CHAPTER - 2

CANCER IN TIME AND SPACE

2.1 NEED FOR STUDYING PALAEOPATHOLOGY

The term palaeopathology is coined by Sir Marc Armand Ruffer (1859-1917). It can be defined as a science of the diseases which can be demonstrated in human and animal remains of ancient times (Halperin, 2004). Palaeopathology helps to answer the basic questions such as “What disease is this?”, “When was this disease first found in humans” and the questions such as “How?”, and “Why?”. It also sheds light on human nutrition and subsistence strategies, and how subsistence strategies could impact the presence of the disease. It also helps to answer the specific questions such as “Why do some populations suffer from conditions that others do not?”, “Why has the presence of some diseases seemingly changed over time?”, “How might a wide range of variables affect the presence of disease and disease processes?” and “How might differences in human social interaction affects the host-pathogen relationships?”. Palaeopathology provides the link between the past and the present and can reveal how health and disease have changed through changes in diet, environment and climate. It also helps to understand environmental variables contributing to health and disease in the past using various techniques (Grauer, 2012).

In the study of ancient diseases, palaeopathologists focus on two lines of evidence, primary and secondary. The former includes skeletal remains and mummified remains. The secondary sources encompass ancient texts, iconographic representations, documents, artistic representations, etc. The first step in palaeopathological analysis is to establish the envelope of what is normal in size, shape and topography for a healthy human skeleton. When skeletal remains fall outside that envelope, pathology is one possible explanation. There are two basic steps in palaeopathological work. The first is the description and second is the diagnosis. Description is the most important step in palaeopathological work because even if the diagnosis is incorrect,
other workers can come along later and amend or modify the diagnosis (White and Folkens, 2005).

Palaeoncology as a part of palaeopathology is a new term established by Halperin (2004) and refers to the study of malignant tumours in ancient human populations and their hominid ancestors. These populations provide information of crucial importance concerning the possible influences of morphological and functional evolution, diet, lifestyle, and other environmental factors on tumourous diseases. This new discipline may have deep impact on our knowledge of the natural history of cancer. The application of improved diagnostic techniques has enabled the palaeoncology to make remarkable contributions to understanding of cancer (Molnár et al., 2009). The palaeopathology of cancer has the potential to improve our understanding of disease prevention, etiology, pathogenesis and treatment (David and Zimmerman, 2010). Capasso (2005) suggests that the palaeopathologists studying cancer focuses on existence of cancer in antiquity; comparison of cancer in both pre-human and ancient human populations; the relationship between cancer prevalence and demographic structure of human populations and its variations over time; the variations in type and prevalence of cancer as related to the genetic or environmental changes that occurred during biological, social, cultural and economic human evolution; the general biological significance of cancer with respect to rest of life.

According to Brothwell (1967), the interpretation of neoplasms is one of the most interesting and difficult aspects of palaeopathology. The most difficulties are linked to the materials available to palaeopathologists. With exception of mummified remains, palaeopathological materials generally consist of osseous remains. The chemical, physical and biological agents can produce erosion which may hide the lesions produced during life or may change their original appearance. The difficulties inherent in palaeopathological analysis involve not just the diagnosis of the single case at the individual level, but also epidemiological aspects. There can be two important sources of error in the palaeopathological analysis. These include the samples under examination may not be the representative of the
population from which it is drawn and the size of the sample can be too small to make an inference of a disease (cf. Capasso, 2005).

2.1.1 Diagnostic techniques used to examine ancient specimens

The techniques and methods used for palaeopathological diagnosis may include macroscopic inspection, radiographic examination, histological examination, molecular techniques and chemical analysis. The various techniques and methods used to examine ancient specimens are discussed as under:

2.1.1.1 Macroscopic inspection: Studying palaeopathology is paramount in the attempt to reconstruct the impact of disease on past human populations; however, population samples of human remains are not representative of the living. Researchers should be careful when interpreting data and making references to living populations from past populations, as a significant difference might be evident. When using archaeological material to make inferences about disease within past populations the data obtained will contain sources of error and bias. The methodology used in palaeopathology often only involves macroscopic analysis of lesions. Each observer identifies the pathology independently, thus interobserver and intraobserver error are common (Martin, 2008). Thus, it is important to combine macroscopic inspection with more reliable techniques and methods such as histological examination and molecular techniques.

