A Mathematical Model for Control of Abnormal Cells in Oral Cancer Patients in India

Rajan K Sharma[1], D.Kandu[2], Pradeep Kumar Singh[3]

1&3 (Department of Mathematics, PSIT -Kanpur, U.P-India.)

2 (Department of Mathematics, MMMUT, Gorakhpur, U.P-India.)

Abstract

Cancer is a very fatal disease. In present scenario the growth rate of cancer patients increases with high rate which is highest in India compare to the others in the world. Due to oral cancer the mortality rate is very high. Cancer can occur in any part of the body who spreads by web form by hurting to normal tissues of organ in human body. In India the people belonging to low income family are suffering by oral cancer by drinking wine and using tobacco regularly in habits whereas the Indian women suffering from cervical cancer at large scale and breast cancer in common. Due to oral cavity cancer and lungs the mortality rate is very high which have been found 25% deaths in males and in female the mortality is also 25% by breast, cervical and oral cavity. In light of above references this is an attempt to translate real world problem in to a mathematical problem for oral cancer patients in India in which, how we can find the control of abnormal cells is discussed assuming that the mortality which depends upon the growth rate of abnormal cells density in cavity of oral cancer patients .

Keywords: Population, cancer cell growth, mortality, density of cancer cells area, life condition, organ system.

Introduction:

It has been observed that the disease Cancer play a very dangerous role for human being and mortality rate is high after cardic patients in India.[1] and 4 to 5 million patients died due to cancer and 8.5 to 9 million patients are diagnosed due to cancer diseases like liver, lungs, breast, rectus, stomach, cervix, protest, skins, blood and mouth oral etc. In all of them one is oral cancer is very fatal in middle class low income family in which mostly oral cancer in young till age 35 years is 2.8% of all cases [2] and mortality rate due to oral cancer is very high. The cancer (malignant neoplasm) cells damaged the DNA in human organs tissues that is cancer cells grow fast and normal cells harmed, DNA is not constructed it harmed and Cancer cells generally spreads their web into a new density area in the form of abnormal cells and form tumors which being very fetal. The abnormal cells which hurting to DNA and form some more new tumors. Their treatments is not easy whenever tumor is generated. There are different tests for its recognization MRI, CT Scan , CBC test, Biopsy. In India and its neighboring countries approx 43000 newly cancer patients come for diagnosis. Nearly 65% patients obtain primary treatment. In oral cancer patients mortality factors depends on smoking, using alcohol which depends also their educational levels.[3] .There are various methods for treatment of cancer by surgery ,by chemo-therapy, by radio-therapy, ect. The main objective is to destroy the infected density web by abnormal cells s before growing big size tumor .During these therapy there are many side effects like tiredness, reaction in skin such as rash or redness and loss of appetite, lowering of the WBC count loss of normal growth control. According to Current feature of Cancer burden in India as well as other part of Global sequences. [4]. Cancer can occur in any part of the body which injured tissue by abnormal cells in organs. In many developing countries cancer is a global problems [5]. In India the people belongs low-income family are suffering by oral cancer, by

drinking wine, using tobacco and smoking. [**6**] as which the mortality rate is very high whereas for Indian women, cervical and breast cancer [**7**], (122,844 diagnosed and 67,477 death which is In Globacon 2018 the data from cancer statistic in India Total deaths due to cancer is 7,84,821 in which men were 4,13,519 and women are 3,71,302. In a report towards ICMR 2016 the disease cancer by use of tobacco is 69.5% and 45% in male and female respectively have been found in district Khasi hills in Meghalaya was very high [**8**].

Cancer Incidence cases in metropolitan cities of India:

Table(1):

City	Total patier	Male	Female
Bangalore	5250	2261	22698
Delhi	13920	6815	7105
Mumbai	8505	4170	5335
Chennai	4824	2296	2825
Bhopal	12155	701	554

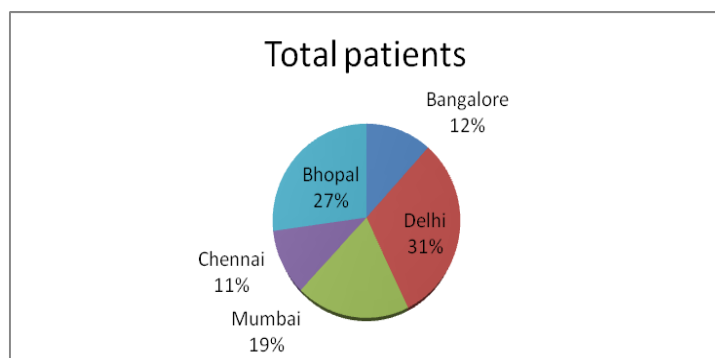Fig 1: Percentage of cancer incidenc metropolitan cities of India.

The one fetal type of cancer is oral cancer in India amongst not only old persons but young also who are using tobacco which involved very harmful chemicals of different brand tobacco products which contains carcinogens (cancer disease produced). Nicotine is one of them is very harmful chemical in tobacco and with their continuously they being mentally and physically not fitted [**9,10**].

