JAMA Oncology | Original Investigation

Incidence, Timing, and Factors Associated With Suicide Among Patients Undergoing Surgery for Cancer in the US

Alexandra L. Potter, BS; Chinmay Haridas, MBBS; Krista Neumann, BMath; Mathew V. Kiang, ScD; Zhi Ven Fong, MD, MPH; Corinne A. Riddell, PhD, MSc; Harrison G. Pope Jr, MD, MPH; Chi-Fu Jeffrey Yang, MD

Editorial

Supplemental content

IMPORTANCE The risk and timing of suicide among patients who undergo surgery for cancer remain largely unknown, and, to our knowledge, there are currently no organized programs in place to implement regular suicide screening among this patient population.

OBJECTIVE To evaluate the incidence, timing, and factors associated with suicide among patients undergoing cancer operations.

DESIGN, SETTING, AND PARTICIPANTS This retrospective population-based cohort study used data from the Surveillance, Epidemiology, and End Results Program database to examine the incidence of suicide, compared with the general US population, and timing of suicide among patients undergoing surgery for the 15 deadliest cancers in the US from 2000 to 2016. A Fine-Gray competing risks regression model was used to identify factors associated with an increased risk of suicide among patients in the cohort. Data were analyzed from September 2021 to January 2022.

EXPOSURES Surgery for cancer.

MAIN OUTCOMES AND MEASURES Incidence, compared with the general US population, timing, and factors associated with suicide after surgery for cancer.

RESULTS From 2000 to 2016, 1 811 397 patients (74.4% female; median [IQR] age, 62.0 [52.0-72.0] years) met study inclusion criteria. Of these patients, 1494 (0.08%) committed suicide after undergoing surgery for cancer. The incidence of suicide, compared with the general US population, was statistically significantly higher among patients undergoing surgery for cancers of the larynx (standardized mortality ratio [SMR], 4.02; 95% CI, 2.67-5.81), oral cavity and pharynx (SMR, 2.43; 95% CI, 1.93-3.03), esophagus (SMR, 2.25; 95% CI, 1.43-3.38), bladder (SMR, 2.09; 95% CI, 1.53-2.78), pancreas (SMR, 2.08; 95% CI, 1.29-3.19), lung (SMR, 1.73; 95% CI, 1.47-2.02), stomach (SMR, 1.70; 95% CI, 1.22-2.31), ovary (SMR, 1.64; 95% CI, 1.13-2.31), brain (SMR, 1.61; 95% CI, 1.12-2.26), and colon and rectum (SMR, 1.28; 95% CI, 1.16-1.40). Approximately 3%, 21%, and 50% of suicides were committed within the first month, first year, and first 3 years after surgery, respectively. Patients who were male, White, and divorced or single were at greatest risk of suicide.

CONCLUSIONS AND RELEVANCE In this cohort study, the incidence of suicide among patients undergoing cancer operations was statistically significantly elevated compared with the general population, highlighting the need for programs to actively implement regular suicide screening among such patients, especially those whose demographic and tumor characteristics are associated with the highest suicide risk.

JAMA Oncol. doi:10.1001/jamaoncol.2022.6549
Published online January 12, 2023.

Author Affiliations: Author affiliations are listed at the end of this article.

Corresponding Author: Chi-Fu Jeffrey Yang, MD, Division of Thoracic Surgery, Department of Surgery, Massachusetts General Hospital, 55 Fruit St, Boston, MA 02114 (cjyang@mgh.harvard.edu).

While many studies have assessed the risk of suicide among all patients diagnosed with cancer,[1-9] the risk and timing of suicide among patients who undergo cancer operations remain largely unknown. Only 1 study, to our knowledge, has specifically assessed the incidence of suicide among patients who have undergone surgery for cancer.[10] However, this study evaluated older data of patients diagnosed from 2004 to 2011, did not include patients diagnosed with stage I cancer, and did not examine the timing of suicide relative to the date of surgery. Importantly, between 6% and 38% of patients who undergo cancer operations are reported to develop major depressive symptoms after surgical treatment,[11-15] suggesting that suicide may be an important risk in this population.[16-19] The objectives of this study were to (1) evaluate the incidence of suicide among patients undergoing cancer operations; (2) examine patterns in the timing of suicide relative to surgery; and (3) identify factors associated with an increased risk of suicide within this population.

Key Points

Question What are the incidence, timing, and factors associated with suicide among patients undergoing cancer operations in the US?

Findings In this cohort study of 1 811 397 patients who underwent cancer surgery, the incidence of suicide, compared with the general US population, was statistically significantly higher among patients undergoing surgery for 10 of the 15 cancers assessed, with approximately 50% of suicides committed within the first 3 years after surgery. Patients who were male, White, and divorced or single had the greatest risk of suicide.

Meaning These findings suggest the need to implement suicide screening among patients undergoing cancer operations, especially patients whose demographic and tumor characteristics are associated with the highest suicide risk.

Methods

Data Source

The Surveillance, Epidemiology, and End Results Program (SEER) 18 database provides data on cancer incidence, treatment, and mortality for the years 2000 to 2016 from 18 population-based US registries. These 18 population-based US registries represent 10 US states, 2 metropolitan areas, and Alaska Native individuals, collectively representing about 28% of the US population.[20] For the present analysis, data from different registries within the same US state were grouped together (eg, the 3 separate registries in Georgia, including the Atlanta [Metropolitan], Rural Georgia, and Greater Georgia registries, were combined into 1 group that we labeled "Georgia").