2.1.1.2 Radiographic examination: The radiographic examination of the palaeopathological specimens enables the direct comparison of the osteological changes in these specimens with that visualised in living patients. As radiography has been used for medical imaging for more than hundred years, there is a substantial published corpus of radiographic images in the medical literature depicting cases of various diseases. These published radiographic records give a more realistic idea of variety of skeletal changes as a result of diseases. The radiographic interpretation in palaeopathology represents its own specific problems. The deposition of various materials on the specimens may hinder the radiographic images. Soil erosion may also
lead to radio-lucencies that might be mistaken for the effects of dis: (Grauer, 2012).

Palaeopathologists, traditionally used both macroscopic radiological methods to determine disease prevalence of past h populations. These methods are useful for a preliminary diagnosis but, provide accurate data. The inferences made from these data cann applied to modern human populations (Martin, 2008).

2.1.1.3 Histological examination: The standard histological process fc tissue examination is based on a technique developed in Cairo, Egy 1921 by Sir Marc Armand Ruffer, the founder of modern palaeopatholc combination of water, alcohol and sodium carbonate (Ruffer’s solutk used to rehydrate the mummified tissue, which is then fixed in ab: alcohol and processed for microscopic examination, in the same way e fresh tissue. The microscopic slides are stained with standard stai haematoxylin and microscopy is sometimes used as an additional diag tool (David and Zimmerman, 2010). The techniques such as stained sec polarised light microscopy, microradiographs, and electron microscop also used by histopathologists. Histopathology provides a more re diagnosis of diseases and the relevant prevalence of those diseases be it can substantiate or correct a macroscopic diagnosis. In ad histopathology provides more accurate age determinations and helps diagnostic analysis of possible environmental and cultural factors that affect the skeletal material (Martin, 2008).

2.1.1.4 Molecular techniques: The palaeopathologists in the past relic macroscopic analysis of ancient remains to provide information i diseases in antiquity. These sources, however, can be vague and diffic interpret. In the last decade, palaeopathologists have begun to incorp modern laboratory methods into their research with intriguing results. Techniques and immunochemical techniques have enabled definitive diag and prevalent studies of infectious diseases in both skeletal and mumr remains. It has contributed to the knowledge of the natural history of dis and has opened the door to such potential new fields such as palaeogen
palaeovirology, and palaeoepidemiology. The use of laboratory techniques in palaeopathology allows researchers to test their traditional methods and provides access to health information previously available only for living populations. Though limited somewhat by problems of contamination and molecular degradation, the results of research conducted thus far, suggest a bright future for modern laboratory methods and the study of ancient health and disease (Allison and Willcox, 2002). The other technique used in palaeopathological analysis include the use of Dual X-ray Absorptometry (DXA), which is a non-invasive and non-destructive method of assessing bone health.

Advances in palaeopathology usually bring to mind new technologically complex techniques. Ironically, behind all skeletal analyses rest macroscopic evaluation and data collection, methods that are comparably less exciting points of discussion and publication. However, changes in theoretical frameworks upon which skeletal analyses are undertaken compel palaeopathologists to re-evaluate how palaeopathological lesions are assessed and recorded. This requires researchers to focus on recognising numerous skeletal changes that might not be pathological, to record a greater number of variables associated with the archaeological/medical context, to focus on careful diagnosis using multiple means of inquiry, and to collect and record data based upon criteria and methods used and disseminated by past and present researchers (Pinhasi et al., 2007).

2.2 PALAEOPATHOLOGICAL EVIDENCES FROM SKELETAL REMAINS

A considerable number of evidences of cancer have been found from human skeletal remains. The oldest example of osteoma is found in dorsal vertebra of a Mosasaurus from the later Cretaceous period of the Mesozoic era (Abel, 1924). Some of the most spectacular cases of osteoma of the skull are reported by Moodie (1923a, 1923b, 1926) in the left side of the skull of an ancient Peruvian from Ancon, now curated at the Peabody Museum of Harvard University. A Saxon tibia with a 10 cm diaphyseal swelling (Brothwell, 1961) and an Anglo-Saxon femur (Wells, 1965) demonstrate the features of osteoid osteoma. Brothwell (1967) found osteoma in the right side of the
Egyptian skull and Vyhnanek (1971) discovered right tibia of an adult male belonging to a medieval Czechoslovakia exhibiting the features of osteoma. Steinbock (1976) found osteoma on the left parietal of an adult pre-Hispanic Peruvian skull from Ancon.

A possible osteosarcoma of the pelvis has been reported in a young individual from Ancient Egypt dating to about 250 AD. Another well-documented case of osteosarcoma, with the typical radiographic “sunburst” pattern has been observed in the femur of a native Peruvian dating to 800 BP. Possible additional case of osteosarcoma have been reported in a young female femur from the pre-historic population of Oahu in Hawaii, in a zygomatic bone from the French Middle Ages, in a 17th century mandible from West Virginia, in a young male from the Saxon necropolis of Standlake (England), in a medieval skulls from the Czech Republic (Aufderheide and Rodriguez-Martin, 1998).

