Sudan University of Sciences and Technology

College of Graduate Studies

Estimation of 5-years Survival Rate of Cancer Patients in Radiotherapy and Isotopes Center of Khartoum

تقدير معدل البقاء لخمس سنوات لمرضى السرطان في مركز الخرطوم القومي للعلاج بالأشعة والطب النووي

A thesis Submitted for Partial Fulfillment of the Requirement of Msc Degree in Nuclear Medicine Technology

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صدق الله العظيم

سورة البقرة – الآية(260)

Dedication

To my parents, brothers and sisters

To the soul of my brother Ashraf.

To my wife, son and daughter.

To my friends.

Acknowledgment

This study would not have been possible without the cooperation of my keen and competent supervisor; Dr. Yousif Mohammed Yousif

I am very grateful to his magnificent guidance.

My thanks extend to the members of the statistical department in Radiotherapy and Isotopes Center of Khartoum (RICK), the members of radiotherapy department in the college of medical radiological sciences and to my friends in the college of medical radiological sciences for their supports.

Abstract

This statistical study conducted to calculate the overall 5-years survival rate of cancer in Sudan and to represent the factors which may affect this rate. The study based on data of 160 adult cancer patients treated in the Radiation and Isotopes Center of Khartoum (RICK) in the period of 2005 -2008 and followed by their treatment sheets and death certificates until 2013. The study found that the overall 5-years survival rate of cancer in Sudan is 33.75% and there is many factors affect this rate, these factors include the patient sex, diagnoses to treatment time, treatment type, cancer site and grade of the disease.

ملخص

هـدفت هـذه الدراسـة الإحصـائية فـي الأسـاس الـى حسـاب معـدل مرضـي السـرطان فـي المركـز القـومي للعـلاج بالأشـعة والطـب النـووي الـذين بقـوا علـي قيـد الحيـاة لمـدة خمـس سـنوات بعـد تشخيص حالاتهم , كما هدفت الى معرفة العوامل التي تؤثر علي هذا المعدل.

اعتمـدت الدراسـة علـى بيانـات ل160 مـن المرضـي البـالغين الـذين تـم تشـخيص إصـابتهم بالسـرطان وتمـت معـالجتهم بمركزالخرطـوم القـومي للعـلاج بالأشـعة والطـب النـووي فـي الفتـرة مـن 2005 الـي 2008 والـذين تمـت متابعـة حـالاتهم عبـر ملفـات العـلاج الخاصـة بهـم وعبـر معلومـات شهادات الوفاة حتي عام 2013.

وجـدت الدراسـة أن معـدل مرضـي السـرطان الـذين بقـوا علـي قيـد الحيـاة لمـدة خمـس سـنوات هـو 33.75% . وأن هنـاك عوامـل عـدة تـؤثر علـي هـذا المعـدل منهـا النـوع الجنسـي للمـريض, المـدة بـين تشـخيص المـرض وأخـذ العـلاج, نـوع العـلاج , العضـو المصـاب بالسـرطان ودرجة (مرحلة) الإصابة بالمرض.

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List of Abbreviations

C : Chemotherapy.

Fig : Figure.

R : Radiotherapy.

RICK : Radiotherapy and Isotopes Center of Khartoum.

S : Surgery.

TNM : Tumor, Node and Metastases. Cancer staging.

T0 : Tumor in situ.

USA : United State of America.

Chapter One

1-1 Introduction

Cancer has been a focus of scientific attention for decades. As the knowledge about the disease increase, the detection, diagnosis and treatment will improve and the survival rates of the patient increase against the mortality rates.

Much of the progress made in the management of cancer is the result of carefully planned clinical trials, these trials can be performed as **retrospective studies** (i.e.: review information from patients treated in the past, collect the data and analysis). **Prospective studies** (i.e.: trials planned before treatment with eligibility of the patient selection and **randomized studies.**

In the clinical stages of any clinical trial an end point must be established, otherwise the study can continues indefinitely with no data analysis.

Rates of survival used as a set end point to determine the benefit of one treatment over another. Cancer survival rates are some of many types of cancer statistics represents the percentage of people who survive a certain type of cancer for specific amount of time.

In addition, rates of survival also used to reflect the prognosis of cancers, the prognosis of cancer depend on the site of the tumor, behavioral characteristics and patient related factors (i.e.: age , gender, trace …. Etc), these factors and other technical factors during the diagnosis, planning and treatment play the main role in the determination (calculation) of survival rates.

Cancer statistics commonly use the 5-years survival rate, but that does not mean that cancer cannot be recurred beyond 5 years. Cancer can be recurred many years after successful treatment.

There are three types of 5-years survival rate:

- Overall: this is not take in account the other suspected causes of death which can affect the people of the data of the study.

- Relative : this describe the percentage of patients that are alive 5years after diagnosis divided by the percentage of the general population of corresponding sex and age that are alive for 5 years.

- Net: which represent the percentage of patients who were alive 5 years with filtering–out the other causes of death than the cancer.

1-2 Problem of the study:

There is no recorded determination of 5 years survival rate of cancer in RICK.

1-3 Significance of the study:

5- years survival rate nowadays is an important criteria which help to take an image about the prognosis of the cancer and help also in developing treatment plans.

1-4 Objectives of the study :-

The ***general purpose*** of this study is to calculate the overall 5-years survival rate of cancer in RICK.

The ***specific objectives***:-

-To put a record value of the 5 years survival rate of cancer in RICK.

-To determine the factors that may affect the 5 years survival rate.

-To compare the calculated 5 years survival rate in RICK with some other universal rates.

