8-10-2018

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Notes/Citation Information
Published in *Advances in Radiation Oncology*, v. 3, issue 4, p. 471-477.

Digital Object Identifier (DOI)
https://doi.org/10.1016/j.adro.2018.08.001

Advances in Radiation Oncology (2018) **3**, 471-477

advances
in radiation oncology

www.advancesradonc.org

Disparities in Radiation Oncology

The pervasive crisis of diminishing radiation therapy access for vulnerable populations in the United States—Part 4: Appalachian patients

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Received 14 June 2018; revised 31 July 2018; accepted 2 August 2018

Abstract

Purpose: Compared with the rest of the United States, the population of Appalachia has lower education levels, higher rates of poverty, and limited access to health care. The presence of disparities in radiation therapy (RT) access for Appalachian patients with cancer has rarely been examined.

Methods and materials: The National Cancer Institute initiatives toward addressing disparities in treatment access for rural populations were examined. An extensive literature search was undertaken for studies investigating RT access disparities in Appalachian patients, beginning with the most common cancers in these patients (lung, colorectal, and cervical).

Results: Although the literature investigating RT access disparities in Appalachia is relatively sparse, studies examining lung, colorectal, cervical, prostate, head and neck, breast, and esophageal cancer, as well as lymphoma, indicate an unfortunate commonality in barriers to optimal RT access for Appalachian patients with cancer. These barriers are predominantly socioeconomic in nature (low income and lack of private insurance) but are exacerbated by paucities in both the number and quality of radiation centers that are accessible to this patient population.

Conclusions: Regardless of organ system, there are significant barriers for Appalachian patients with cancer to receive RT. Such diminished access is alarming and warrants resources devoted to addressing these disparities, which often go overlooked because of the assumption that the overall wealth of the United States is tangibly applicable to all of its citizens. Without intelligently targeted investments of time and finances in this arena, there is great risk of exacerbating rather than alleviating the already heavy burden facing Appalachian patients with cancer.

Sources of support: This work had no specific funding.
Conflicts of interest: The authors have no conflicts of interest to disclose.

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https://doi.org/10.1016/j.adro.2018.08.001

Introduction

Optimal treatment of cancer requires access to the most advanced tools of care, among which radiation therapy (RT) is a prominent component.[1] Given the advances in radiation oncology technology and efficacy over the past 3 decades, disparities in RT access arguably result in larger discrepancies in patient care than ever before.[2] The current Advances in Radiation Oncology disparities series has focused on the vulnerable populations within the United States that most likely to suffer disparities in RT access and previously examined African American, Native American, and Hispanic American patients.[3–6] This manuscript concludes the series by investigating the barriers Appalachian patients with cancer face in receiving RT care, a population from which prior research has produced important information for intervention, research, and control of cancer.[7]

According to the Appalachian Regional Commission (federally mandated in 1965 to support social and economic development in the Appalachian region), Appalachia comprises 406 counties that span 13 states (Alabama, Georgia, Kentucky, Maryland, Mississippi, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia, and West Virginia) along the Appalachian mountain chain, containing >8% of the U.S. population.[8] The Appalachian Regional Commission is composed of the governors of these 13 states as well as a presidential appointee who represents the federal government (most recently Earl Gohl in 2010).

However, a March 2017 federal budget proposal for the 2018 fiscal year proposed the complete elimination of Appalachian Regional Commission federal funding.[8–10] Compared with the rest of the United States, Appalachians have lower education levels, higher rates of poverty, and limited access to health care.[11] Consequently, the National Cancer Institute has designated any rural population as a special population due to high death risk from cancer and other diseases.[12]

An analysis of mortality by the Centers for Disease Control National Center for Health Statistics using Surveillance, Epidemiology, and End Results (SEER) data from 1994 to 1998 found the cancer death rate for rural Appalachia to be 176.3 per 100,000 people and 173.1 per 100,000 for all Appalachia, compared with the general United States at 166.7 per 100,000 population.[8] Death rates for lung (57.2 vs 48.9 per 100,000) and cervical (3.1 vs 2.7 per 100,000) cancer were each significantly higher in rural Appalachia than in the United States overall, with the Appalachian region of Kentucky having the highest death rate for lung cancer (73.7 per 100,000), cervical cancer (3.8 per 100,000), and all cancers (196.6 per 100,000). The colorectal cancer death rate of 6 of 13 Appalachian states was significantly higher than that of the overall U.S. rate of 16.9 per 100,000.[8]

