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Original Research Article

Epidemiology of lung cancer of central India population: a single tertiary cancer centre 5-year prospective study

Shyam Ji Rawat*, Ekta Kotwal, Lalit Mohan Patel, Garima Uikey, Sindhuja Ramachandran, Gaurav Hindoliya

Department of Radiation Oncology, State Cancer Institute, Netaji Subhash Chandra Bose Medical College, Jabalpur, Madhya Pradesh, India

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***Correspondence:**
Dr. Shyam Ji Rawat,
E-mail: drshyamjirawat@yahoo.co.in

ABSTRACT

Background: Globally, there have been varied changes in trends of lung cancer epidemiology depending on the geographic region, gender, histological subtype, and incidence. Also, there is a dearth in our current understanding of the changing epidemiological trends of lung cancer among Indian patients. Indian epidemiological data on lung cancer are limited, particularly in the central region.
Methods: We conducted a 5-year prospective study (January 2020-December 2024) at the Department of State Cancer Institute, Jabalpur (Madhya Pradesh), to evaluate the demographic and clinico-radiological profiles of primary lung cancer in Central India. Cases with confirmed histological or cytological diagnoses were reviewed, collecting data on demographics, risk factors, residence, histological subtype, and stage at presentation.
Results: A total of 546 patients (median age: 58.4 years; male-to-female ratio: 3.9:1) were included, with 60% smokers and 68.5% from rural areas. Most of the patients presented with non-small-cell carcinoma (NSCLC), with squamous cell carcinoma being the most common histological subtype (49.6%), followed by adenocarcinoma (34.6%), undifferentiated carcinoma (2.5%), and large-cell carcinoma (1.8%). Small-cell lung carcinoma accounted for 9.5% of cases. Over half of the patients (57.4%) presented with stage IV disease at diagnosis. Common metastatic sites included the pleura, liver, brain, bone, and adrenal glands, with bone metastases more commonly observed in smokers.
Conclusions: A significantly high proportion of lung cancer patients in Central India are smokers. Passive smoking is also a risk factor in our region. Squamous cell carcinoma remains the predominant subtype.

Keywords: Lung cancer, Cancer epidemiology, Histological subtypes, Smoking, Gender association, Metastasis, Central India

INTRODUCTION

Lung cancer is a major health problem in India and worldwide and is the most common cause of cancer-related morbidity and mortality. The GLOBOCAN 2022 database indicates that nearly 2.5 million new cases and over 1.8 million deaths occurred worldwide, accounting for close to one in eight (12.4%) cancers diagnosed globally and one in five (18.7%) cancer deaths. The disease ranks first among men and second among women for both incidence and mortality, with male-to-female lung cancer incidence and mortality ratios of approximately 2:1.[1] In India, lung cancer cases account for 5.8% of all cancer diagnoses in the country and represent 7.8% of all cancer-related fatalities. Moreover, two-thirds (76%) of lung cancer diagnoses in India are in men, suggesting a male preponderance.[2] In India, lung cancer typically manifests ten years earlier than in Western countries, with a mean age at diagnosis of 54-70 years.[3] Tobacco smoking is the leading cause of lung cancer, accounting for about

90% of cases.[4] The marked geographic and temporal patterns observed in lung cancer rates and trends across countries, or between males and females within each country, largely reflect stage at presentation and the degree of tobacco exposure.[5] Other risk factors include exposure to environmental tobacco smoke (ETS), indoor pollution, arsenic, radon, petroleum exposure, and alcohol consumption. Evidence also exists regarding the role of oncogenes and familial predisposition in lung cancer.[6] Given that Southeast Asia is a hotspot for both tuberculosis (TB) and lung cancer. Awareness of the coexistence of tuberculosis and lung cancer has increased in recent years. Lung cancer and tuberculosis can happen simultaneously or consecutively; that is, either lung cancer comes after tuberculosis or viceversa.[7] Pleuropulmonary TB was found in 0.9% of patients with lung cancer, according to data from the Postgraduate Institute of Medical Education and Research in Chandigarh, India.[8] Non-small cell lung cancer (NSCLC), which includes squamous cell carcinoma, adenocarcinoma, and large-cell lung cancer (LCLC), as well as other unspecified types (NOS), accounts for over 80% of all lung cancers. Less than 20% of all histological categories are small cell lung cancer (SCLC). Developed nations have observed a shift in histology, with adenocarcinoma surpassing squamous cell carcinoma as the most prevalent subtype.[9] Although lung cancer incidence in India is rising, the histological shift is not uniformly observed across the country.[10-15] Some studies report squamous cell carcinoma as the most common type, while others indicate equal prevalence between squamous and adenocarcinoma subtypes.[3]