Data in the SEER 18 include individual-level patient, tumor, and treatment characteristics as well as cause-specific mortality, including suicide. Mortality codes in SEER are obtained from death certificates, which are completed by the patient's physician at the time of the patient's death. Patients whose cause of death was coded as suicide or self-inflicted injury (SEER code: 50220) were considered to have committed suicide.[21]

This retrospective cohort study was deemed exempt from review by the Massachusetts General Hospital institutional review board. The requirement for patient informed consent was waived because only deidentified data were analyzed. This study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline.

Study Design

Patients in the SEER database who underwent surgery for 1 of 15 solid-organ cancers in the US from 2000 to 2016 were identified for analysis using the SEER site recode *International Classification of Diseases for Oncology*, *Third Edition* codes.[22,23] The cancer sites selected are shown in eTable 1 in the Supplement. We excluded patients who were diagnosed with multiple primary cancers to avoid potential biases resulting from the influence of past or future cancer diagnoses on suicide risk. Cancer staging was based on the SEER summary staging information.

We first computed standardized mortality ratios (SMRs) for patients in the cohort—namely, the incidence of suicide among patients compared with the incidence of suicide in the general US population, adjusted by age, sex, race, and calendar year of death. We used 5-year age categories (eg, 50-54 years, 55-59 years) for standardization. Standardized mortality ratios are commonly used to compare the incidence of death from a certain cause in a study population with that of a standard population.[1,7,24]

Next, for each cancer site, we calculated the 5-year overall survival rate of patients in the study cohort. We then assessed the association between the 5-year overall survival rate for that type of cancer and the SMR for suicide among patients diagnosed with that type of cancer. To ensure that patients included in the 5-year overall survival rate calculation had adequate follow-up time, we calculated the 5-year overall survival rate of patients diagnosed with cancer from 2000 to 2011. Subgroup analyses were conducted by cancer stage (eg, localized, regional, distant).

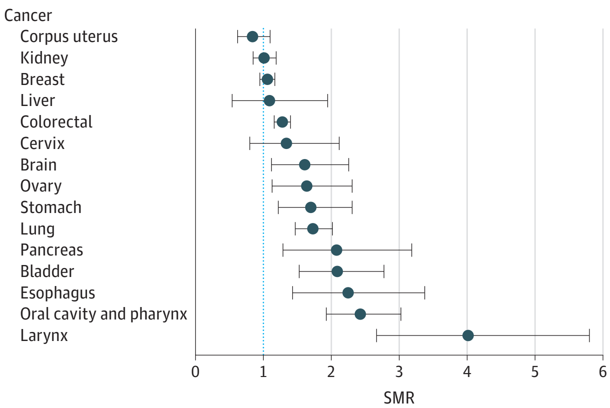
We also evaluated patterns in the timing of suicide relative to the date of surgery by cancer site. We assessed whether the median time to suicide after surgery for each cancer site was associated with the 5-year overall survival rate for that cancer site. In addition, we assessed whether the median time to suicide after surgery for each cancer site was associated with the SMR for suicide among patients with that type of cancer.

Finally, we examined the risk of suicide among patients in the cohort to determine whether there were any patient or tumor characteristics associated with an increased risk of suicide. We also assessed heterogeneity in the association between marital status and suicide risk by patient sex.

Statistical Analysis

The rate of suicide among patients in the study cohort was defined as the ratio of the number of suicides to the number of person-years at risk for suicide. Standardized mortality ratios for the entire cohort and for subgroups of patients by each cancer site were calculated using SEER*Stat software, version 8.3.9

Figure 1. Standardized Mortality Ratios (SMRs) of Suicide by Cancer Site



The SMRs of suicide compare the incidence of suicide among patients undergoing cancer-directed surgery with the incidence of suicide in the general US population. The SMRs were standardized by age, sex, race, and year of death. Error bars indicate 95% CIs.

(National Cancer Institute). All analyses were conducted between September 2021 and January 2022. To investigate whether individuals diagnosed with deadlier cancers (ie, those with lower survival rates) were more likely to commit suicide, we assessed the association between the SMR for each cancer site and the 5-year overall survival rate for that type of cancer using linear regression weighted by the number of suicides for each cancer site. Survival time in months was calculated from the time of surgery to death.

Next, we calculated the median time from surgery to suicide. In addition, we calculated the percentage of suicides committed by month and by year relative to the date of surgery. To investigate whether individuals diagnosed with deadlier cancers were more likely to commit suicide a shorter time after surgery, we evaluated the association between the median time from surgery to suicide for each cancer site and the 5-year overall survival rate for that cancer site using linear regression weighted by the number of suicides for each cancer site. We also assessed the association between median time from surgery to suicide for each cancer site and the SMR of suicide for that cancer site.