The Centers for Disease Control attempted to address these findings by promoting screening services through the National Breast and Cervical Cancer Early Detection Program and the National Colorectal Cancer Action Campaign.[13] The cancer with the largest impact on the all-cancer death rate for Appalachian patients is lung cancer, which has been attributed to a high prevalence of smoking in this population.[8]

Most common cancer-related death sites in Appalachian patients (lung, colorectal, cervical)

Lung cancer

Overall, lung cancer has a higher incidence in Appalachia than non-Appalachia areas of the United States. In a recent review by Wilson et al., the male rate of lung and bronchus cancer incidence is 100.4 cases per 100,000 persons, and the female rate is 61.0 per 100,000. This is relatively higher than the rates in the U.S. non-Appalachia areas, with 79.5 cases per 100,000 for men and 54.7 cases per 100,000 for women.[14] Moreover, for both female and male Appalachian residents, there has been a steady increase of 1.4% for men and 0.6% for women.[14] A higher incidence has been attributed to lifestyle, occupation, low income, and lack of education.[15,16]

Rural areas tend to have variations in quality, availability, and access to medical services compared with metro areas.[17] In North Carolina, surveys showed that among respondent rural facilities, only 52% followed lung cancer screening guidelines. Moreover, in the active facilities, overall patient volumes were low.[18] However, when a free lung screening program was implemented in the southeastern United States, a 2-fold increase in prevalence was found compared with the National Lung Screening Trial.[19] This indicates that more patients can be diagnosed if guidelines are followed.

Along with higher incidence and poor access to facilities for preventative services in Appalachia, several demographic factors serve as a barrier to obtaining treatment, specifically RT. Whether radiation is received by patients with non-small cell lung cancer in rural areas based on demographic factors have been reviewed by several studies. In a study performed in Georgia, higher

disease stage and number of comorbidities were associated with less radiation receipt, but race was not.

Interestingly, nonmetropolitan area residents had a higher probability of receiving radiation compared with patients residing in metropolitan areas.[20] In this particular study, this counterintuitive finding was explained by the fact that even though travel distances were greater for patients in rural areas, many radiation facilities provided transportation to help minimize the gap in care. In general, 26.3% of patients did not receive any therapy within a year of diagnosis. These patients were more likely to be older and without insurance coverage.[20] In rural areas of Alabama, race was not a significant factor for RT receipt, which was the case in urban areas.[21] This may highlight that racial disparities tend to become minimal in the context of Appalachian locations.

Factors leading to disparities in rural areas (eg, age) have been found to translate to worse outcomes. In rural West Virginia, elderly patients had significantly better survival outcomes with lung cancer if they received the appropriate therapy, which may be surgery plus RT and chemotherapy. Appropriate care was only received by 46% of patients in the cohort and was not affected by timeliness of care. The disparity was attributed to the disproportionate lung cancer burden, facilities in the area that did not completely follow guideline concordant care, and underuse of diagnostic and management services of Medicare.[22] Another study evaluating disparities in cancer care in West Virginia noted that the supply and proximity of radiation oncologist and facilities may contribute to the significant disparity. Of note, the author urges large university centers in the area to develop radiation oncology residency programs to ensure a better cancer care workforce.[23]

Lung cancer is a prominent burden in the Appalachian population compared with the U.S. non-Appalachian population because of many demographic and lifestyle factors. However, the difficulty of access to radiation facilities with adequate resources to guideline-driven practices provides a significant barrier to obtaining radiation if necessary and can subsequently translate to worse outcomes.