Recent evidence from North India suggests a trend similar to the global pattern, with adenocarcinoma being the predominant histological type.[12] Indian epidemiological data on lung cancer are relatively limited, especially from the central part of the country and rural areas. The most recent data from the National Cancer Registry Program (NCRP, 2022), published in 2023 by the Indian Council of Medical Research-NCDIR, covers only a few urban regions with very few cases in this part of the country, providing partial insights into lung cancer trends.[2] To date, there are no comprehensive or specific studies focusing on the Central Indian population.

Therefore, we conducted this study to evaluate the clinical and epidemiological profile of lung cancer in the Central Indian population at our tertiary care center, the State Cancer Institute, Jabalpur, and to assess whether the current epidemiological trends apply to this population.

METHODS

This was a hospital-based prospective observational study conducted over a period of 5 years, extending from January 2020 to December 2024 in the Department of State Cancer Institute, Jabalpur, Madhya Pradesh, in Central India. The institute's ethics committee approved the study (IEC/2025/4585). Patients older than 18 years of age diagnosed with a confirmed pathological diagnosis of lung cancer were included in the study. Patients with secondary lung cancer, malignant pleural effusion of unknown primary, sarcomatoid tumors, and other rare varieties were excluded from this study. Histopathological confirmation was done by either transthoracic ultrasound or computed tomography (CT)-guided fine-needle aspiration or biopsy or bronchoscopic lavage, endobronchial ultrasound (EBUS)-guided fine-needle aspiration according to the site of the tumour, supplemented by pleural fluid cytology, peripheral lymph node biopsy, or biopsy from any other site for definitive diagnosis as appropriate.

A total of 546 patients were enrolled in the study after obtaining consent from the patients. A thorough history was taken, and data on demographics (age, sex, and residence), family history, etiological risk factors, clinical presentation, radiological findings, histological type, tumour location, metastatic site, and stage of cancer were collected prospectively. Tumour location was assessed radiologically using a 128-slice CT scan or HRCT thorax. Patients who had a clinico-radiological suspicion of lung cancer, but no histological or cytological evidence were not included. Staging was done as per the 8th edition of AJCC classification based on Tumour size and extension (T), lymph node involvement (N), and presence of distant metastasis (M). Lung cancer frequently manifests clinically. Symptoms like cough, dyspnea, hemoptysis, chest pain, hoarseness, fever, loss of appetite, and weight loss occur more commonly. In addition, paraneoplastic syndromes and metastatic symptoms can occur with lung cancer. Thus, the diagnostic evaluation not only involves the stage of the disease, histological grading, but also the presence of metastasis and associated paraneoplastic syndromes.

Statistical analysis

The data collected was entered into a Microsoft Excel spreadsheet. Categorical and continuous variables of the clinical characteristics of the study population were described as percentages and means±standard deviation (SD), respectively. Where appropriate, the Chi-square test, or Fisher's exact test, was used to compare the significance of differences in the distribution of discrete variables.

RESULTS

The study included 546 patients with lung cancer. Table 1 shows the main demographic and baseline characteristics of the study group. 434 (79.5%) were males and 112 (20.5%) were females, resulting in a male-to-female ratio of 3.9:1. The age of the study population ranged from 28 to 86 years. In this study, the median age of the lung cancer patients was 58.4 years, with a standard deviation of 10.87. Most of the patients were between the ages of 50-70 years. 68.5% (374) were from a rural background and 31.5% from an urban background.

Squamous carcinoma remained the most prevalent histopathological subtype, approximately 49.6% (279) of

all cases. Adenocarcinoma accounting for 36.4% (201), small cell carcinoma with 9.5% (52) and large cell carcinoma with 1.83% (10), and Undifferentiated lung cancer with 2.5% (14) of all cases. Six patients belonged to stage I (1.09%), 37 patients in stage II (6.77%) and 189 in stage III (34.6%), and 314 patients (57.5%) in Stage IV.