To identify factors associated with an increased risk of suicide among patients undergoing surgery, we used a multivariable Fine-Gray competing risks regression model.[25] The covariates included in this model were patient sex, race (American Indian or Alaska Native, Asian or Other Pacific Islander, Black, White), age, cancer site, cancer stage, receipt of radiation, receipt of chemotherapy, Yost index, and year of diagnosis. In addition, we included the SEER registry where the patient was diagnosed with cancer as a covariate in the model to account for differences in gun laws by US state. Data on patients' race were obtained from medical records that are submitted to regional or state cancer registries. The Yost index is a composite, continuous score based on 7 different measures of social vulnerability[26]; a higher Yost index score indicates higher socioeconomic status. For the present study, we categorized the Yost index into quartiles. We chose to use a Fine-Gray model instead of a Cox proportional hazards model because it allowed us to evaluate survival data in the presence of competing risks.[25] For example, deaths from causes other than suicide (eg, cancer or heart disease) may influence the estimate of the probability of death from suicide. To account for competing risks, the Fine-Gray model uses a hazard function adjusting for covariates for each cause of death (suicide vs other causes).

Differences in the association between marital status and suicide risk by patient sex were examined by including an interaction term between marital status and patient sex in the overall model, in addition to stratifying the study cohort by patient sex and fitting separate models to each stratum. Statistical analysis was performed using R, version 4.1.2 (R Foundation), and all *P* values were 2-sided and considered statistically significant at $P < .05$. We did not adjust for multiple comparisons in the analysis.

Results

Patient Population

From 2000 to 2016, 1 811 397 patients who underwent cancer surgery met study inclusion criteria. During a median (IQR) follow-up of 4.6 (1.7-9.0) years, 1494 (0.08%) patients committed suicide after undergoing surgery for cancer—a rate of 14.5 suicides per 100 000 person-years. The incidence of suicide among patients in the study cohort compared with the incidence of suicide in the general US population, adjusted by age, sex, race, and calendar year of death, was statistically significantly elevated (SMR, 1.29; 95% CI, 1.23-1.36). Baseline characteristics of patients who did and did not commit suicide in the study cohort are described in eTable 2 in the Supplement.

Incidence of Suicide Among Patients Undergoing Surgery

Standardized mortality ratios for individual cancer sites were statistically significantly elevated for cancers of the brain, bladder, colon and rectum, esophagus, larynx, lung, oral cavity and pharynx, ovary, pancreas, and stomach (**Figure 1** and eTable 3 in the Supplement). Patients undergoing surgery for cancers with higher 5-year overall survival rates showed lower SMRs than patients undergoing surgery for cancers with lower 5-year overall survival rates (slope, −0.022; 95% CI, −0.039 to −0.004; $P = .02$; **Figure 2**). Notably, patients who underwent surgery for cancers with 5-year overall survival rates greater than 80% (cancers of the corpus uterus, kidney, breast, and cervix) showed no statistically significant increased incidence of suicide relative to the US population. In a subgroup analysis of patients diagnosed with localized disease (eFigure in the Supplement), patients undergoing surgery for cancers with higher 5-year overall survival rates showed lower SMRs compared with patients undergoing surgery for cancers with lower 5-year survival rates; a similar finding was observed for patients diagnosed with regional disease, though this association did not reach statistical significance. No association between 5-year overall survival rates and SMRs was observed for patients diagnosed with distant disease.

Timing of Suicide Relative to the Time of Surgery

Approximately 3%, 21%, and 50% of suicides occurred within the first month, first year, and first 3 years after surgery, respectively (**Figure 3**A and B). The median (IQR) time from surgery to suicide varied by cancer site (Figure 3C), ranging from 11.5 (2.0-37.0) months for patients with brain cancers to 78.0 (44.0-134.0) months for those with cervical cancers. About 50% of suicides committed after surgery for brain cancer occurred within the first year after surgery, compared with less than 6% of suicides within the first year after surgery for cervical cancer (Figure 3D).

Patients undergoing surgery for cancers with lower 5-year survival rates committed suicide sooner after surgery than patients undergoing surgery for cancers with higher 5-year survival rates (slope, 1.327; 95% CI, 0.734-1.920; $P < .001$; **Figure 4**A). Additionally, patients undergoing surgery for cancers with higher SMRs of suicide committed suicide sooner after surgery than patients undergoing surgery for cancer with lower SMRs (slope, −0.032; 95% CI, −0.062 to −0.002; $P = .04$; Figure 4B).

Incidence of Suicide by Patient Characteristics

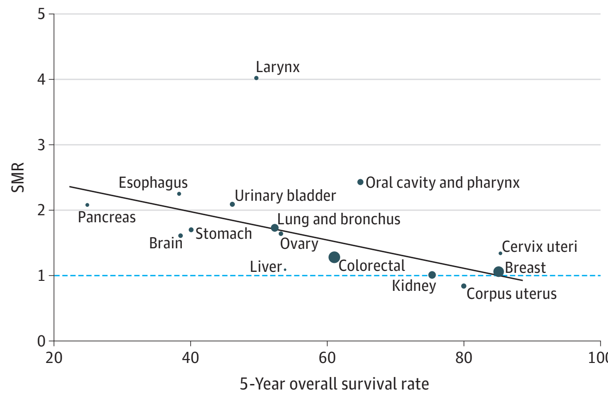
The rate of suicide per 100 000 person-years and the SMR of suicide varied by patient characteristics (eTable 4 in the Supplement). Patients who were male had a higher rate of suicide compared with patients who were female. Patients who were American Indian or White had higher rates of suicide compared with patients who were Black or Asian. To illustrate the combined effects of cancer site and patient characteristics on suicide risk, we found that the rate of suicide per 100 000 person-years among White male patients undergoing surgery for laryngeal cancer was 63 times greater than the rate of suicide per 100 000 person-years among Black female patients undergoing surgery for breast cancer.