Colorectal cancer

The incidence of colon cancer in Appalachia is 56.6 per 100,000 persons for men and 41.8 per 100,000 for women. These statistics are higher than those of non-Appalachian men and women in the United States.[14] When comparing rural and non-rural Appalachia using SEER data, Appalachia incidence was found to be greater than what was shown in the SEER data.[24] Moreover, the incidence of unstaged colon and rectal cancer in rural Appalachia was substantially elevated, which translated to access to and use of diagnostic and treatment services.[24]

In Kentucky, patients from Appalachian counties were half as likely to have a colonoscopy or sigmoidoscopy performed within the past 10 years compared with non-Appalachian patients.[25] Recent data also suggest decreased odds of receiving RT for rural Georgia residents.[26] Treatment access and use has great implication in terms of outcomes. The presence of a radiation facility in a county in Appalachia results in a 12% to 47% decline in mortality.[27]

Beyond a higher incidence and barriers to access of care, up-to-date medical facilities are scarce as well. Hatzell et al performed a study evaluating the impact of educational activities updating on newer methodologies in colon and rectal treatments. Pre-and-post surveys showed that 70% of participants failed to acknowledge chemotherapy as experimental for patients with Dukes' B colon cancer, and 25% failed to recognize a combination of surgery, chemotherapy, and RT as a standard treatment for rectal cancer. The authors concluded that a stronger consensus for appropriate cancer treatment is necessary.[28]

The disparity in colon and rectal cancer in Appalachia is a domino effect that starts with inadequate screening and leads to the scarcity of radiation facilities in the vicinity. Additionally, rural facilities may not be up to date on recent guidelines, and patients may not be receiving standard of care in terms of RT. However, other factors such as race and socioeconomic factors have not been completely elucidated. Further research on the specific barriers to receipt of adequate radiation in colorectal cancer should be further explored and described.

Cervical cancer

The epidemiology, risk factors, and clinical outcome of patients with cervical cancer are closely related to race, smoking, and poor socioeconomic status. In a study of 153 women by the University of Maryland,[29] African-American women were more likely to have stages III and IV cervical cancer and had poorer survival across all stages of disease compared with white women. Another study[30] by the same institution noted that being African American and/or having Medicaid or uninsured status were associated with more emergency visits and admissions for cervical cancer and treatment-related complications in the Appalachian regions. In a large study of >2000 patients, alarmingly increased rates of African-American women were found to have locally advanced or stage IV cervical cancer at diagnosis, even after adjusting for insurance status, compared with their white counterparts.[31] However, there is certainly good news as well: At a large and experienced tertiary hospital in Kentucky with patients with cervical cancer, no differences were observed by race, insurance coverage, or socioeconomic status in patient outcomes including survival over a 10-year period.[32] Furthermore, the increased case volumes of the medical facility were proportionally

related to improved cervical cancer outcomes in a study using the Virginia state cancer registry.[33]

Additional cancer sites in Appalachian patients

Prostate cancer

Data on the use of RT for the Appalachian region is limited; however, current studies suggest that RT disparities may indeed exist. The Virginia Prostate Cancer registry was published, analyzing 28,244 men with stage 0 to IV prostate cancer between 1970 and 1997.[34] Only 3.3% had stage 0 disease and 13.2% had stage IV at diagnosis. The registry showed that the first course of treatment for the entire cohort consisted of surgery alone for 9632 patients (34.1%) and radiation alone for 5556 patients (19.7%). Combined surgery and radiation were given to 898 patients (3.2%), surgery and hormone therapy to 1398 patients (4.9%), and RT and hormone therapy to 1246 patients (4.4%). The article compared the results to those of a prior National Cancer Database on prostate cancer statistics, which showed a similar national trend with surgery alone in 41.0% and radiation only in 22.0% of patients for first-line treatment.[35] The American Cancer Society along with Massachusetts General Hospital published a National Cancer Database report that focused on the declining use of postoperative RT after radical prostatectomy for prostate cancer with adverse features between 2005 and 2011.[36] The adverse features were either pathologic T3/4 or positive margins. Overall, the use of postoperative radiation in this high-risk population decreased by approximately 2% (9.1% to 7.3%) across the United States. Geographically, the article showed that the majority of patients received surgery alone versus the addition of radiation with or without hormones in the Midwest (89% vs 8.9%) and South (91% vs. 7.3%). These regions encapsulate the Appalachian population. Also, the odds ratio showed that patients in the South were less likely to receive postoperative radiation compared with those in the Northeast.

