

GYNECOLOGY

The economic impact of surgical care for morbidly obese endometrial cancer patients: a nationwide study

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BACKGROUND: Obesity significantly impacts the cost of cancer treatment, yet the impact of morbid obesity on inpatient hospital charges related to endometrial cancer treatment is not well-defined.

OBJECTIVES: The purpose of this study was to determine the charges that are associated with inpatient surgery, hospitalization, and postoperative care of morbidly obese patients with endometrial cancer.

STUDY DESIGN: Data were obtained from the National Inpatient Sample from 2010. Chi-square test, *t*-test, and linear regression were used for statistical analyses.

RESULTS: Six thousand five hundred sixty patients who underwent hysterectomy for endometrial cancer were identified. Mean age was 62 years (range, 22–99 years). The majority were white (78%), and the remainder were black (10%), Hispanic, (8%), Asian (3%), and Native American (1%). Insurance types were private (45%), Medicare (45%), Medicaid (5%), and uninsured (7%). One thousand eighty-eight of these patients (17%) were coded as morbidly obese. The mean postoperative stay for the morbidly obese was 4.0 days (range, 0–46 days) compared with 3.5 days (range, 0–81 days) for the non—morbidly obese patients

($P < .01$). Morbidly obese patients required more intensive care with mechanical ventilation (5.5% vs 1.6%; $P < .01$). The median hospital charges were higher for morbidly obese patients compared with their counterparts (\$46,654 vs \$41,164; $P < .01$). After adjustment for charges that were associated with insurance type, hospital type, and the surgery that was performed, the incremental increase in hospital charges that were associated with treating the morbidly obese patient was \$5096 per patient (95% confidence interval, \$2593–\$7598; $P < .01$).

CONCLUSION: In this economic analysis, the health care charges that were associated with inpatient endometrial cancer treatment in the morbidly obese patient was significantly higher compared the non—morbidly obese patient. Resources are needed to support the needs of this population, and programs to encourage weight loss and optimize general health should be encouraged.

Key words: endometrial cancer, health care expenditure, hospitalization, obesity

In the United States, approximately 50,000 additional cancer cases per year are attributed to obesity. These obesity-related cancers account for 20% of cancer-related deaths in women.^{1,2} In gynecology, endometrial carcinoma is the most common pelvic malignancy, and most of these tumors are associated with obesity.^{3,4}

In addition to cancer, obesity is associated with a myriad of medical comorbidities that include diabetes mellitus, hypertension, and heart disease. The cancer treatment and management of these related comorbidities in obese patients leads to a significant increase in health care expenditures.⁴ A recent large randomized prospective

trial that compared laparoscopy with open surgery in the treatment of endometrial cancer (LAP2) found that morbidly obese patients required additional hospital resources because of comorbid conditions and treatment-related complications.⁵ Moreover, morbid obesity was a predictor for all-cause death, likely because of the medical comorbid conditions and surgical complications. However, this study did not evaluate the financial implications that specifically were associated with care in the morbidly obese.

Over the last 30 years, health care expenditures have outpaced the growth of the US economy.⁶ In addition to the higher direct surgical charges, obese patients require additional or modified equipment that includes bariatric beds, operating room tables, gurneys, wheelchairs, commodes, scanners, and radiation oncology treatment tables. These patients also use additional resources such as physical therapy, lift teams, and rehabilitation.⁷ A cross-sectional analysis

of >16,000 adults from the 2000 Medical Expenditure Panel Survey showed that morbid obesity was associated with an 81% greater per capita health care expenditure compared with normal-weight adults, with >\$11 billion dollars expended per year.⁸ Additionally, this was an upward moving trend, with 10.2% of US health care expenditures (\$56.0 billion) in the year 2000 that increased from 9.1% (\$51.5 billion) in 1998, that was associated with excess body weight.⁸

Although obesity is known to impact cancer treatment with associated increased expenditures, few studies have analyzed the incremental increases in hospital charges related to the treatment of endometrial cancer in morbidly obese patients on a nationwide level. This study evaluated the demographic and geographic location of these patients and the associated inpatient resources used that resulted in the increased hospital charges in a comprehensive analysis of both academic and community hospitals.

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Materials and Methods

Study design and sample population

Data were extracted from the US Agency for Health Care Administration and the National Inpatient Sample (NIS).⁹ The NIS represents a 20% stratified sample of US hospital discharges and comprises data from approximately 1051 hospitals. The NIS records contain demographic data and clinical information that include diagnosis, procedures, admission and discharge status, payment source, and hospital information.