Factors Associated With Increased Risk of Suicide

The proportional hazards assumption of the Fine-Gray model was evaluated with no violation identified. In the multivariable Fine-Gray competing risks regression model, Black and Asian patients displayed a lower risk of suicide compared with White patients, and older patients showed a lower risk of suicide than younger patients (eTable 2 in the Supplement). Male patients showed a statistically significant increased risk of suicide compared with female patients. Patients who were divorced or single (never married) had a higher risk of suicide than married patients. There was a statistically significant interaction between patient sex and marital status (subdistribution hazard ratio [SHR], 2.71; 95% CI, 1.83-4.01; $P < .001$). Compared with female patients who were married, female patients who were widowed did not have an increased risk of suicide (SHR, 0.91; 95% CI, 0.65-1.27; $P = .57$). In contrast, compared with male patients who were married, male patients who were widowed did have an increased risk of suicide (SHR, 1.56; 95% CI, 1.19-2.05; $P = .001$).

Patients undergoing cancer operations who also received radiation had a statistically significant lower risk of suicide compared with patients who did not receive radiation. Similarly, patients in the study cohort who received chemotherapy showed a lower risk of suicide compared with patients who did not receive chemotherapy, though this association did not reach statistical significance (SHR, 0.88; 95% CI, 0.78-1.01; $P = .07$). Patients undergoing cancer operations for distant disease had a statistically significant lower risk of suicide compared with patients undergoing operations for localized disease (eTable 2 in the Supplement).

Figure 2. Scatterplot of the Standardized Mortality Ratio (SMR) of Suicide for Each Cancer Site vs the 5-Year Overall Survival for Each Cancer Site



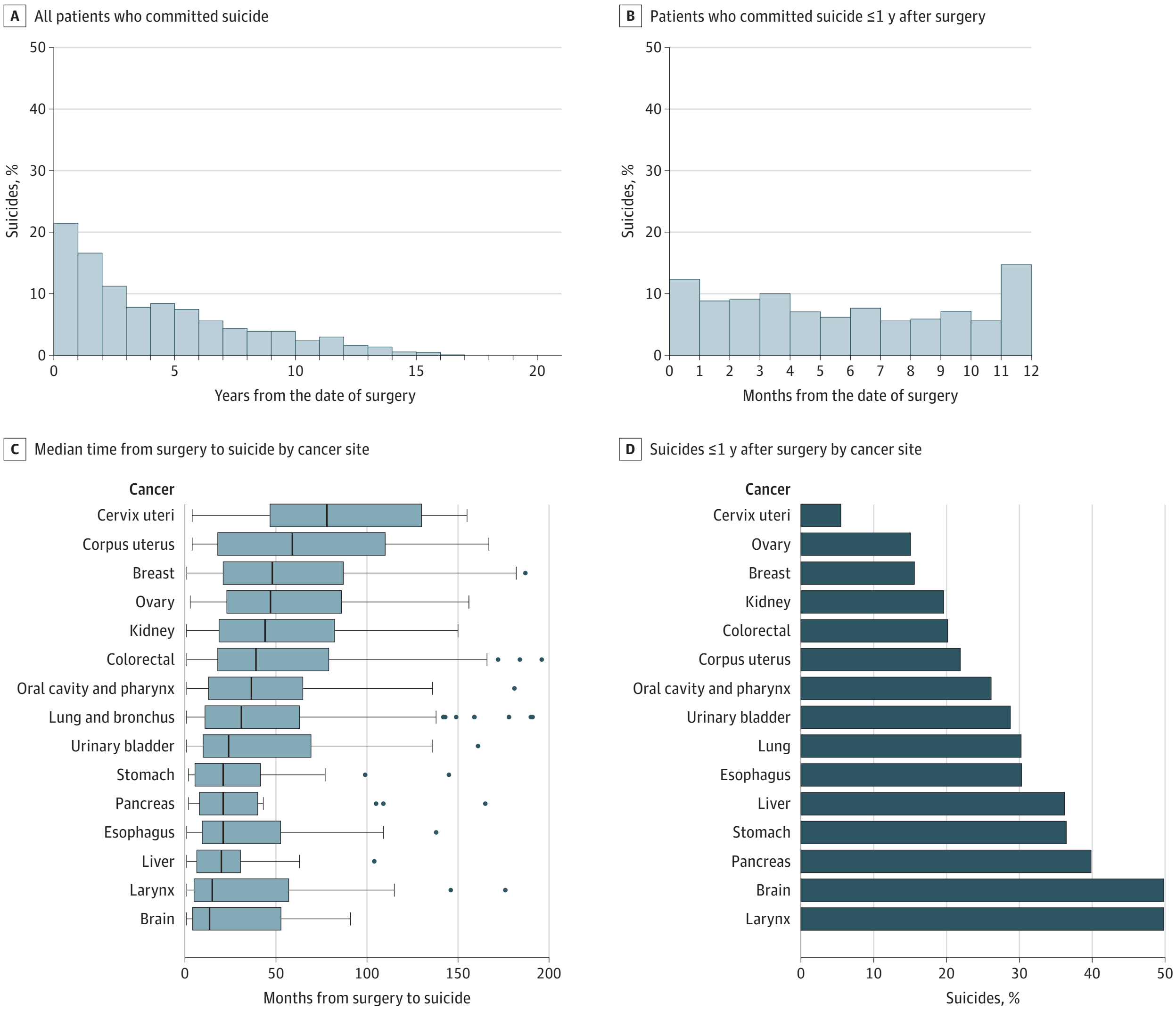
The SMRs were standardized by age, sex, race, and year of death. The size of each point corresponds to the number of suicides for each cancer site. The line of best fit was calculated using linear regression weighted by the number of suicides for each cancer site.