Most of the patients had the lesion on the right side, predominantly involving the upper lobes on both sides, followed by the lower lobes. 63% of tumors were found centrally, and 37% were located peripherally, as shown in Table 2. Table 3 shows a list of presenting symptoms of lung cancer, with cough 337 (61.72%), shortness of breath 280 (51.28%), and chest pain 280 (51.28%) being the predominant ones. Other noted symptoms include loss of weight and appetite 266 (48.7%), fever 102 (18.6%), hemoptysis 69 (12.6%) and SVC obstruction 69 (12.6%), and hoarseness of voice 48 (8.8%), respectively.

Metastasis to multiple sites was also studied. The American Joint Committee on Cancer (AJCC) categorized M1a as intrathoracic metastases, which included contralateral lung nodules, pleural metastases, and pericardial effusion, and M1b or M1c as single or multiple extrathoracic metastases, per the 8th AJCC staging. Within the lung, 174 (31.8%) patients had the same side and 146(26.73%) had opposite side metastasis. However, bilateral mets were seen in 113(20.69%) patients. Pleural-based metastasis was the most common site of intrathoracic metastasis, 33.15% (181). The most common extrathoracic metastases were to the liver 15.56% (85), brain 14.28% (78), and bone 12.7% (67); followed by the adrenal gland 10.25% (10) and distant nodal mets 8.24% (45). Other sites of metastasis include skin, renal, thyroid, pancreas, omentum, peritoneal, spleen, and muscular deposits, being rare ones, less than 2%. Multiple-site metastasis was more common compared to single-site metastasis [192 (35.16%) versus 106 (19.41%)] (Table 4).

Our analysis included a total of 60% (328) smokers and 40% (218) non-smokers. 49% (270) of patients were active smokers, and 11% (58) were passive smokers. A large proportion of men were active smokers, whereas most of the women were passive smokers.

There was a higher incidence of squamous carcinoma in smokers than in nonsmokers. Among the different histopathological types, squamous carcinoma was the most common among all smokers (active and passive), while adenocarcinoma was found more commonly in nonsmokers. Almost 90% (60/67) of bone metastases occurred in smokers. The most commonly affected sites in both groups were the liver (smokers: 49, non-smokers: 36), brain (31 verses 47), and adrenal (34 verses 22), suggesting that these sites are common destinations for metastatic spread regardless of smoking status.

These findings are consistent with previously published patterns of metastatic spread in lung and other solid organ cancers, where pleural involvement and brain metastases are frequent due to anatomical and vascular factors. Notably, several less common sites, such as the thyroid, pancreas, and muscular deposits, showed very low absolute frequencies (Table 5).

Table 1: Demographic and baseline characteristics of patients.

Parameters	No. of patients (n=546)	Percentage (%)
Sex		
Male	434	79.5
Female	112	20.5
Age groups (years)		
≤40	30	5.9
41-50	93	17
51-60	187	34.2
61-69	156	28.6
≥70	80	14.7
Background		
Rural	374	68.5
Urban	172	31.5
History of tuberculosis		
Yes	49	9
No	497	91
Smoking history		
Non-smokers	218	40
Smokers	328	60
Active smokers	270	49.45
Passive smokers	58	10.6

Table 2: Histological subtypes and radiological presentation.

Parameters	No of patients (n=546)	Percentage (%)
Histological type		
Squamous carcinoma	271	49.6
Adenocarcinoma	199	36.4
Small cell carcinoma	52	9.5
Large cell carcinoma	10	1.8
Undifferentiated carcinoma	14	2.5
Location of tumor		
Right lung	347	63.5
Upper lobe	206	37.7
Middle lobe	56	10.2
Lower lobe	85	15.5
Left lung	199	36.4
Upper lobe	135	24.7
Lower lobe	64	11.7
Eccentricity		
Peripheral	201	37
Central	345	63
Nodal stage		
N0	145	26.5
N1	52	9.5
N2	213	39.5
N3	136	24.5
T stage (cm)		
<3	36	36.59
3-5	101	8.5
5-7	140	25.64
>7	269	49.2
Stage		
1	06	1.1
2	37	6.8
3	189	34.6
4	314	57.5

Table 3: Clinico-radiological manifestation.

