—	—	155	8.7	1.00	—	—	1294	72.3
Low	1829	24.9	1.29	1.10	1.50	529	7.2	1.25	0.97	1.61	558	7.6	0.86	0.70	1.04	4425	60.3
Unknown	394	14.4	0.54	0.54	0.78	145	5.3	0.77	0.57	1.03	297	10.9	1.03	0.83	1.29	1897	69.4

CI, confidence interval; OR, odds ratio; SES, socioeconomic status.

Long. NCCN guideline deviations in ovarian cancer treatment. Am J Obstet Gynecol 2015.

TABLE 4
Patient characteristics and multinomial logistic model by treatment sequence

Characteristic	No treatment					Only surgery					Only chemotherapy					Surgery and chemotherapy, unknown sequence					Neoadjuvant chemotherapy and surgery					Surgery and adjuvant chemotherapy	
	n	%	OR	95% CI		n	%	OR	95% CI		n	%	OR	95% CI		n	%	OR	95% CI		n	%	OR	95% CI		n	%
Total	1281	11	—	—		1937	16	—	—		1418	12	—	—		193	2	—	—		1123	10	—	—		5913	50
Race																											
White	889	10.4	1.00	—	—	1416	16.6	1.00	—	—	959	11.3	1.00	—	—	148	1.7	1.00	—	—	798	9.4	1.00	—	—	4299	50.5
African American	95	16.9	2.08	1.45	2.99	87	15.5	1.17	0.90	1.53	93	16.6	1.55	1.10	2.18	4	0.7	0.53	0.19	1.47	45	8.0	1.04	0.74	1.46	237	42.2
Hispanic	190	10.5	1.15	0.90	1.47	284	15.7	0.98	0.83	1.15	240	13.2	1.34	1.07	1.68	23	1.3	0.76	0.47	1.22	193	10.6	1.22	1.01	1.48	883	48.7
Asian/Pacific Islander	107	10.9	1.33	0.98	1.82	150	15.3	1.13	0.92	1.38	126	12.8	1.35	1.02	1.78	18	1.8	1.23	0.74	2.04	87	8.9	1.03	0.81	1.33	494	50.3
Socioeconomic status																											
Lowest SES	222	14.4	1.95	1.44	2.64	279	18.1	1.67	1.38	2.03	207	13.4	1.17	0.89	1.55	22	1.4	1.26	0.73	2.17	147	9.5	1.03	0.81	1.31	668	43.2
Low-mid SES	273	12.7	1.58	1.20	2.07	391	18.1	1.46	1.24	1.73	288	13.4	1.14	0.89	1.45	35	1.6	1.21	0.77	1.91	185	8.6	0.92	0.75	1.14	984	45.6
Middle SES	283	11.3	1.48	1.14	1.92	428	17.1	1.31	1.11	1.54	310	12.4	1.05	0.83	1.32	45	1.8	1.22	0.80	1.86	231	9.2	0.95	0.78	1.15	1211	48.3
High-mid SES	287	10.4	1.20	0.93	1.55	432	15.6	1.10	0.94	1.29	319	11.5	0.94	0.74	1.17	44	1.6	1.00	0.66	1.52	248	9.0	0.87	0.72	1.05	1439	52.0
Highest SES	216	7.5	1.00	—	—	407	14.1	1.0	—	—	294	10.2	1.00	—	—	47	1.6	1.00	—	—	312	10.8	1.00	—	—	1611	55.8
Stage																											
IIIC	447	6.1	1.00	—	—	1315	18.1	1.00	—	—	485	6.7	1.00	—	—	140	1.9	1.00	—	—	586	8.1	1.00	—	—	4299	59.1
IV	834	18.2	3.53	2.98	4.20	622	13.5	1.18	1.05	1.33	933	20.3	3.47	2.97	4.06	53	1.2	0.96	0.7	1.33	537	11.7	2.20	1.92	2.51	1614	35.1
Hospital volume																											
High	114	5.4	1.00	—	—	247	11.7	1.00	—	—	173	8.2	1.00	—	—	16	0.8	1.00	—	—	187	8.8	1.00	—	—	1382	65.2
Low	1167	12.0	1.59	1.21	2.08	1690	17.3	1.94	1.67	2.26	1245	12.8	1.41	1.13	1.76	177	1.8	3.21	1.91	5.41	936	9.6	1.42	1.19	1.69	4531	46.5
Physician volume																											
High	11	0.6	1.00	—	—	324	18.1	1.00	—	—	0	0	1.00	—	—	37	2.1	1.00	—	—	222	12.4	1.00	—	—	1197	66.8
Low	1224	16.7	15.7	8.34	29.4	1124	15.3	1.00	0.86	1.15	805	11	n/a			116	1.6	0.88	0.60	1.29	626	8.5	0.80	0.67	0.96	3446	46.9
Unknown	46	1.7	1.61	0.8	3.24	489	17.9	1.22	1.03	1.46	613	22.4	n/a			40	1.5	0.82	0.51	1.32	275	10.1	0.98	0.80	1.21	1270	46.5