Discussion

In this national analysis, we found that the incidence of suicide among the entire patient cohort, and among patients receiving surgery for 10 of the 15 cancer sites evaluated, was statistically significantly greater than that expected in the general US population. Variations in suicide incidence among different cancer sites appeared at least partially associated with differences in patients' expected prognosis after surgery for that type of cancer. Specifically, SMRs for suicide tended to be lower among patients who had received surgery for cancers with higher 5-year overall survival rates, and indeed patients undergoing surgery for cancers with survival rates above 80% showed no statistically significant increase in suicide incidence compared with the general US population. Depression[5,27,28] and feelings of hopelessness[5,29] associated with a poor-prognosis cancer diagnosis may contribute to these differences. Losses in quality of life following cancer operations that are more extensive,[30,31] result in noticeable cosmetic changes,[32,33] or substantially limit patients' day-to-day functioning[31,34-36] may also contribute to an increased risk of suicide.

In addition, we found that approximately 3%, 21%, and 50% of suicides were committed within the first month, first year, and first 3 years after surgery, respectively. Notably, the timing of suicide after surgery varied by cancer site, and cancer sites with lower 5-year overall survival rates and higher

Figure 3. Distribution of the Time From Surgery to Suicide, Median Time From Surgery to Suicide by Cancer Site, and Suicides Committed During the First Year After Surgery

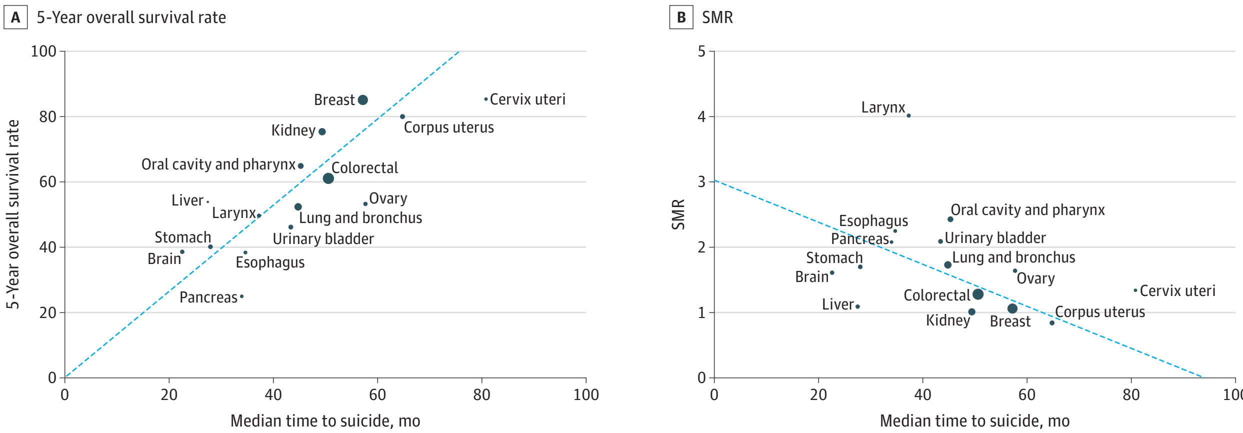


A, The distribution of the time from surgery to suicide in years among all patients who committed suicide. B, The distribution of the time from surgery to suicide in months among patients who committed suicide during the first year after surgery. C, A box plot of the time from surgery to suicide by cancer site. The median is denoted as the bar in the center of each box, the first and third quartiles are denoted by the ends of each box, 95% CIs are denoted by whiskers, and outliers are denoted as solid dots outside of the whiskers. D, The percentage of suicides committed during the first year (as opposed to later years) after surgery by cancer site.

SMRs for suicide were associated with shorter time to suicide after surgery. In addition, patients who were male, White, or divorced or single (never married) showed the greatest risk of suicide compared with other patients, which is consistent with characteristics associated with higher risk of suicide in the general US population.[37] We also found that patients receiving chemotherapy or radiation in addition to surgery displayed a lower risk of suicide compared with patients who received surgery without chemotherapy or radiation, respectively. This finding may reflect the influence of greater patient engagement in their cancer treatment and closer patient surveillance by the patient's health care team during the perioperative period.[38,39]

The findings of this study suggest that suicide is an important risk following cancer surgery and highlight the importance of improving access to support groups and implementing regular screening for distress during the postoperative period. While screening for distress is recommended for all patients with cancer by major medical professional societies,[16,17] and is mandated by the American College of Surgeons Commission on Cancer, overall adherence to these recommendations has been shown to be low.[40-43] Moreover, efforts to implement psychosocial distress screening in clinical practice have largely focused on the integration of psychosocial distress screening in medical oncology practices[42] and not surgical oncology practices. Many patients with cancer who undergo

Figure 4. Scatterplots of the 5-Year Overall Survival Rate for Each Cancer Site and the SMR of Suicide for Each Cancer Site vs the Median Time to Suicide After Surgery



The standardized mortality ratios (SMRs) were standardized by age, sex, race, and year of death. The size of each point corresponds to the number of suicides for each cancer site. For each graph, the line of best fit was calculated using linear regression weighted by the number of suicides for each cancer site.

surgical treatment receive their primary cancer care through their surgeon, and many do not ever see a medical oncologist. Thus, distress screening implemented in medical oncology practices may never reach patients who undergo cancer operations. Further work is needed to develop and implement distress screening programs in surgical oncology practices and to ensure that such programs adequately address the unique psychosocial needs of patients undergoing cancer operations.