-To reflect the importance of calculation of 5 years survival rate.

1-5 Overview:

The study consist of 5 chapters , chapter one is an introduction , chapter two (literature review) include general information about cancer statistics and cancer survival rates and some previous studies which touch the aim of the study, chapter three describe the material and methods which used to conduct the study, chapter four represent the results of the study in bars and graphs with written explain under each bar or graph, in addition to discussion for the results, chapter five include conclusion of the results , some recommendations and some suggestions for the other researchers . in the end there is a list of references.

Chapter Two

2-1 Literature review:

2-1-1 Cancer:

2-1-1-1 Mechanism of cancer:

Cancer is a class of diseases characterized by out-of-control cell growth. There are over 100 different types of cancer, and each is classified by the type of cell that is initially affected.

Cancer harms the body when damaged cells divide uncontrollably to form lumps or masses of tissue called tumors (except in the case of leukemia where cancer prohibits normal blood function by abnormal cell division in the blood stream). Tumors can grow and interfere with the digestive, nervous, and circulatory systems, and they can release hormones that alter body function. Tumors that stay in one spot and demonstrate limited growth are generally considered to be benign.

More dangerous, or malignant, tumors form when two things occur:
- a cancerous cell manages to move throughout the body organ using the blood or lymph systems, destroying healthy tissue in a process called invasion

- That cell manages to divide and grow, making new blood vessels to feed itself in a process called angiogenesis.

When a tumor successfully spreads to other parts of the body and grows, invading and destroying other healthy tissues, it is said to have metastasized. This process itself is called metastasis, and the result is a serious condition that is very difficult to treat.

Cancer is ultimately the result of cells that uncontrollably grow and do not die. Normal cells in the body follow an orderly path of growth,

division, and death. Programmed cell death is called apoptosis, and when this process breaks down, cancer begins to form. Unlike regular cells, cancer cells do not experience programmatic death and instead continue to grow and divide. This leads to a mass of abnormal cells that grows out of control.

2-1-1-2 Cancer symptoms:

Cancer symptoms are quite varied and depend on where the cancer is located, where it has spread, and how big the tumor is. Some cancers can be felt or seen through the skin - a lump on the breast or testicle can be an indicator of cancer in those locations. Skin cancer (melanoma) is often noted by a change in a wart or mole on the skin. Some oral cancers present white patches inside the mouth or white spots on the tongue.

Other cancers have symptoms that are less physically apparent. Some brain tumors tend to present symptoms early in the disease as they affect important cognitive functions. Pancreas cancers are usually too small to cause symptoms until they cause pain by pushing against nearby nerves or interfere with liver function to cause a yellowing of the skin and eyes called jaundice. Symptoms also can be created as a tumor grows and pushes against organs and blood vessels. For example, colon cancers lead to symptoms such as constipation, diarrhea, and changes in stool size. Bladder or prostate cancers cause changes in bladder function such as more frequent or infrequent urination.

As cancer cells use the body's energy and interfere with normal hormone function, it is possible to present symptoms such as fever, fatigue, excessive sweating, anemia, and unexplained weight loss.

However, these symptoms are common in several other maladies as well. For example, coughing and hoarseness can point to lung or throat cancer as well as several other conditions.

When cancer spreads, or metastasizes, additional symptoms can present themselves in the newly affected area. Swollen or enlarged lymph nodes are common and likely to be present early. If cancer spreads to the brain, patients may experience vertigo, headaches, or seizures. Spreading to the lungs may cause coughing and shortness of breath. In addition, the liver may become enlarged and cause jaundice and bones can become painful, brittle, and break easily. Symptoms of metastasis ultimately depend on the location to which the cancer has spread.
There are five broad groups that are used to classify cancer.

2-1-1-3 Classification:

1. Carcinomas are characterized by cells that cover internal and external parts of the body such as lung, breast, and colon cancer.
2. Sarcomas are characterized by cells that are located in bone, cartilage, fat, connective tissue, muscle, and other supportive tissues.
3. Lymphomas are cancers that begin in the lymph nodes and immune system tissues.
4. Leukemias are cancers that begin in the bone marrow and often accumulate in the bloodstream.
5. Adenomas are cancers that arise in the thyroid, the pituitary gland, the adrenal gland, and other glandular tissues.

2-1-1-4 Diagnoses and staging:

Early detection of cancer can greatly improve the odds of successful treatment and survival. Physicians use information from symptoms and several other procedures to diagnose cancer. Imaging techniques such as X-rays, CT scans, MRI scans, PET scans, and ultrasound scans are used regularly in order to detect where a tumor is located and what organs may be affected by it. Doctors may also conduct an endoscopy, which is a procedure that uses a thin tube with a camera and light at one end, to look for abnormalities inside the body.

Extracting cancer cells and looking at them under a microscope is the only absolute way to diagnose cancer. This procedure is called a biopsy. Other types of molecular diagnostic tests are frequently employed as well. Physicians will analyze your body's sugars, fats, proteins, and DNA at the molecular level. For example, cancerous prostate cells release a higher level of a chemical called PSA (prostate-specific antigen) into the bloodstream that can be detected by a blood test. Molecular diagnostics, biopsies, and imaging techniques are all used together to diagnose cancer.

After the diagnosis is made, doctor find out how far the cancer has spread and determined the stage of the cancer. The stage determines which choices will be available for treatment and informs prognoses. The most common cancer staging method is called the TNM system. T (1-4) indicates the size and direct extent of the primary tumor, N (0-3) indicates the degree to which the cancer has spread to nearby lymph nodes, and M (0-1) indicates whether the cancer has metastasized to other organs in the body. A small tumor that has not spread to lymph nodes or distant organs may be staged as (T1, N0, M0), for example.