In South Asia people are suffering with oral cancer are using tobacco and alcohol. Who do not aware of initial stage and when patients crossed its initial stage before tumor so cancer cells covers strongly to cavity and in absence proper medicinal treatment patients dead died with the use of tobacco and alcohol and chewing tobacco cancer cells comes towards that part of cavity where it is placed or usages a lot. To prevent it before tumor surgery is the well define mode in oral cancer patients [**11**]. According to Globocan 2018 data [**12**], 80% to 90% by oral cancer have been directed affected by using tobacco. Generally the average age of men by oral cancer patients is 50 years[**13,14**] . There are many types of cancers which can generates in any organs and tissue, in the form of breast, bones, skin, nerve tissue etc., it's reason is that increment of uncontrolled abnormal cells in the bodyare not stopping. The main five types of cancer in man and women for 47.2% of all cancer prevented at early stage before fatal that banning e-cigarettes would not be effective alone. Government has ceased all the produced which related to tobacco which is very unfavorable for our society with e-cigarettes which is not good for health. On demand of this many state level government has ceased the tobacco product in India. In a report towards ICMR, it has been found that by use of e-cigarettes it directly affect to DNA as the result our immune system, respiratory system and cardiovascular system not working properly and gradually the working function of organs in our body has stopped and it drop opposite reaction in pregnancy.
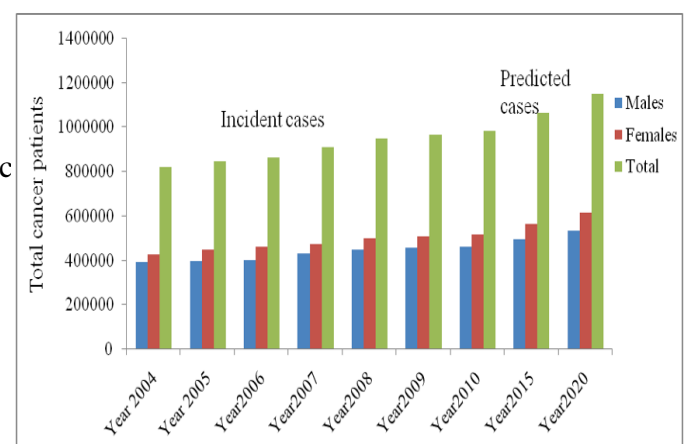

Fig2: Cancer trend year wise in India by – ICMR(2009) .

In a report towards ICMR data about cancer trend was describing in which for year 2004 the number of cancer [patients in male were 390809 and female were 428545,their numbers continuously raised and till 2009 male were 454842 and female were 507990 and on this basis it predicted that it will be raise continuously till 2020 also..

India is the third position in oral cancer cases in the world has been found around 30% of all cancers diseases. In Globocan, 2018 [15] the male cases was 246420 as world 5.8 and female cases was 108444 as world 2.3 whenever mortality cases in male was 119693 as world 2.8 and female cases was 57691 as world 1.2 due to oral cavity oral cancer in tissues of oral cavity (lips till tonsils) or oropharynx which is main part of throat , tongue, salivary glands ect. Oral cancer abnormal cells present in one lymph node and gradually spread in head and neck at same direction as form of initially tumor till 3 to 6 cm, across and opposite side.[16]
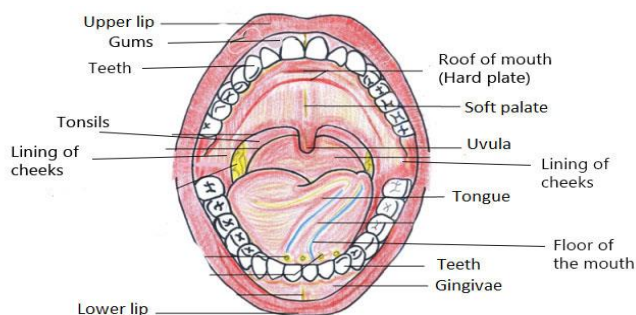

Fig3: Different parts in oral cavity are:
[17]

Patients Growth Model By Oral Cancer :

The study of oral cancer in tissues of mouth is a subject great interest in oral cancer patients. With the advancement of medicinal era the life style of people is very zig-zag their nutrients which is a great challenge in our society There are some report in which incidence of oral cancer from cancer registries in India.[18]

The simple exponential growth model [19] in human as well as for cancer cells is

$$\frac{dp}{dt} = ap \,, t > 0$$

Where $p(t)$ is the number of abnormal cells in oral cancer patients in oral cavity, at time $t > 0$ and $a > 0$ is specific growth rate of the abnormal cells. Assuming this changed as above growth model [20] is

$$\frac{dp}{dt} = ap - bp^2, t > 0 \,,$$

where $b > 0$ being the degree to which density decreases the rate of increase of abnormal cells in mouth cavity of patients.