Limitations

There are important limitations to this study. First, the SEER database covers approximately 28% of the US population. The number of suicides reported in this study represent only a fraction of the total number of suicides committed by patients undergoing cancer operations in the US. If the results were extrapolated to the rest of the country, the number of suicides committed by patients undergoing cancer operations from 2000 to 2016 may well have exceeded 5300. Second, the SEER database does not include data on the number of suicide attempts. A previous systematic review found that between 5% and 11% of suicide attempts resulted in death.[44] Based on these rates, we estimate that approximately 49 000 to 108 000 patients undergoing cancer operations in the US may have attempted suicide from 2000 to 2016. Third, the SEER database does not include information on the method of suicide or patients' mental health condition at the time of cancer surgery. Fourth, there is the possibility that the cause of death was misclassified on patients' death certificates. However, misclassification of the cause of death is unlikely when considering reports of suicide, given that there is little discrepancy in the underlying cause of death in this scenario. Fifth, there may be heterogeneity in the association between cancer stage and suicide risk across cancer sites that we were unable to evaluate due to the small number of patients who underwent surgery for distant disease in this cohort. Lastly, patients with cancer have been shown to have a higher risk of chronic health conditions[45] compared with members of the general population of a similar demographic. Chronic conditions have been shown to be associated with increased risks of suicide.[46] Thus, the increased incidence of suicide observed among patients with cancer compared with the general population may be attributed to several factors in addition to cancer, including other chronic conditions.

Conclusions

The findings of this cohort study suggest the need for efforts to reduce suicide risk among patients undergoing surgery for cancer. These data suggest that strategies to reduce suicide risk in such patients may start by focusing on higher-risk demographic subgroups such as patients who are male, White, and divorced or single. Similarly, patients undergoing surgery for cancers of the head and neck, bladder, esophagus, and pancreas appeared to display higher risk and may benefit from more intensive postoperative surveillance. Efforts to implement regular psychosocial distress screening of patients during preoperative evaluation and postoperative recovery and efforts to increase psychosocial support for these patients during postoperative recovery may represent possible strategies to reduce suicide risk among patients undergoing cancer operations.

ARTICLE INFORMATION

Accepted for Publication: September 22, 2022.

Published Online: January 12, 2023.
doi:10.1001/jamaoncol.2022.6549

Author Affiliations: Division of Thoracic Surgery, Department of Surgery, Massachusetts General Hospital, Boston (Potter, Haridas, Yang); Division of Epidemiology, School of Public Health, University of California, Berkeley (Neumann, Riddell); Department of Epidemiology and Population Health, Stanford University School of Medicine, Stanford, California (Kiang); Department of Surgery, Massachusetts General Hospital, Boston (Fong); Division of Biostatistics, School of Public Health, University of California, Berkeley (Riddell); Biological Psychiatry Laboratory and Psychiatric Epidemiology Research Program, McLean Hospital, Belmont, Massachusetts (Pope); Department of Psychiatry, Harvard Medical School, Boston, Massachusetts (Pope).

Author Contributions: Ms Potter and Dr Yang had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.
Concept and design: Potter, Fong, Pope Jr, Yang.
Acquisition, analysis, or interpretation of data: All authors.
Drafting of the manuscript: Potter, Haridas, Fong, Pope Jr, Yang.
Critical revision of the manuscript for important intellectual content: All authors.
Statistical analysis: Potter, Haridas, Neumann, Pope Jr, Yang.
Administrative, technical, or material support: Haridas, Kiang, Fong.
Supervision: Neumann, Fong, Riddell, Yang.

Conflict of Interest Disclosures: Dr Kiang is supported by the National Institute on Drug Abuse of the National Institutes of Health under award number K99DA051534. No other disclosures were reported.

Disclaimer: This content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

REFERENCES

1. Zaorsky NG, Zhang Y, Tuanquin L, Bluethmann SM, Park HS, Chinchilli VM. Suicide among cancer patients. *Nat Commun*. 2019;10(1):207. doi:10.1038/s41467-018-08170-1

2. Amiri S, Behnezhad S. Cancer diagnosis and suicide mortality: a systematic review and meta-analysis. *Arch Suicide Res*. 2020;24(suppl 2):S94-S112. doi:10.1080/13811118.2019.1596182

3. Ahn MH, Park S, Lee HB, et al. Suicide in cancer patients within the first year of diagnosis. *Psychooncology*. 2015;24(5):601-607. doi:10.1002/pon.3705

4. Ahn E, Shin DW, Cho S-I, Park S, Won Y-J, Yun YH. Suicide rates and risk factors among Korean cancer patients, 1993-2005. *Cancer Epidemiol Biomarkers Prev*. 2010;19(8):2097-2105. doi:10.1158/1055-9965.EPI-10-0261