Symptoms	No. of patients N (%)
Cough	337 (61.7)
Chest pain	280 (51.3)
Loss of weight and appetite	266 (48.7)
Dyspnea	312 (57.1)
Fever	102 (18.6)
Hemoptysis	69 (12.6)
Hoarseness of voice	48 (8.8)
SVC obstruction	69 (12.6)

Table 4: Metastatic presentation.

Site of metastasis	Number	Percentage (%)
Lung		
Same side	174	31.8
Opposite side	46	26.73
Bilateral	113	20.19
Pleural effusion	181	33.15
Bone-axial	50	9.15

Continued.

Site of metastasis	Number	Percentage (%)
Bone-peripheral	17	3.11
Liver	85	15.56
Brain	78	14.28
Adrenal	56	10.25
Nodal	45	8.24
Skin	6	1.09
Renal	3	1.26
Thyroid	2	0.84
Pancreas	1	0.42
Omental/peritoneal	5	1.29
Muscular deposits	2	0.84
Spleen	3	1.26
Frequency of metastasis		
Solitary	106	19.41
Multiple	192	35.16

Table 5: Smokers versus non-smokers.

Parameters	Smokers		Non-smokers	P value
No. of patients	328		218	
Gender	**Active**	**Passive**		
Men	263	28	163	<0.0001
Women	07	30	55	
Age groups (years)				
≤40	09		21	<0.0001
41-50	48		47	
51-60	104		83	
61-69	87		69	
≥70	80		0	
Histology				
Squamous carcinoma	190		81	<0.0001
Adenocarcinoma	86		113	
Small cell carcinoma	34		18	
Large cell carcinoma	06		02	
Undifferentiated	12		04	
Stage				
I	03		03	0.0013
II	29		08	
III	128		61	
IV	168		146	
Metastasis				
Bone	60		07	<0.0001
Liver	49		36	
Brain	31		47	
Adrenal	34		22	
Skin	05		01	
Renal	03		02	
Thyroid	02		0	
Pancreas	01		0	
Omental and peritoneal spleen	05 03		02 0	
Muscular deposits	02		0	
Distant nodal	14		31	

DISCUSSION

Our analysis included 546 patients over a period of 5 years. The demographic analysis revealed a male predominance (79.5%), consistent with the recognized higher incidence of smoking and smoking-related cancers among men.[16] The median age of presentation was 58.4 years, aligning with global trends for lung and thoracic malignancies and previous Indian studies.[17]

For instance, Malik et al. reported a median age of 58 years and male preponderance (~80%) among lung cancer patients in North India.[18] Similarly, Noronha et al., in a large Indian cohort, found that the majority of lung cancer cases occurred in men, with smoking being the most significant risk factor.[3] Passive smoking, as in a non-smoker, has also been one of the etiological risk factors in our region. Over 38% of Indian adults are exposed to second-hand smoke at home.[19,20-23] Histologically, squamous cell carcinoma was the most common subtype, especially among smokers (57.9% of smokers verses 37.2% of non-smokers, p=0.001), whereas adenocarcinoma is twice as common in nonsmokers (51.8%) as it is in smokers (26.2%).

This correlates with established literature linking tobacco exposure predominantly to squamous histology. This pattern is also consistent with Indian registries, where squamous cell carcinoma continues to be the predominant histology, particularly among smokers, in contrast to Western populations, where adenocarcinoma has overtaken squamous carcinoma.[12,24]

A comparison of the distribution of histological subtypes and gender association with respect to other previous Indian studies is shown in Table 6.

Table 6: A comparison of Indian studies of lung cancer.

