

Is there an increased incidence of retroperitoneal malignancies due to fracking?

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Abstract

Background: Retroperitoneal malignancies are a rare group of cancers with an annual incidence of 2.7 cases per 1 million. Due to their rare occurrence, the understanding of these malignancies is very poor. The prominent oil industry in West Texas is a potential source for both occupational and environmental exposures of chemical carcinogens. We suspect that chemical exposures in the local environment have led to an increased incidence of retroperitoneal neoplasms in the local population.

Method: We reviewed a retrospective departmental database to examine all retroperitoneal neoplasms diagnosed in long-term residents of the region over a 4 year period. Occupational and potential exposure histories were documented.

Results: There were nine cases of retroperitoneal neoplasms identified over 4 years. This represents a 278% increase over the expected incidence of 3.24 cases per 4 years. Six of the nine patients either worked in the oilfields themselves or had spouses that did so. The remaining three patients may have had passive chemical exposure due to close proximity to oil drilling and production.

Conclusion: Taking the two other regional hospitals that service the area and the multiple tertiary care centers outside of the region into account, the retroperitoneal malignancy incidence rate in West Texas is most likely even higher than reported in this study. We recommend a 20 year temporal correlation for retroperitoneal malignancies and oil manufacturing, as well as any other malignancies that might be associated.

Keywords: Retroperitoneal malignancies, Retroperitoneal neoplasms, Sarcomas, Permian basin, Oil and gas production, Oil drilling, Fracking.

Introduction

Primary retroperitoneal malignancies are a group of rare cancers that present with a stable annual incidence of 2.7 cases per 1 million [1], accounting for only 0.1-0.2% of all malignancies [2]. Categorized as either solid or cystic, the most common types of primary solid retroperitoneal neoplasms are soft tissue sarcomas, tumors of neurologic origin, and extra-germinal site germ-cell tumors. Often much more likely to be malignant than neoplasms found in other areas [3,4], retroperitoneal neoplasms are generally asymptomatic until they present as large tumors causing mass effect to surrounding structures. This presentation may also be due to symptoms resulting from metastasis [5]. The understanding of

retroperitoneal malignancies and their pathogenesis remains poor due to their heterogeneity and rare occurrence.

Treatment for retroperitoneal malignancies primarily involves surgical resection [6,7], but there is no consensus on the extent of this resection, nor on the efficacy of radiotherapy and the use of systemic chemotherapy [8]. In a multivariate analysis of patients with primary retroperitoneal sarcomas, Bonvalet et al. [9] demonstrated a decrease in 5 year overall survival rates with high grade, positive margins and tumor rupture. The authors recommended that treatment for these tumors occur in high-volume, tertiary referral centers with multidisciplinary teams [10].

The Permian Basin is a region of West Texas that includes the greater Midland/Odessa municipalities, as well as surrounding

rural counties. Covering over 30,000 square miles, much of the region includes rural, medically underserved areas that lack access to several surgical and medical sub-specialties. Historically, oil and gas production have dominated the economic landscape of the Permian Basin, an industry that has dramatically increased over the past decade due to hydraulic fracturing, a novel technique colloquially known as “fracking”. In 2012, the Permian Basin produced 430 million barrels of crude oil, an amount that made up 57% of the annual oil production in Texas and 14% of the annual oil production in the United States overall [11].

Environmental exposure to the chemicals used in the oil production process is linked to carcinogenesis. Common chemical carcinogens released in the oil drilling and production process include benzene [12], toluene [13], heavy metals (i.e., arsenic) [14], halides [13] and polyaromatic hydrocarbons (PAHs). Increased concentrations of these chemicals in both the air and water of nearby communities and environments is caused by fracking [13-19]. Yao et al. [20] demonstrated altered transcriptomes and unregulated growth in human bronchial epithelial cells grown in flow-back water from fracking sites of the Marcellus shale. McKenzie et al. [18] additionally reported that residents living less than half-a-mile away from oil wells have greater cancer risks than residents living farther away, with benzene being the greatest contributor to this risk. Using this data, Reap [21] projected 7.2 additional cases of cancer resulting from hydrocarbon exposure due to fracking in the United Kingdom. Living near an oil refinery leads to greater rates of DNA damage [22] and lymphohematopoietic malignancies [23] by several researchers, including Balisse et al. [24] who demonstrated an increased risk of prostate cancer for residents living near oil production.

Exposure to chemicals used in the extraction and production of oil is inevitable for workers in the industry and residents who live near oilfields [16], areas of land that predominate the landscape of the Permian Basin. Surface water contamination with carcinogens from oil production is unavoidable [25] and it is important to note that oil and gas companies are exempt from sections of federal environmental regulation laws such as the Safe Drinking Water Act, Clean Water Act and the Clean Air Act [26].