In oral cancer patients normal cells injected by abnormal cells and tissues of cavity till rapidly damaged with multiple rates so due to uncontrolled of normal cells so mortality rate being high. When normal cells damaged, cancer cells produce new abnormal cells and again DNA cells damaged.

In reference of above model, let $p(t)$ being the abnormal cells at time t in a oral cancer patient .when abnormal cells damaged to DNA cells suppose the mortality rate is affect by two things

(i) increase density of abnormal cells (ii) increasing concentration of new abnormal cells who damaged to normal cells in cancer patients by

$$\frac{dp}{dt} = ap - kcp,$$

where c is concentration of new out of control cells with constant rate $k,$ a positive constant.

Or

$$\frac{dp}{dt} = ap - kc \left(\int_0^t p(s)ds + \int_0^t 2p(s)\,ds + \int_0^t 3p(s)ds + \ldots + \int_0^t mp(t)\,dt \right)$$

Then

$$\frac{dc}{dt} = rp$$

Or

$$\frac{dp}{dt} = ap - kpr\left\{ (1 + 2 + 3 + \cdots + m) \int_0^t p(s)ds \right\}$$

Or

$$\frac{dp}{dt} = ap - kpr\left\{\left(\frac{m(m+1)}{2}\right)\int_0^t p(s)ds\right\} \qquad \ldots(1)$$

Where m is a positive constant.

This is an integro-differential equation which can be solved by assuming $P(t) = \int_0^t p(s)ds$

Equation (1) reduces as

$$P''(t) = aP'(t) - kr\frac{m(m+1)}{2}P(t)P'(t)$$

Multiplying by $e^{P(t)}$ both side we get

$$\frac{d}{dt}\left(e^{P(t)}P''(t)\right) = \frac{d}{dt}\left\{\left(aP'(t) - kr\frac{m(m+1)}{2}P(t)P'(t)\right)e^{P(t)}\right\}$$

Integrate it between 0 and t, we get

$$e^{P(t)}P''(t) - p(0) = e^{P(t)}\left\{\left(a - kr\frac{m(m+1)}{2}\right)P(t) - a\right\}$$

Since $P_0(t) = 0$ and $P'(0) = p(0)$

That is

$$e^{P(t)}P''(t) = p(0)e^{-P(t)} + \left(a - kr\frac{m(m+1)}{2}P(t)\right) - ae^{-P(t)}$$

$$p(t) = \left(a - kr\frac{m(m+1)}{2}P(t)\right) - (a - p(0))e^{-p(t)}$$
$$\ldots(2)$$

$$= f(P)$$

Or $\qquad \frac{dP}{dt} = f(P)$

Therefore $\qquad t = \int_0^{P(t)} \frac{dP}{f(P)}$

eq (2) represent the abnormal cells in oral cavity at time t

Result and Discussion :

Now $\qquad \frac{dp}{dt} = f'(P)\frac{dP}{dt} = f'(P).p(t)$

$$= \left\{(p(0) - a)(-e^{-P(t)}) - kr\frac{m(m+1)}{2}(1 - e^{-P(t)})\right\}$$

It follows that

(a) If $p(0) \geq a$ then $\frac{dp}{dt}$ is always gives negative and abnormal cells steadly decreases zero.

(b) If $p(0) < a$ then value of $\left(\frac{dp}{dt}\right)_{t=0} = -(p(0) - a) > 0$, so that the abnormal cells initially increases and reaches a maximum when $\frac{dp}{dt} = 0$ which gives

$$p(t) = log\left(\frac{k - \frac{2p(0)}{rm(m+1)} + \frac{2a}{rm(m+1)}}{k}\right)$$

This implies

$$P_{max} = \left\{a - kr\frac{m(m+1)}{2}log\left(\frac{k - \frac{2p(0)}{rm(m+1)} + \frac{2a}{rm(m+1)}}{k}\right) - (a - p(0)(-p(t))\right\} < a$$

So here abnormal cells decreases and tends to zero. Thus we conclude that by proper reorganization of cancer stages and by use of proper medicine before radio and chemo therapy in earlier stage no of abnormal cells decreases that is $p(0) \geq a$ or $p(0) < a$ the abnormal cells tends to extinction,

Conclusion: From above analysis we have been observed that the cancer cells in oral cancer patients fluctuate periodically between two values that is first increases with time then decreases and how In oral cancer patients normal cells injured by abnormal cells and tissues of cavity till rapidly damaged with multiple rates so due to uncontrolled

of normal cells mortality rate being high and DNA cells damaged So the above study can be useful to prevent this diseases by making a plan to aware about it to educate the people not for young age but in every group in people. Now before generating tumor if people aware and identify its symptoms and avoiding drugs then mortality rate will be decrease in oral cancer patients. In low income family and young people who are not responsible, who are using drinking wine, using tobacco, smoking ect. without any limitation they damaged their health in absence of nutritious food. To improve such people it's a great responsibility for educated people, social workers, NGO's, it is advice to them that by many government schemes, educational programms to trained them as such type of people that they can isolate themselves for using drugs and adopt good nutrition and good conduct to change his life style for mankind.

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