Although there is sparse data on the use of RT for prostate cancer in the Appalachian region, we can use the available literature to state that disparity in radiation management is likely.

Head and neck cancer

Reports on the disparities of RT for head and neck cancer (HNC) are sparse, and we were unable to find reports targeting this specific subset. However, data are available that tangentially reflect radiation delivery in this population. A SEER analysis of patients with HNC who were treated between 2007 and 2010 was reported in 2016.[37] The retrospective analysis showed that Medicaid patients were less likely to be treated with definitive radiation and/or surgery. Also, patients with Medicare coverage or no insurance were less likely to have definitive treatment and present with metastatic disease. Patients in disadvantaged areas such as the Appalachian region are more likely to be uninsured or have government-sponsored insurance as opposed to private insurance. Thus, they may also have a higher risk of not receiving definitive RT.

Harvard also conducted a SEER analysis on the use of intensity modulated RT (IMRT) and conformal RT for HNC.[38] The authors showed that having a higher median income predicted for a higher use of IMRT. The interaction seemed to have a linear relationship because the second lowest income quartile had a higher use of IMRT than the lowest income quartile. Because IMRT has been shown to decrease morbidity,[39] an increase in toxicity from treatment may dissuade this patient population from receiving or completing RT. Because patients in the Appalachian region are usually low income, this study may pertain to care in their community.

Although there is sparse data regarding use of RT in this population, income and insurance seem to be associated with receipt and type of care. This shows the need for more reports targeting this patient population.

Esophageal cancer

Although the disparities in incidence rates for esophageal cancer, lymphoma/leukemia, and other miscellaneous cancers are not as large, they still exist. For esophageal cancer, the incidence in Appalachian men is 9.0 cases per 100,000 compared with 8.5 cases per 100,000 for non-Appalachian men ($P < .05$).[14] When specifically looking at adenocarcinomas of the esophagus, this difference becomes much more pronounced. According to a study by Hebert et al. on esophageal cancer disparities in South Carolina, a steady increase in the incidence of esophageal adenocarcinomas was observed since the late 1980s, with rates rising at approximately 3% to 4% per year.[40] Furthermore, this increase is predominantly seen in the European-American population.[40]

Another study, from 2005, estimated the increase in incidence of esophageal adenocarcinoma to be in the range of 300% to 500% over the last 40 years (contemporary to the time of the study) and again predominantly in European-Americans.[41] One hypothesis suggests that the geographic pattern of incidence of esophageal adenocarcinoma overlaps that of obesity fairly substantially, which could in part explain the increased rates of esophageal adenocarcinoma in these areas.[41] Although this disparity exists and some research has been done into why it exists, there is very little research on the impact of any disparities in the receipt of treatment on overall survival.

Hematologic malignancies

Although RT has a more limited role in leukemia, there are disparities with regard to leukemia incidence and

survival between Appalachian and non-Appalachian patients that need to be addressed. Appalachian men have a leukemia incidence of 16.9 cases per 100,000 compared with 16.7 cases per 100,000 for non-Appalachian men. Appalachian women have a leukemia incidence of 10.4 cases per 100,00 in comparison with 10.2 cases per 100,000 for non-Appalachian women.[14]

In a paper analyzing the geographical variation in survival outcomes for adult patients with acute myeloid leukemia within the state of North Carolina, Medicaid patients had an increased likelihood of death when compared with patients covered by private insurance (hazard ratio, 1.36; confidence interval, 1.00-1.85; $P < .05$).[42] Also, as an independent association, patients who did not undergo allogenic hematopoietic stem cell transplantation (standard of care for definitive treatment) within 1 year of diagnosis had a hazard ratio of 2.09 compared with those who were able to receive allogenic hematopoietic stem cell transplantation (confidence interval, 1.15-3.83; $P < .05$).[42] Although these data are for hematopoietic stem cell transplantation, access to RT may have a role to play in this disparity because total body irradiation is a prerequisite for stem cell transplantation.