TNM descriptions then lead to a simpler categorization of stages, from 0 to 4, where lower numbers indicate that the cancer has spread less. While most Stage 1 tumors are curable, most Stage 4 tumors are inoperable or untreatable.

2-1-1-5 Treatment:

Surgery is the oldest known treatment for cancer. If a cancer has not metastasized, it is possible to completely cure a patient by surgically removing the cancer from the body. This is often seen in the removal of the prostate or a breast or testicle. After the disease has spread, however, it is nearly impossible to remove all of the cancer cells. Surgery may also be instrumental in helping to control symptoms such as bowel obstruction or spinal cord compression.

Innovations continue to be developed to aid the surgical process, currently, when a tumor is removed ,surgeons also take out a “margin” of healthy tissue to make sure no malignant cells are left behind. This usually means keeping the patients under general anesthetic for an extra 30 minutes while tissue samples are tested in the lab for “clear margins”. If there are no clear margins, the surgeon has to go back in and remove more tissue (if possible).

2-1-1-5-1 Radiation:

Radiation treatment, also known as radiotherapy, destroys cancer by focusing high-energy rays on the cancer cells. This causes damage to the molecules that make up the cancer cells and leads them to commit suicide. Radiotherapy utilizes high-energy gamma-rays that are emitted from metals such as radium or high-energy x-rays that are created in a

special machine. Early radiation treatments caused severe side-effects because the energy beams would damage normal, healthy tissue, but technologies have improved so that beams can be more accurately targeted. Radiotherapy is used as a standalone treatment to shrink a tumor or destroy cancer cells (including those associated with leukemia and lymphoma), and it is also used in combination with other cancer treatments.

1- 2-1-1-5-2 Chemotherapy*:*

Chemotherapy utilizes chemicals that interfere with the cell division process - damaging proteins or DNA - so that cancer cells will commit suicide. These treatments target any rapidly dividing cells (not necessarily just cancer cells), but normal cells usually can recover from any chemical-induced damage while cancer cells cannot. Chemotherapy is generally used to treat cancer that has spread or metastasized because the medicines travel throughout the entire body. It is a necessary treatment for some forms of leukemia and lymphoma. Chemotherapy treatment occurs in cycles so the body has time to heal between doses. However, there are still common side effects such as hair loss, nausea, fatigue, and vomiting. Combination therapies often include multiple types of chemotherapy or chemotherapy combined with other treatment options.

2- 2-1-1-5-3 Immunotherapy*:*

Immunotherapy aims to get the body's immune system to fight the tumor. Local immunotherapy injects a treatment into an affected area, for example, to cause inflammation that causes a tumor to shrink. Systemic immunotherapy treats the whole body by administering an agent such as the protein interferon alpha that can shrink tumors. Immunotherapy can

also be considered non-specific if it improves cancer-fighting abilities by stimulating the entire immune system, and it can be considered targeted if the treatment specifically tells the immune system to destroy cancer cells. These therapies are relatively young, but researchers have had success with treatments that introduce antibodies to the body that inhibit the growth of breast cancer cells. Bone marrow transplantation (hematopoetic stem cell transplantation) can also be considered immunotherapy because the donor's immune cells will often attack the tumor or cancer cells that are present in the host.

3- 2-1-1-5-4 Hormone therapy:

Several cancers have been linked to some types of hormones, most notably breast and prostate cancer. Hormone therapy is designed to alter hormone production in the body so that cancer cells stop growing or are killed completely. Breast cancer hormone therapies often focus on reducing estrogen levels (a common drug for this is tamoxifen) and prostate cancer hormone therapies often focus on reducing testosterone levels. In addition, some leukemia and lymphoma cases can be treated with the hormone cortisone.

4- 2-1-1-5-5 Gene therapy:

The goal of gene therapy is to replace damaged genes with ones that work to address a root cause of cancer: damage to DNA. For example, researchers are trying to replace the damaged gene that signals cells to stop dividing (the p53 gene) with a copy of a working gene. Other gene-based therapies focus on further damaging cancer cell DNA to the point where the cell commits suicide. Gene therapy is a very young field and has not yet resulted in any successful treatments.

2-1-1-6 Cancer statistics:

Cancer statistics include many criterions, most of these criterions turn around the 5 key statistical measures of cancer, and these keys are:

2-1-1-6-1 The incidence:

A **cancer incidence rate** is the number of new cancers of a specific site/type occurring in a specified population during a year, usually expressed as the number of cancers per 100,000 populations at risk. That is,

Incidence rate = (New cancers / Population) × 100,000

The numerator of the incidence rate is the number of new cancers; the denominator is the size of the population. The number of new cancers may include multiple primary cancers occurring in one patient. The primary site reported is the site of origin and not the metastatic site. In general, the incidence rate would not include recurrences. The population used depends on the rate to be calculated. For cancer sites that occur in only one sex, the sex-specific population (e.g., females for cervical cancer) is used.

An age-adjusted rate is a weighted average of the age-specific rates, where the weights are the proportions of persons in the corresponding age groups of a standard population. The potential confounding effect of age is reduced when comparing age-adjusted rates computed using the same standard population

2-1-1-6-2 The mortality:

cancer mortality rate is the number of deaths, with cancer as the underlying cause of death, occurring in a specified population during a year. Cancer mortality is usually expressed as the number of deaths due to cancer per 100,000 population. That is,

Mortality Rate = (Cancer Deaths / Population) × 100,000

The numerator of the mortality rate is the number of deaths; the denominator is the size of the population. The population used depends on the rate to be calculated. For cancer sites that occur in only one sex, the sex-specific population (e.g., females for cervical cancer) is used. The mortality rate can be computed for a given cancer site or for all cancers combined.