CI, confidence interval; n/a, not applicable; OR, odds ratio; SES, socioeconomic status.

Long. NCCN guideline deviations in ovarian cancer treatment. Am J Obstet Gynecol 2015.

It is clear that quality of care is an important factor in ovarian cancer outcomes. Several retrospective studies associate optimal cytoreduction and platinum/taxane chemotherapy regimens with improved survival,¹⁶⁻¹⁸ and a prior analysis of California Cancer Registry data by Bristow et al¹⁹ found decreased disease-specific survival (hazard ratio, 1.18; 95% CI, 1.07–1.32) in patients who received care not adherent to NCCN guidelines. Despite the importance of appropriate care, minority and low-SES patients are also less likely to receive care that conforms to NCCN guidelines. In a recent study by Bristow et al,³ African American race, Medicaid or uninsured status, and median household income of <\$35,000/y were independently associated with lower rates of NCCN guideline-adherent care, and non-NCCN guideline-adherent care was an independent predictor of shorter overall survival. Still, specific aspects of treatment deviations within the context of NCCN ovarian cancer treatment guidelines have not been well defined. The objective of this study was to investigate differences in ovarian cancer-related surgical procedures, chemotherapy regimens, and treatment sequence according to racial and socioeconomic classification in women with stage IIIC/IV disease and identify which of these factors contribute to the observed deviations from guideline care.

Strengths of the current study include the large study population, the reliability of the California Cancer Registry, and the inclusion of a recent time period during which there were no major changes to treatment guidelines. Treatment during this time period is presumed to be homogenous, as it occurred prior to the addition of intraperitoneal chemotherapy was widely adopted in response to GOG-172. There are also several limitations. First, this was a retrospective study using a population-based data set. This type of data carries an inherent risk of election and reporting bias. We were also unable to control for unreported variables that could influence the likelihood of receiving recommended care.

Such variables include the presence of medical comorbidities, the extent of initial disease, and cumulative chemotherapy dose and intensity. We were also unable to analyze the complexity of the surgical procedures, amounts of residual disease, or physician specialty, as this information is not recorded by the California Cancer Registry.

Despite these limitations, the current data offer several new observations that could account for the disparities in ovarian cancer survival. Race and SES are significantly and independently associated with specific treatment elements contributing to NCCN guideline care, and a linear association is noted between decreasing SES and an increasing risk of not receiving appropriate surgery or chemotherapy. Because debulking surgery is the cornerstone of modern ovarian cancer treatment, disparities in surgical care likely account for much of the survival gap in this disease. Our results show that African American patients are significantly less likely to undergo any surgery and more likely to undergo inappropriate surgery (ie, removal of an ovarian mass without staging or debulking). Lower SES was not associated with a statistically significant increase in the risk of not undergoing surgery for ovarian cancer, although patients classified as SES-1 were less likely to receive debulking surgery. While higher rates of comorbid conditions in African American and low-income patients could contribute to the decreased rate of surgical intervention in these groups, such conditions are unlikely to completely account for the disparities seen in this study. Both low SES and African American race were associated with nonreceipt of chemotherapy, although the strongest association was seen with decreasing SES. Decreased rates of chemotherapy seen in low-SES patients may be explained by lack of insurance funding for chemotherapy, as “other” payer status was the only payer group statistically associated with no chemotherapy despite provider recommendations.

While additional research is needed to further characterize the survival gap in ovarian cancer, the current study

highlights several areas where survival gains could be made. Interventions should focus on improving access to high-volume providers and hospitals that provide NCCN guideline-adherent regimens. Further research should aim to define other reasons for deviation from guidelines, control for variation due to differences in medical comorbidities, and develop appropriate risk-adjusted measurement models. ■

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