Author	Study location	Total patients	M: F ratio	Median age	Smoking history	SCC %	ADC %	Large cell %	Small cell %	Undifferen-tiated %
Rawat et al[25]	Uttarakhand (2009)	203	8.2:1	-	81.8	44.8	19.7	8.4	16.8	~3.2
Dey et al[15]	Kolkata (2012)	607	4.14:1	57.9	67.2	35.1	30.8	5.9	16.5	19.6 (NOS)
Noronha et al[3]	Mumbai (2012)	489	3.5:1	56	47.9	26.2	43.8	2.1	8	1.5
Malik et al[18]	Delhi (2013)	434	4.6:1	55	68	29.5	37.3		14.7	8.3
Mandal et al[14]	Manipur (2013)	466	1.09:1	-	78.8	49.1	30.8	3.7	14.8	7.7
Prasad et al[33]	Eastern UP (2014)	120	4.2:1	58.3±10.2	72.5	52.5	27.5	-	15.0	5.0
Baburao et al[26]	Bangalore (2015)	96	3:1	-	69.7	47.9	28.1	3.1	12.5	
Kumar et al[27]	Rajasthan (2015)	310	9:1	-	83.2	50.3	32.9		9.03	10.3
Panigrahi et al[28]	Puducherry (2018)	125	3.1:1	55±9.6	56.8	31.2	53.6	1.6	8	
Mohan et al[12]	North India (AIIMS, 2020)	1862	~4.85:1	59±11.1	76.2	28.6	34	-	16.1	21.4(NOS)
Banerjee et al[29]	West Bengal (2021)	248	4.2:1	62.4±10.5	86.3	42.3	35.1	—	14.5	8.1
Jose et al[30]	Kerala (2023)	761	4.28:1	65.1±10.2	55.3	25.6	56.4	1.3	7.3	11.7

We observed an increase in the cases of lung cancer incidence over the five years at our centre. Squamous Cell Carcinoma was the predominant histological subtype. However, a gradual increase in the incidence of adenocarcinoma cases was seen in the past 3 years at our institution. Adenocarcinoma was also more common among females and the younger population. This upward trend could be attributed to various factors, including improved detection methods, increased awareness, or changes in lifestyle and environmental exposures.[18,31] Staging analysis revealed a greater proportion of smokers and nonsmokers both presenting at advanced stages (Stage III and IV; p<0.001). This reflects the aggressive biological behaviour and possibly delayed healthcare-seeking behaviour among smokers, a trend also highlighted in Indian studies.[19]

We reported that about 49 (8.9%) had a history of tuberculosis. 17 patients (3.1%) of them, initially reported as TB, were subsequently diagnosed with LC. Importantly, TB and lung cancer can present with overlapping clinical and radiographic features, complicating accurate diagnosis. As such, post-tubercular status had not much significance on lung cancer, but misdiagnosis or delayed

diagnosis can adversely affect treatment outcomes. Misdiagnosing lung cancer as TB, especially in patients treated empirically for TB without microbiological confirmation, may lead to critical delays in initiating cancer treatment, resulting in progression to an advanced stage.[32-34] The COVID-19 pandemic has only made things worse by delaying the diagnosis and treatment.

Pleural effusion is the most common intrathoracic metastasis, and the brain, liver, and axial skeleton were the most frequent extrathoracic metastatic sites. These findings are in agreement with the data from Indian studies by Noronha et al and Ghosh et al where pleura and brain were among the leading metastatic sites irrespective of smoking history.[3,35] Notably, Ghosh et al also observed no significant difference in metastatic patterns based on smoking status, suggesting that smoking predominantly influences carcinogenesis and local tumour aggressiveness rather than metastatic organotropism. This again echoes findings from Indian series, such as the study by Prasad et al which demonstrated that liver metastasis was common but not significantly associated with smoking status.[36] Rare metastasis sites (thyroid, pancreas, muscle deposits) were infrequent in both groups, consistent with global and Indian data indicating their rare occurrence.[37]

Limitations

The actual number of patients diagnosed with primary lung cancer in this part of the country is much higher than reported in this study. The limitation of our study was that a control group was not included. As this is a prospective single-centre, short-period observational study with a small number of patients. We should conduct long-term, multicentric, prospective, randomised controlled studies to understand the cause-and-effect relationship in patients with the changing epidemiological trends of cancer in India and worldwide.

CONCLUSION

In this tertiary care hospital-based study from the central region, we studied the epidemiology, demographics, clinical, and histological profile of primary lung cancer in 546 consecutive lung cancer patients. Compared with our study and the studies conducted in various Indian regions, there are changes concerning risk factors and the incidence of histopathological types of lung cancer. In our study, the most common histopathological type is still squamous cell carcinoma, in contrast to adenocarcinoma, which is now prevalent worldwide and in some parts of India. Lung cancer is still more common among males, and the majority of the population is from rural areas, which is similar to that of various studies. The common age group of incidences of lung cancer has shifted from the 6th and 7th decades. Tobacco smoking is the strongest risk factor, but passive smoking in the non-smoking population is increasing, which is relevant in the increasing incidence of lung carcinoma among non-smokers.

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