2-1-1-6-3 Cancer prevalence :

Prevalence is defined as the number or percent of people alive on a certain date in a population who previously had a diagnosis of the disease. It includes new (incidence) and pre-existing cases and is a function of both past incidence and survival. Information on prevalence can be used for health planning, resource allocation, and an estimate of cancer survivorship.

5- **2-1-1-6-4 Lifetime Risk of Developing or Dying of Cancer:**

Lifetime risk is the **probability of developing or dying from cancer** in the course of one's lifespan. Statistical models are used to compute the probability of developing or dying of cancer from birth or conditional on a certain age.

2-1-1-6-5 survival rates:

Cancer survival is the proportion of patients alive at some point subsequent to the diagnosis of their cancer, or from some point post-diagnosis (conditional survival). It is represented as the probability of a group of patients "surviving" a specified amount of time (e.g. 3 years, 5 years, 20 years).

There are several Measures of Cancer Survival using different end points for survival depending on the question of interest. For example:

- Some may be interested in death from any cause (overall survival), while others may be interested in just death from cancer (net survival).
- Policy makers and others may be interested in death from cancer where the confounding effects of death from other causes are removed (e.g. when comparing survival from cancer for different racial/ethnic groups with very different other cause mortality).
- Individuals may be interested in the both the probability of death from cancer and the probability of death from other causes each estimated in the presence of the other.

Important Facts about Survival:

- Unlike incidence or mortality statistics where the total population is included in the denominator, only diagnosed patients are included in the survival calculations. In the past there has been some confusion when people use the term mortality to mean (1-survival). This is misleading, since mortality statistics include the entire population at risk, where survival (and 1-survival) only

includes diagnosed patients at risk. We use the term Cumulative Probability of Death for (1-survival).

- One problem inherent in estimating long- term survival is that only cohorts diagnosed a long time ago have enough follow-up to directly estimate these quantities. Thus direct estimates of long term survival may not be very relevant for newly diagnosed patients, especially in cancer sites where there have been dramatic improvements in survival.

  Population-based survival derived from cancer registries differs in several important ways from survival derived in clinical trial settings. In a clinical trial there is a detailed review of the medical record to ascertain the cause of death, whereas in population-based registry settings one must depend on death certificates which have inherent inaccuracies.

2-2 Previous Studies:

2-2-1:

Mawada M.E , (2010), epidemiological distribution of cancer in Sudan, Msc study , SUST. Mentioned that the third cause of death in Sudan after Malaria and viral pneumonia is the cancer. This may reflect a high mortality and low survival rates of cancer, but the determination of the exact statistics is very important to help for putting the planning and methods against cancer. Also the factors which correlated or may affect these statistics must be reflected.

2-2-2:

Ahmed S.A (2000), cancer incidence and survival rates in Sudan. Calculated 19% overall 5-years survival rate based on data collected in Alobaied hospital.This rate is lower than the rate which calculated by this study. But because Sudan is a wide country, and patients from many other states cannot come to Alobaied hospital, his calculation may not reflect the general image of cancer survival rate all over the country. This study depended on data from (RICK) which is in the capital and most if not all Sudanese people treated in it.

2-2-3:

WHO statistics for cancer in the period of 2005-2010 represent the average 5-years survival rate in developing countries, it was 25% for male and 36% for female. WHO statistics depended on data of 100,000 patients selected all over the developing countries, so, the results may affected by the different calculation of each separate country. For this

study the data is only for Sudanese patients who were living and treated in Sudan.

2-2-4:

In 2008 the American medical society calculated the global mortality and survival rates of cancer. the average survival rate in Africa was 22% .This calculations also affected by the separate calculations in each country.

Chapter Three

Material and methods

3-1 Population:

- This study based on data (160 sample) of adults (20-90 years) patients diagnosed with cancer by all stages and take treatment in (RICK).
- Duration: the information was taken from patients diagnosed in the period of 2005-2008 and followed to 2013 by their treatment sheets and death certificates.
- This passive follow up used with this study because there was no enough information from other sources rather than death certificates and treatment sheets.
- The close date of the study was the 31th of December 2013.
- Any patient alive more than 5 years after the diagnose was considered survived, and any one died within 5 years after the diagnosis considered none survived.

3-2 data collection:

- Data was collected from the treatment and follow-up sheets in the statistics department in (RICK) and from the information's of death certificates (in case of death).

3-4 Data analysis:

- Excel and word Microsoft computer programs were used to analyze the data and represent it in bars.
- Actuarial table (life table) used to calculate the survival rate with filtering out the other causes of death.

K	I	H	G	F	E	D	C	B	A
	0.00089	140	0.875	0.875	0.125	160	20	160	0
	0.00113	120.5	0.644	0.864	0.136	139.5	19	140	1
	0.00158	100.5	0.54	0.841	0.159	119.5	19	121	2
	0.00251	80	0.455	0.8	0.2	100	20	102	3
	0.00689	50.5	0.405	0.652	0.348	77.5	27	82	4
								55	More than 5

A: years, B: survived patients in the beginning of the year, C: No of deaths, E: death probability, F: survival probability, G: survival rate.