Ortner et al. (2010) discovered an incomplete skeleton of male aged 45 years with multicentric osteosarcoma from a 19th century cemetery site in Wolverhampton, England.

A young male from Late Neolithic in Ctalonam Spain, demonstrating 16 different tumour foci in bones showing a honeycomb structure with irregular margins represent Ewing’s sarcoma (Campillo and Mari-Balcells, 1984). A medieval Westphalia (Germany) site skeleton had a spindle-shaped expansion of the distal ulna that demonstrated a spongy, honeycomb internal structure suggestive of Ewing’s sarcoma (Lowen, 1994).

The first evidence of metastatic carcinoma is found by Moller and Moller-Christensen (1952) from a medieval female skull showing evidences of metastasis from a malignant growth. Anderson et al. (1992) discovered an elderly male skeleton from medieval Canterbury which displayed evidences of metastatic carcinoma. The dry bone findings, scanning electron microscopy (SEM), and radiography suggest a primary focus in the prostate. This was the first reported case of prostate carcinoma from medieval England. Molnar et al. (2009) reported 13 cases of malignant bone tumours among the
Plate 2.1: Circular osteolytic lesions of the right hip bone

Source: Molnar et al., 2009

Plate 2.2: Massive osteolytic alterations in hip bone

Source: Molnar et al., 2009
osteoarchaeological samples from Hungary dates to the 3rd to 16th century. In most cases, multiple osteolytic lesions with slight osteoblastic reactions, in characteristic skeletal distributions were strongly suggestive of metastatic carcinoma. A mature male with pronounced osteoblastic reactions, particularly on the hip bones, seemed to be most compatible with the diagnosis metastatic prostate cancer. These findings suggested that carcinomas were present in human populations living on the territory of present-day Hungary over the last two millennia. The photographs showing the reported malignant bone tumours are given in Plates 2.1, 2.2, 2.3 and 2.4. These photographs are produced with the permission of Erika Molnar (Appendix-I).

Tkocz and Bierring (1984) reported another case of metastatic carcinoma of prostate gland is found among the skeleton of a mature male from the Middle Ages, excavated in Svendborg, Denmark. Grevin et al. (1997) reported a case of metastatic prostate carcinoma in a cremated pelvis dating from 1st century AD. Schultz et al. (2007) reported the oldest known case of metastatising prostate carcinoma in the skeleton of a king aged 50 years from Arzhan (Siberia, Russia). The skeleton was found to be around 2700 year old from the date of discovery. The use of various microscopic and proteomic techniques led to the diagnosis of carcinoma.

Osteolytic lesions and necrosis are described in a human skull dating from 3500 to 3000 BC from Tepe Hissar in Iran (Aguirre, 1972) and in a skull approximately 4500 years old, from the II to V Egyptian dynasty. The latter had extensive destruction at the base, and its radiography revealed 26 circular rarefactions in the outer table, and Wells (1963) considered that “the overall picture leaves no doubt that this is a case of primary carcinoma of the nasopharynx, with primary destruction of the maxillary, palatal and pterygoid elements and secondary deposits widely scattered in skull”.

Gestsdottir and Eyjolfsson (2005) reported a female skeleton dated between the 11th and 15th century with myeloma and evidences of metastatic cancer. The skeleton is the first published case of this malignant disease from Iceland. Brooks and Melbye (1967) identified a 40 year old female from about 1200 AD in Missouri with characteristic myeloma lesions. Morse et al. (1974)
reported myeloma among the samples from Florida dated 500-1250 AD while Steinbock (1976) noted such lesions in an isolated pre-Hispanic Peruvian skull from Kentucky about 3300 BC. The oldest case of multiple myeloma is found in a Neolithic 40-50 years old female from Austria with many purely lytic lesions throughout the skeleton (Strouhal, 1991). A medieval example estimated to be a 60-80 year old female from Germany also displayed myeloma lesions (Alt and Adler, 1992).