While these numerous studies have pointed to the link between oil production and carcinogenesis, there has been no specific evidence of a link between environmental exposure to chemicals and retroperitoneal malignancies. We theorized that an increased incidence of retroperitoneal malignancies exists in the local population of the Permian Basin region, likely stemming from increased carcinogenic chemical exposures in the local environment due to oil drilling (fracking) and production.

Materials and Methods

Our community hospital serves a population of approximately 300,000 and is one of three main healthcare providers for two of the most populous counties in the region (Table 1).

Table 1. Catchment area est 2015 [27].

Area Name	Total Population
Midland MSA	1,52,835
Odessa MSA	1,48,260
Total	3,01,095

We reviewed our hospital based surgical oncology database to examine all retroperitoneal neoplasms that identified and diagnosed with tissue pathology over the past 4 years. Patient histories for exposure to oil manufacturing were documented to establish a history of exposure to environmental and occupational hazards. Details about past work history, possible direct or indirect exposures to oilfields and oilfield related jobs were elicited.

Patients with retroperitoneal neoplasms who lived farther than 50 miles away from the hospital or did not live in the area for greater than 25 years were not included in this analysis.

Results

We identified nine cases of primary retroperitoneal malignancies confirmed by tissue diagnosis between 2011 and 2015. This equates to an incidence of nine cases for a population of approximately 300,000 people over 4 years or an annual incidence of 7.5 cases per 1 million. This is a 278% increase from the expected incidence of 3.24 cases for a population of approximately 300,000 people over 4 years, or an annual expected incidence of 2.7 cases per 1 million.

Six out of the nine patients with primary retroperitoneal malignancies had directly worked in the oilfields themselves, or had spouses who worked in the oilfields. A 67% positive occupational exposure history hints at a possible etiology to the elevated incidence encountered in this study.

Of the nine patients, eight underwent surgical resection and one patient refused resection resulting in death from the disease. Five of the patients had sarcomas, two had cystic neoplasms, one had a primary retroperitoneal neuroendocrine tumor and one had a lymphangioma.

Discussion

The results of this study represent the baseline incidence of primary retroperitoneal malignancies in the Permian Basin over the last 4 years. However, it is important to note that two additional, similarly sized community hospitals service the same catchment area, as well. Many patients were also likely referred to tertiary care centers in larger metropolitan areas because of the complexity of management and rarity of this group of diseases. Therefore, the true incidence of retroperitoneal malignancies in the study population over the 4 year study period is likely to be higher than what we found in this study.

Chemical exposures originating from the oil industry seem to be the likely sentinel carcinogenic event. Studies have shown

that oil production can lead to elevated malignancies in populations where the oil industry is prevalent. Direct occupational and spousal occupational exposure was positive in 2/3rd our patient population. In addition, evidence has shown that water or air pollution from fracking may be a conduit of environmental exposures causing carcinogenesis in susceptible individuals. Water and/or air sources of carcinogens may provide a passive exposure pathway to patients with negative occupational or spousal occupational history.

The observed increased incidence of retroperitoneal malignancies may represent a true process or may represent a statistical anomaly over time. In either case, it is necessary to perform a two-step study with the aims of both definitively establishing a true phenomenon of elevated retroperitoneal malignancy incidence over time, and identifying causal carcinogenic agent(s) responsible for this phenomenon. Therefore, we suggest that a surveillance program be established to identify all patients diagnosed with retroperitoneal malignancies from the Permian Basin area, to elucidate a temporal and casual relationship between a yet-to-be identified carcinogenic source and the elevated incidence of retroperitoneal malignancies in West Texas. Such a program will require coordination between all potential healthcare entry providers of the region and probable tertiary care centers outside of the region to document all cases of retroperitoneal malignancies diagnosed in patients from the Permian Basin, as well as all other malignancies. Collection of detailed occupational and environmental exposure history in all patients will also be vital in discovering a potential carcinogenic source.

Conclusion

It is likely that the elevated observed annual incidence of primary retroperitoneal malignancies in the Permian Basin is due to carcinogen exposure from the oil industry of the region. The elevated incidence may also represent a statistical anomaly with no causation from the oil industry of the region. We propose a long-term study be completed to survey retroperitoneal malignancies in the region to confirm this phenomenon. Ultimately, it is hoped that extended surveillance and intervention program will lead to a reduction in the incidence of retroperitoneal malignancies in West Texas and improve the health of the region's population.

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Disclosure

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Author Contributions

Saju Joseph, Allen Zhong were involved with the conception and development of the study; Saju Joseph, Allen Zhong, and Elesea Villegas were involved with data collection; Saju Joseph and Matthew Helm were involved with data analysis and interpretation; Saju Joseph and Matthew Helm were involved with writing the article; Saju Joseph was involved with the approval of the final version.

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