Chapter Four

Results

After applying the previous methods the results of the study can be represent as following:

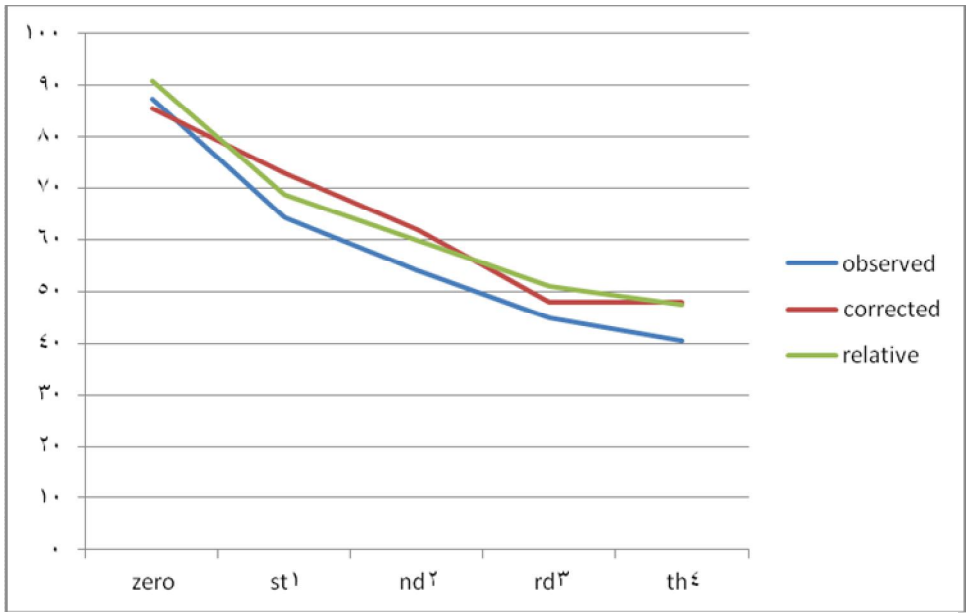

Fig4-1: Observed, corrected and relative survival rates among the study patients.

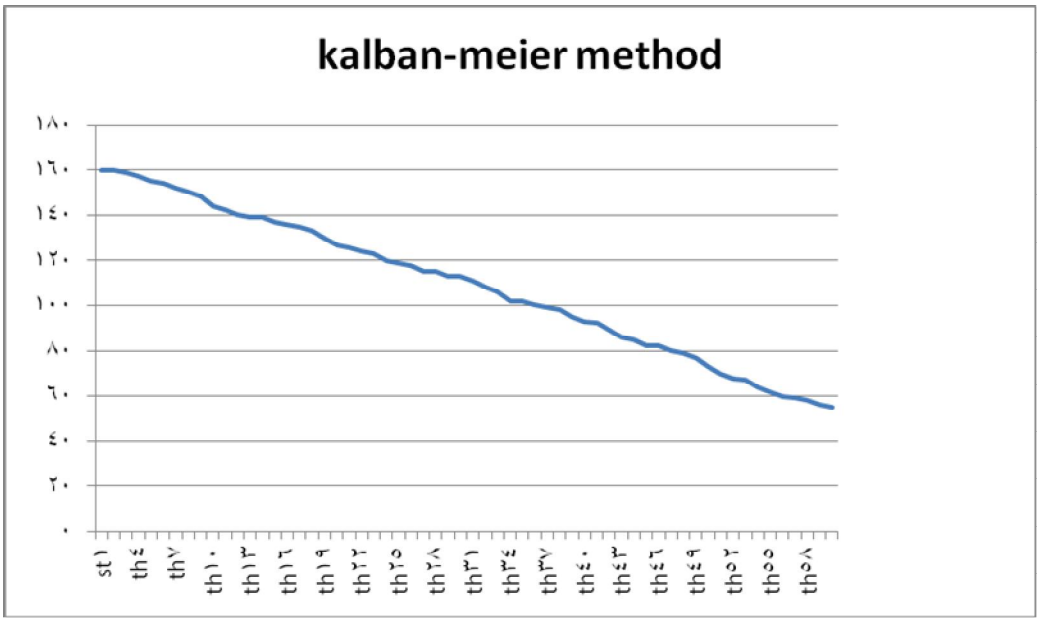

Fig4-2 5-years survival rate representation for Kalban-Meier method calculation (month by month).