The NIS database was queried for all discharge reports of patients with endometrial cancer who underwent surgery in 2010; 6560 patients were identified. Patients who underwent hysterectomies for uterine cancer were identified by International Classification of Diseases, 9th Revision (ICD-9), coding (174.0, 174.1, 174.3, 174.3, 174.5, 174.9). Patients who underwent an open surgical approach were identified by the codes 68.0, 68.3, 68.39, 68.4, 68.49, 68.5, 68.59, 68.6, 68.69, 68.7, 68.79, 68.9, 68.99; patients who underwent laparoscopic surgery were identified by codes 68.31, 68.41, 68.51, 68.61, 68.71, 68.91; and patients who had robotic surgery were identified by codes 17.4, 17.41, 17.42, 17.43, 17.44, 17.45, 17.49. Morbidly obese patients were identified by ICD-9 diagnostic code 278.01 and were defined by the Centers of Medicare Services as having a body mass index (BMI) of ≥ 40 kg/m² or of > 35 kg/m² with 1 medical comorbidity; the latter group was somewhat controversial in ICD-9 coding.¹⁰

Variables that were extracted from the Healthcare Cost and Utilization Project (HCUP) database included patient age, race, socioeconomic status, and insurance type. Race was categorized into white, black, Hispanic, Asian, and Native American. The patient's insurance was grouped as Medicare, Medicaid, private, or other. The patient's median annual household income was categorized based on the zip code and divided into higher ($> \$51,000$) and lower ($< \$50,999$) socioeconomic status, based on HCUP coding. Hospital location was

categorized according to the US Census-defined regions of West, Midwest, South, and Northeast. The total hospital volume for surgery for endometrial cancer was divided into higher volume (median, ≥ 20 operations/year) or lower volume (median, < 20 operations/year). Use of mechanical ventilation was defined using Clinical Classifications Software diagnosis code 216. Hospital charge data were obtained; the edited total charges were rounded to the nearest dollar.¹⁰ This study was institutional review board exempt because it used a nationwide database of deidentified patient parameters and did not involve any specific institutional data.

Statistical analysis

Chi-square test, *t*-test, analysis of variance, and linear multivariate regression models analyses were used for statistics. Data were analyzed with R software (version 3.0.2; R Foundation for Statistical Computing, Vienna, Austria).

Results

Demographics and socioeconomic of morbidly obese

Of 6560 women with endometrial cancer, the mean age was 62 years (range, 22–99 years). The majority were white (78%); the remainder black (10%), Hispanic (8%), Asian/Pacific Islander (3%), and Native American (1%; Table 1). Of the overall study group, 1088 women (17%) were diagnosed as morbidly obese. A greater proportion of Native American and black women were morbidly obese vs white, Hispanic, and Asian/Pacific Islander women (33% and 18% vs 16%, 15%, and 4%; $P < .01$). The Midwest had the greatest percentage of morbidly obese patients compared with the South, Northeast, and West (22% vs 15%, 14%, and 15%; $P < .01$). Morbidly obese patients were more likely to have a lower ($< \$50,999$) income compared with non-morbidly obese patients (57% vs 48%; $P < .01$). Additionally more morbidly obese patients were uninsured (7% vs 4%; $P < .01$) and received Medicaid (9% vs 7%; $P < .01$), compared with their non-morbidly obese counterparts.

Treatment of the morbidly obese

In addition, morbidly obese patients were more likely to be treated in a higher volume (81% vs 70%; $P < .01$) and nonteaching hospitals (84% vs 76%; $P < .01$) compared with non-morbidly obese patients. Although the morbidly obese patients were less likely to receive minimally invasive surgery (34% vs 38%; $P < .01$), of those who underwent minimally invasive procedures, robotic-assisted laparoscopy was the preferred approach over laparoscopy (79% vs 21%; $P < .01$). The mean postoperative stay for the morbidly obese patients was 4.0 days (range, 0–46 days) compared with 3.5 days (range, 0–81 days) for the non-morbidly obese patients ($P < .01$). Moreover, morbidly obese patients required more intensive care with mechanical ventilation (5.5% vs 1.6%; $P < .01$) compared with their non-morbidly obese counterparts (Figure 1).

Hospital charges related to morbid obesity

The mean total inpatient hospital charges were higher for morbidly obese patients compared with their counterparts (\$46,654 vs \$41,164; $P < .01$; Figure 2). With a multivariate linear regression model that was adjusted for charges that were associated with insurance type, hospital type, and surgery performed, the incremental cost of treating the morbidly obese patients was \$5096 per patient (95% confidence interval, \$2593–\$7598; $P < .01$; Table 2). Given the recent trends towards minimally invasive surgery, especially in the morbidly obese population, we attempted to look at costs for laparoscopic and robotic surgery in our population. Robotic costs were higher, with a mean cost of \$47,029 vs \$37,723 (Table 3).

Comment

Endometrial cancer is the most common gynecologic cancer in the United States, with an estimated 52,630 new cases in 2014.³ More than one-half of these uterine cancer cases may be attributed to obesity.¹¹ Even though obesity impacts cancer treatment with associated incremental costs, few reports have reviewed

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