5. Cheung YB, Law CK, Chan B, Liu KY, Yip PS. Suicidal ideation and suicidal attempts in a population-based study of Chinese people: risk attributable to hopelessness, depression, and social factors. *J Affect Disord*. 2006;90(2-3):193-199. doi:10.1016/j.jad.2005.11.018

6. Suk R, Hong YR, Wasserman RM, et al. Analysis of suicide after cancer diagnosis by US county-level income and rural vs urban designation, 2000-2016. *JAMA Netw Open*. 2021;4(10):e2129913. doi:10.1001/jamanetworkopen.2021.29913

7. Zaorsky NG, Churilla TM, Egleston BL, et al. Causes of death among cancer patients. *Ann Oncol*. 2017;28(2):400-407. doi:10.1093/annonc/mdw604

8. Liu Q, Wang X, Kong X, et al. Subsequent risk of suicide among 9,300,812 cancer survivors in US: a population-based cohort study covering 40 years of data. *EClinicalMedicine*. 2022;44:101295. doi:10.1016/j.eclinm.2022.101295

9. Heinrich M, Hofmann L, Baurecht H, et al. Suicide risk and mortality among patients with cancer. *Nat Med*. 2022;28(4):852-859. doi:10.1038/s41591-022-01745-y

10. Jayakrishnan TT, Sekigami Y, Rajeev R, Gamblin TC, Turaga KK. Morbidity of curative cancer surgery and suicide risk. *Psychooncology*. 2017;26(11):1792-1798. doi:10.1002/pon.4221

11. Park S, Kang CH, Hwang Y, et al. Risk factors for postoperative anxiety and depression after surgical treatment for lung cancer. *Eur J Cardiothorac Surg*. 2016;49(1):e16-e21. doi:10.1093/ejcts/ezv336

12. Kim M-S, Kim SY, Kim J-H, Park B, Choi HG. Depression in breast cancer patients who have undergone mastectomy: a national cohort study. *PLoS One*. 2017;12(4):e0175395. doi:10.1371/journal.pone.0175395

13. Powell-Chandler A, Boyce K, James O, et al; PISA Trial Management Group. Psychological sequelae of colonic resections. *Colorectal Dis*. 2020;22(8):945-951. doi:10.1111/codi.14986

14. Lemiński A, Kaczmarek K, Bańcarz A, Zakrzewska A, Małkiewicz B, Słojewski M. Educational and psychological support combined with minimally invasive surgical technique reduces perioperative depression and anxiety in patients with bladder cancer undergoing radical cystectomy. *Int J Environ Res Public Health*. 2021;18(24):13071. doi:10.3390/ijerph182413071

15. Suzuki M, Deno M, Myers M, et al. Anxiety and depression in patients after surgery for head and neck cancer in Japan. *Palliat Support Care*. 2016;14(3):269-277. doi:10.1017/S1478951515000930

16. Andersen BL, DeRubeis RJ, Berman BS, et al; American Society of Clinical Oncology. Screening, assessment, and care of anxiety and depressive symptoms in adults with cancer: an American Society of Clinical Oncology guideline adaptation. *J Clin Oncol*. 2014;32(15):1605-1619. doi:10.1200/JCO.2013.52.4611

17. Riba MB, Donovan KA, Andersen B, et al. Distress management, version 3.2019, NCCN Clinical Practice Guidelines in Oncology. *J Natl Compr Canc Netw*. 2019;17(10):1229-1249. doi:10.6004/jnccn.2019.0048

18. Cancer program standards: ensuring patient-centered care. American College of Surgeons. 2015. Accessed December 4, 2022. https://www.facs.org/media/t5spw4jo/2016-coc-standards-manual_interactive-pdf.pdf

19. Lazenby M, Ercolano E, Grant M, Holland JC, Jacobsen PB, McCorkle R. Supporting commission on cancer-mandated psychosocial distress screening with implementation strategies. *J Oncol Pract*. 2015;11(3):e413-e420. doi:10.1200/JOP.2014.002816

20. Howlader N, Noone AM, Krapcho M, et al, eds. SEER Cancer Statistics Review (CSR), 1975-2017. National Cancer Institute. April 15, 2020. Accessed December 4, 2022. https://seer.cancer.gov/csr/1975_2017/

21. SEER Cause of Death Recode 1969+ (03/01/2018). National Cancer Institute. Accessed December 4, 2022. https://seer.cancer.gov/codrecode/1969_d03012018/index.html

22. Site Recode ICD-O-3/WHO 2008 Definition. National Cancer Institute. Accessed December 4, 2022. https://seer.cancer.gov/siterecode/icdo3_dwhoheme/index.html

23. United States Cancer Statistics: Data Visualizations. Centers for Disease Control and Prevention. Accessed December 4, 2022. https://www.cdc.gov/cancer/dataviz

24. Shahian DM, Wolf RE, Iezzoni LI, Kirle L, Normand SL. Variability in the measurement of hospital-wide mortality rates. *N Engl J Med*. 2010;363(26):2530-2539. doi:10.1056/NEJMsa1006396

25. Fine JP, Gray RJ. A proportional hazards model for the subdistribution of a competing risk. *J Am Stat Assoc*. 1999;94(446):496-509. doi:10.1080/01621459.1999.10474144