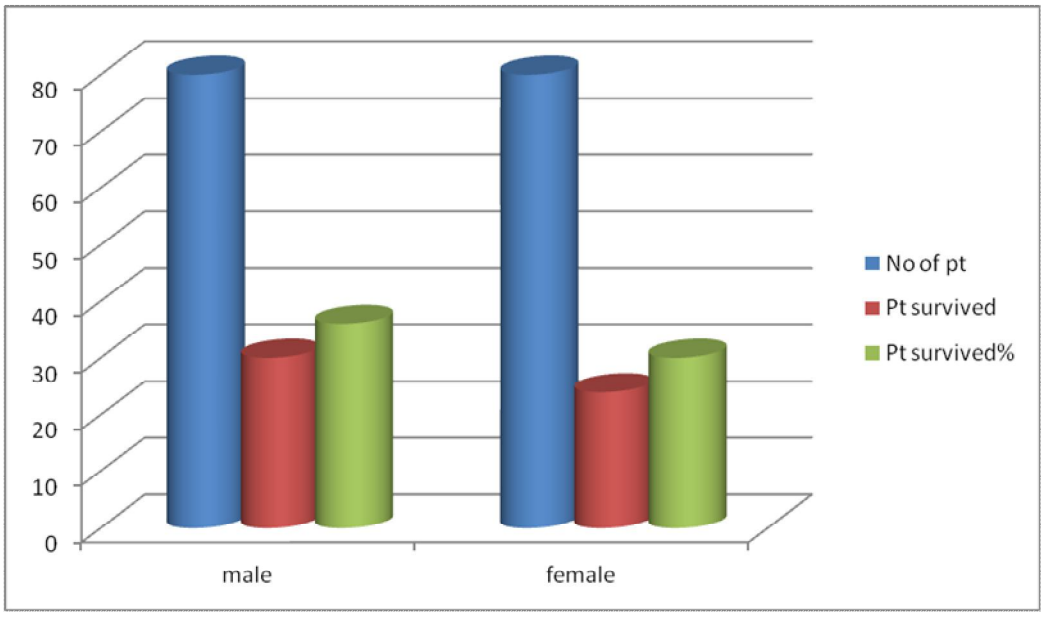

Fig 4-3: represent the overall 5-years survival rate according to the sex of the patient.

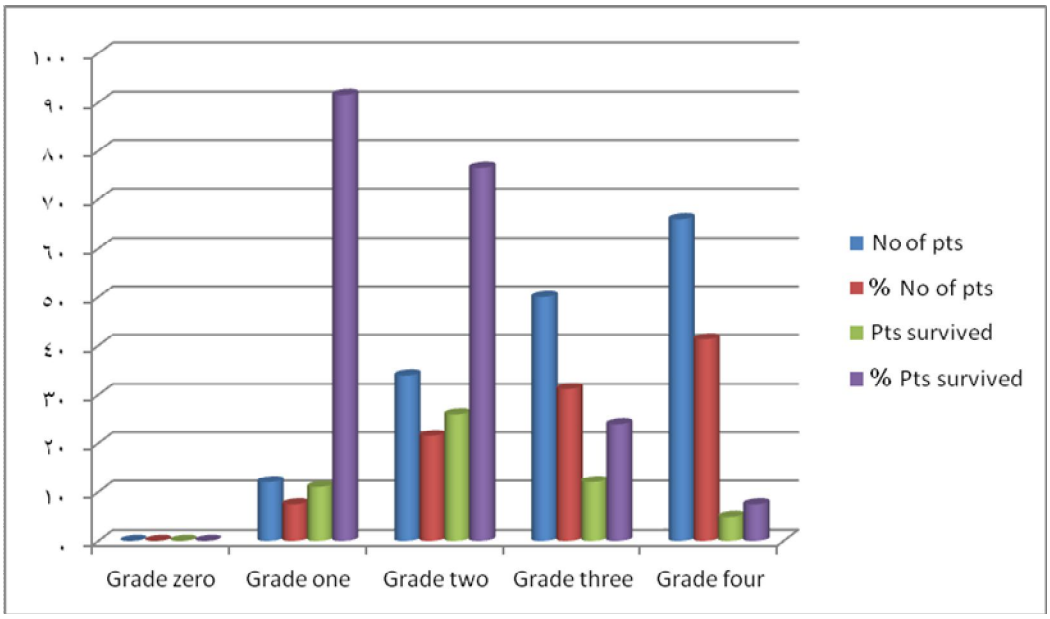

Fig 4-4: represent the overall 5-years survival rate according to the grade of cancer.

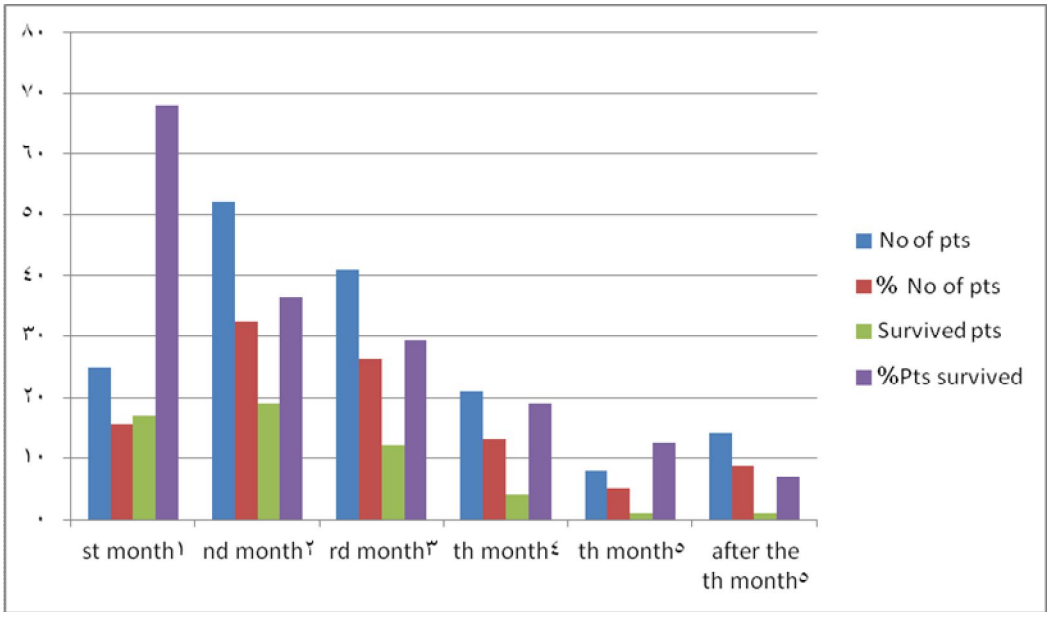

Fig 4-5: The overall 5-years survival rate according to the period between the diagnosis of the cancer and the beginning of treatment.