Although data are sparse, there is some context for increasing research of radiation-related cancer disparities for esophageal cancer, lymphoma, leukemis, and other miscellaneous cancers.

Breast cancer

Multiple studies have suggested that women in Appalachia are at a higher risk for inadequate health access and appropriate clinical screening for breast cancer.[43–48] Using central cancer registry data, Anderson et al.[44] showed that less-populated counties in 3 Appalachian states were statistically significantly underscreened, especially for the early detection of locally advanced breast cancer. Another study of 344 women in North Carolina[43] reported that up to one third of patients did not receive RT after breast-conserving surgery (BCS), and risk factors included living in less populated counties, having BCS at smaller hospitals, and residing in counties that were specialist scarce. Similar findings were reported in South Carolina.[49] Having on-site RT availability increased breast-conserving therapy rates at a community hospital.[50] Surgeons were also less likely to refer patients for adjuvant therapies if the patient had Medicaid coverage or was not insured.[45]

Additionally, working women, especially those receiving aggressive treatments, experienced significant employment disruptions.[51] Two studies using the Kentucky Cancer Registry reported that postmastectomy[47] and whole-breast[52] RT were still vastly underused, especially for older and poorer patients in rural regions. Overall, only 66% of women received breast-conserving therapy between 1998 and 2007.[52] Older age, race, poor socioeconomic status, and lack of access or further distance to a RT center were also noted as factors for more women choosing mastectomy or forgoing RT altogether after BCS in Appalachian states.[48,53–56] In rural Virginia, increased distance to an RT center was the only independently predicted factor for increased mastectomy rates in 20,094 patients.[57] Similar findings were noted in North Carolina[58] and Kentucky[59] (mountainous states).

There are multiple opportunities and needs for intervention. A study that surveyed rural physicians in North and South Carolina found that 55% failed to acknowledge that adjuvant RT was required after lumpectomy for breast cancer treatment.[28] Another report also highlighted the need for standardized pathologic information on surgical specimen reports (eg, margin status, tumor size, histologic grade, and angiolymphatic invasion) in both urban and rural hospitals.[60] In a large study of >4500 patients with breast cancer in Appalachian regions,[61] the authors pointed out that nonprofit hospitals in rural and underserved areas may experience delays in diagnosing new breast cancer cases. For many regions in Appalachia, the main efforts remain reaching out to rural and very rural populations and systemically improving the entire care network at individual components (screening, diagnosis, surgery, and adjuvant therapies) with local health care providers.[62,63]

Discussion

An unfortunate commonality of these disease sites in Appalachian patients is the disparate access to optimal RT as a result of a number of socioeconomic factors, including but not limited to low income, lack of private insurance, limited access to diagnostic and treatment services (ie, colonoscopy for colorectal cancer screening), paucities in both number and quality of radiation centers, decreased access to up-to-date treatment recommendations, and the geographic region of the United States. In fact, the median household income in Appalachia is 82% of the U.S. median income, with only 19 Appalachian counties having household incomes at or above the national mean.[64]

This patient population suffers from these socioeconomic barriers and from the barrier of relative invisibility. The disparities they face in receiving optimal care are not as widely publicized as those of racial and ethnic minorities, such as African Americans or Hispanic Americans. Furthermore, an unfortunate reality is that many people both within and outside the United States rely on the flawed assumption that the overall wealth of the United States is tangibly applicable to all of its citizens, which may diminish their understanding of the great lack of resources Appalachian patients with cancer face.

We hope that this manuscript will help to shed light on the difficulties Appalachian patients with cancer face,

with the goal of inspiring financial and policy-driven interventions to tackle these difficulties, many of which may be less formidable than they appear at first glance. Based on the results elucidated in this manuscript for multiple cancer sites, it may be wiser for the federal government to increase aid to Appalachian patients with cancer rather than (as the 2018 fiscal year budget proposed) completely eliminating financial aid to this vulnerable population.[8–10]

Furthermore, newer tools developed to identify patients at increased risk of toxicity after RT will need to be governed with the priority of optimizing access to care rather than optimizing profit.[65,66] Otherwise, there is great risk of exacerbating rather than alleviating the already heavy burden facing Appalachian patients with cancer.

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