26. Yost K, Perkins C, Cohen R, Morris C, Wright W. Socioeconomic status and breast cancer incidence in California for different race/ethnic groups. *Cancer Causes Control*. 2001;12(8):703-711. doi:10.1023/A:1011240019516

27. Chochinov HM, Wilson KG, Enns M, Lander S. Depression, hopelessness, and suicidal ideation in the terminally ill. *Psychosomatics*. 1998;39(4):366-370. doi:10.1016/S0033-3182(98)71325-8

28. Klaassen Z, Arora K, Wilson SN, et al. Decreasing suicide risk among patients with prostate cancer: implications for depression, erectile dysfunction, and suicidal ideation screening. *Urol Oncol*. 2018;36(2):60-66. doi:10.1016/j.urolonc.2017.09.007

29. Beck AT, Kovacs M, Weissman A. Hopelessness and suicidal behavior: an overview. *JAMA*. 1975;234(11):1146-1149. doi:10.1001/jama.1975.03260240050026

30. Avery KNL, Blazeby JM, Chalmers KA, et al. Impact on health-related quality of life of video-assisted thoracoscopic surgery for lung cancer. *Ann Surg Oncol*. 2020;27(4):1259-1271. doi:10.1245/s10434-019-08090-4

31. Scarpa M, Valente S, Alfieri R, et al. Systematic review of health-related quality of life after esophagectomy for esophageal cancer. *World J Gastroenterol*. 2011;17(42):4660-4674. doi:10.3748/wjg.v17.i42.4660

32. Rhoten BA, Murphy B, Ridner SH. Body image in patients with head and neck cancer: a review of the literature. *Oral Oncol*. 2013;49(8):753-760. doi:10.1016/j.oraloncology.2013.04.005

33. Callahan C. Facial disfigurement and sense of self in head and neck cancer. *Soc Work Health Care*. 2004;40(2):73-87. doi:10.1300/J010v40n02_05

34. Rausei S, Mangano A, Galli F, et al. Quality of life after gastrectomy for cancer evaluated via the EORTC QLQ-C30 and QLQ-STO22 questionnaires: surgical considerations from the analysis of 103 patients. *Int J Surg*. 2013;11(suppl 1):S104-S109. doi:10.1016/S1743-9191(13)60028-X

35. Nassiri F, Price B, Shehab A, et al; International Consortium on Meningiomas. Life after surgical resection of a meningioma: a prospective cross-sectional study evaluating health-related quality of life. *Neuro Oncol*. 2019;21(suppl 1):i32-i43. doi:10.1093/neuonc/noy152

36. Heerkens HD, Tseng DS, Lips IM, et al. Health-related quality of life after pancreatic resection for malignancy. *Br J Surg*. 2016;103(3):257-266. doi:10.1002/bjs.10032

37. Hedegaard H, Curtin SC, Warner M. *Suicide Mortality in the United States, 1999–2019*. National Center for Health Statistics; 2021. doi:10.15620/cdc:101761

38. Nguyen BKH, Wu BS, Sanoff HK, Lafata JE. Patient-oncologist communication regarding oral chemotherapy during routine office visits. *JCO Oncol Pract*. 2020;16(8):e660-e667. doi:10.1200/JOP.19.00550

39. Trevino KM, Abbott CH, Fisch MJ, Friedlander RJ, Duberstein PR, Prigerson HG. Patient-oncologist alliance as protection against suicidal ideation in young adults with advanced cancer. *Cancer*. 2014;120(15):2272-2281. doi:10.1002/cncr.28740

40. Cartmell KB, Sterba KR, Pickett K, et al. Availability of patient-centered cancer support services: a statewide survey of cancer centers. *PLoS One*. 2018;13(3):e0194649. doi:10.1371/journal.pone.0194649

41. Rohan EA, Gallaway MS, Huang GC, et al. Disparities in psychosocial distress screening and management of lung and ovarian cancer survivors. *JCO Oncol Pract*. 2022;18(10):e1704-e1715. doi:10.1200/OP.22.00078

42. Ercolano E, Hoffman E, Tan H, Pasacreta N, Lazenby M, McCorkle R. Managing psychosocial distress: lessons learned in optimizing screening program implementation. *Oncology (Williston Park)*. 2018;32(10):488-490.

43. Zebrack B, Kayser K, Sundstrom L, et al. Psychosocial distress screening implementation in cancer care: an analysis of adherence, responsiveness, and acceptability. *J Clin Oncol*. 2015;33(10):1165-1170. doi:10.1200/JCO.2014.57.4020

44. Owens D, Horrocks J, House A. Fatal and non-fatal repetition of self-harm: systematic review. *Br J Psychiatry*. 2002;181:193-199. doi:10.1192/bjp.181.3.193

45. Guy GP Jr, Yabroff KR, Ekwueme DU, Rim SH, Li R, Richardson LC. Economic burden of chronic conditions among survivors of cancer in the United States. *J Clin Oncol*. 2017;35(18):2053-2061. doi:10.1200/JCO.2016.71.9716

46. Erlangsen A, Stenager E, Conwell Y. Physical diseases as predictors of suicide in older adults: a nationwide, register-based cohort study. *Soc Psychiatry Psychiatr Epidemiol*. 2015;50(9):1427-1439. doi:10.1007/s00127-015-1051-0