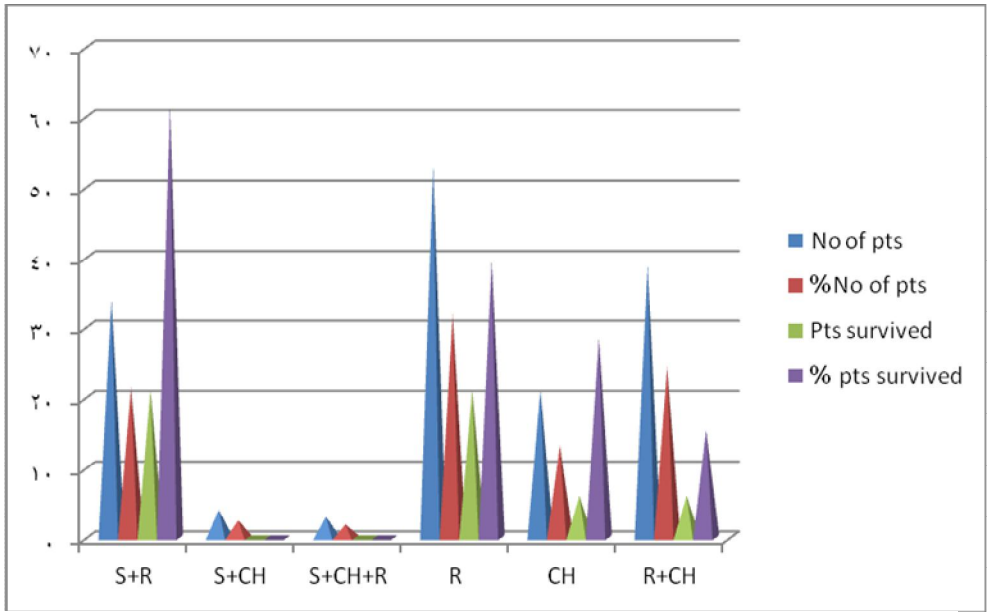

Fig4-6 : theoverall 5-years survival rate according to the type of treatment.

R: radiotherapy. CH: chemotherapy.S: surgery.

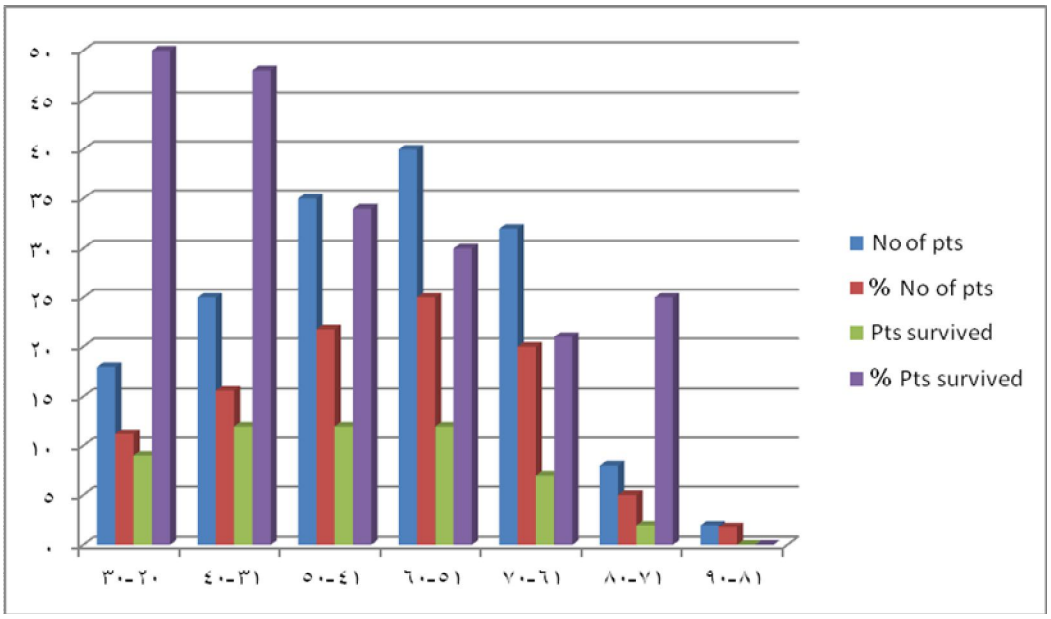

Fig 4-7: the overall 5-years survival rate according to the age group of patient.

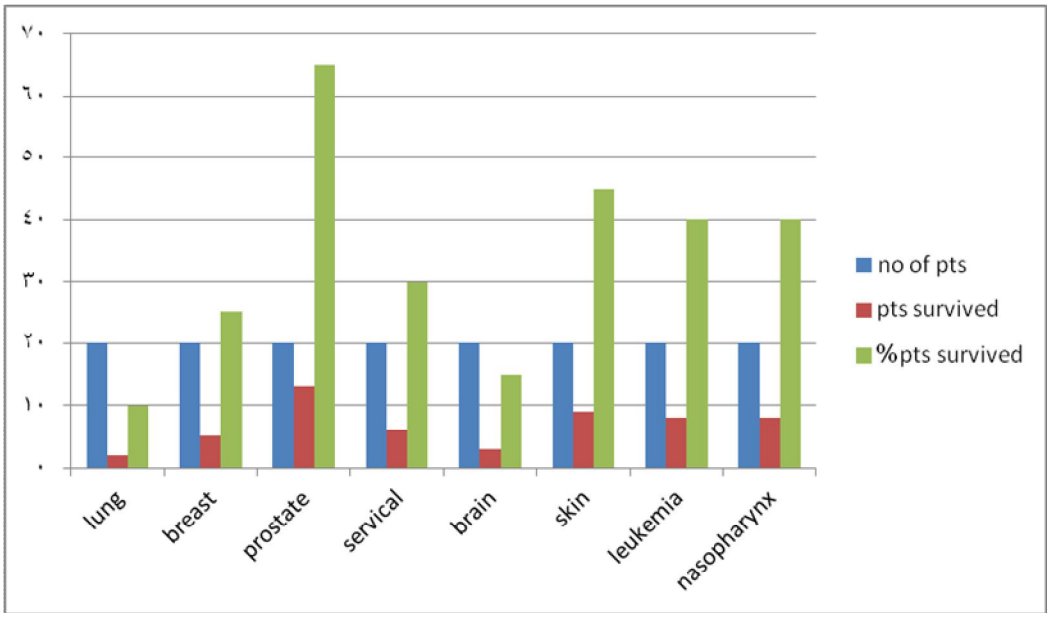

Fig 4-8: overall 5-years survival rate according to the site of cancer.

Chapter Five

5- 1Discussion:

- The overall 5-years survival rate of cancer in Sudan is 33.7% , this percent is in the upper limit of the average of the 5-years survival rate in the developing countries, which was calculated by different universal organizations and institutes. also it is in the upper limit of the average 5-years survival rate in African countries.
- Female survival rate is less than male by 6% , this may need for research about the incidence of cancer in female and male to know if there is more incidence in female , or there is another factors which make this different.
- The study represent that the less the time between diagnosing of cancer and beginning treatment , the better the 5-years survival rate, this also related to cancer grade which is an another important factor interested in the study. The study found that the survival rate declined gradually with the increase of the grade. And from all samples of the study no one diagnosed in the 0 grade (tumor in situ). Unfortunately, there are some patients diagnosed with cancer in a certain grade and when they found the chance to begin their treatment, the disease spread and became in a superior grade and this reduce their survival probability.
- The study showed that The 5-years survival rate was better in the younger patients, and it gradually decreased with the increase in age until the 70 years age, in the age group of 71-80 years there is 5-years survival rate better than 61-70, this may be according to a common behavior of old persons in Sudan, that they are prefer to stay at home with their diseases than going to doctor. And in the age group of 81-90 years there was no survival rate recorded, but that may not mean that

they are all died by cancer, in this age the probability of other suspected causes of death increase.

- Although the treatment protocol of cancer which determined by doctor depend on many factors (ex: grade, site, patient situation…etc), but the very low survival rate after treatment by some protocols may need for another vision.
- Lung cancer is the most fatal cancer in Sudan, and this also true in many countries (ex: USA). And the prostate cancer which is in many countries come in the end of the fatal cancer list is the better recurred cancer in Sudan.

5-2 Conclusion:

- The overall 5-years survival rate of cancer in Sudan is 33.75% for all patients. it is 30% in female patients and 36% in male.

- The survival rate of the lung cancer was the lowest one by 10% followed by brain, breast, cervical, leukemia, nasopharynx, skin and prostate which survived for 5-years by 15%, 25%, 30%, 40%, 40%, 45% and 65% respectively.
- The 5-years survival rate was 91.6% for patients who diagnosed in grade 1 of the disease,76.5% in grade 2, 24%in grade 3 and 7.5% in grade 4. For all study samples no one diagnosed in grade0.
- From all patients who treated within the first month after the diagnose there are 68% survived more than 5 years, 36.5% for those who treated within the second month,29.3% for the third month,19% for the forth , 12.5% for the fifth month and 7% for patients who treated after more than 5 months from their diagnose.
- The best treatment given was the combination between surgery and radiotherapy which used for 21.2% of patients and resulted in 61.7% 5-years survival rate, followed by radiotherapy, chemotherapy, radiotherapy and chemotherapy, surgery and chemotherapy, and surgery+ radiotherapy+ chemotherapy .these protocols used for 31.9,13.1, 24.3 ,2.5 and 1.9 % of all patients respectively and resulted in 21% ,6%, 6%, 0% and 0% 5-years survival rates respectively.
- Patients of the age group of 20-30 years were 11.2% from all patients and their 5-years survival rate was 50%, 31-40 years group was 15.6% from all patients and survived by 48%,41-50

years group was 21.8% of all patients and survived by 34.3%, age group of 51-60 was 25% from all patients and there are 30% survived from this group, 61-70 years group was 20% and survived by 21.8% , the group of 71-80 years was 5% from all patients and there were 25% survived and the age group of 81-90 years was 1.8% from all patients and survival rate in this group was 0%.

- The observed, corrected and relative 5-years survival rate of cancer in Sudan are 40.5%, 52% and 47% respectively.

5-3: Recommendations:

- When any patient diagnosed with cancer the treatment must be determined and given as quickly as possible.
- It should always be remembered that cancer is not one disease but many and each separate site represent a different disease, different natural history and different problem.
- The higher background mortality in older patients must be taken in account.
- There is great deal that can be done for almost all cancer patients that can make a very significance difference to the quality of their life (e.g.: good doctoring, good nursing and choosing the proper treatment
- Future suggestions:

- Comparison between the different protocols which used for cancer treatment in Sudan, to know what is the best one.

- The technical factors which may affect the survival rates of cancer.

- Risk of cancer recurrence.

- disease-free and progress-free survival rates of cancer.

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