Meningioma has been described in many ancient human populations with first case found in pre-historic America (MacCurdy, 1923) and the earliest clear occurrence involving skeleton from Egypt dating to the First Dynasty (Rogers, 1949). Several researchers reported that this type of neoplasm was probably relatively frequent in various pre-historic and ancient historic populations. Brothwell (1967) identified meningioma-type response in a Roman skull from United Kingdom. Probably the oldest case of meningioma in a Neolithic adult skull from the Catalonia region of Spain, demonstrating an inner osteolytic lesions with exocranial bulging and a prominently imprinted middle meningeal artery (Campillo, 1991). Anthropologists have recovered and studied thousands of fossil bones pertaining to Neanderthal men in Europe, finding only one lesion possibly related to neoplasm. In Stetten II parietal bone (from Germany, dating to about 35,000 years BP), the lesions consisted of a new bone formation theoretically linked to possible meningioma although the evidence is neither clear or convincing (Capasso, 2005).

Hemangioma and fibrous tumours of the bones have also been reported in some ancient human remains (Capasso, 2005). Malignant primary bone tumours were very rare in antiquity and continue to be rare in modern populations. The earliest known case is found in a 15 years old male (about 800-600 BC) from Switzerland (Brothwell, 1967). Hereditary multiple exostoses have been demonstrated in ancient remains (Gladykowska-Rzeczycka and Urbanowicz, 1970). Cartilagenous exostoses have been demonstrated from early on, with one of the earliest known cases dating to the 12th Dynasty in Egypt (Ortner, 2003). They were also present in Europe (Capasso, 2005). Other extremely rare neoplastic forms have also been
Plate 2.3: Lytic alterations of the skull

Source: Molnar et al., 2009

Plate 2.4: Porosity of the bone adjacent to the margin of the lytic lesion

Source: Molnar et al., 2009
documented in the palaeopathological literature. These include histiocytoma in ancient Egypt (Brothwell, 1967; Zimmerman, 1981), eosinophil granuloma in prehistoric native American child from Illinois (Morse, 1969), possible Ewing's sarcoma in a juvenile skull from Bronze Age of Tartaren, Spain (Campillo, 1976) and Hand-Schuller-Christian disease in a pre-historic Native American from New York (Steinbock, 1976). Kramar et al. (1983) found an isolated and calcified mass, leiomyoma of the uterus from a 5,000 years old skeletal remains dating to Neolithic period. The only one known case of Chondroma is found in the metacarpal bone from Neolithic skeleton from the Zlota cemetery in Poland (Capasso, 1985). Sawyer et al. (1990) found a case of facial lesions in a 600 year old skeletal remains of a young female aged 22-25 years from pre-Columbian Chile. A case of osteoclastoma is also found in England and Italy (Capasso, 2005).

2.3 PALAEOPATHOLOGICAL EVIDENCES FROM MUMMIFIED REMAINS

In 1914, a team of archaeologists found a two-thousand-year old Egyptian mummy in the Alexandrian catacombs with a tumour invading the pelvic bone. In 1932, L.S.B. Leakey, the archaeologist who dug up Lucy, one of the earliest known human skeletons, also discovered a jawline dating 4000 BC from a nearby site that carried the signs of a peculiar form of lymphoma. The jawline exhibited a distinctive swelling consistent with Burkitt's lymphoma that appeared to be the result of malignant tumour but later on it was diagnosed as a benign bone callus of an infected fracture (Fitzgerald, 2000). Another interesting fossilised remnant belonging to Homo erectus, from the Solo river in central Java (about 500,000 years) also exhibited the characteristics consistent with lymphoma. Zimmerman (1977) reported the presence of rectal cancer in an unnamed mummy who had lived in the Dakhleh Oasis during the Ptolemaic period (CE 200-400). Apart from this discovery, various other types of cancerous tissues had been found among other mummified remains.

In 1990s, Aufderheide, a palaeopathologist discovered a thousand year old grave site with 140 mummified remains of individual belonging to Chiribaya tribe. He found the presence of cancers among the mummified
remains. In the remains of a young woman, he found the presence of a “bulbous mass” in her left upper arm. In another mummy, he found the presence of thousand year old malignant bone tumour. In addition to the tantalising discoveries of fossilised tumours, other ancient human remains have also revealed evidence of cancer. Bone tumours and nasopharyngeal cancers have been observed in some Egyptian mummies from 5000 BC. Similarly, mummified skeletal remains of the Incas, found in Peru (2400 BC) had lesions characteristic of metastatic myeloma, a form of skin cancer. In another case, lesions found in the skull of a woman from the Bronze Age (1900-1600 BC) are consistent with those that occur in metastatic breast cancer or melanoma (Aufderheide and Rodriguez-Martin, 1998).

Finally, evidence for some tumours that produce calcifications can be found in ancient human burials. The ossified masses produced by fibroleiomyomas of the uterus have been found in correspondence of the small pelvis in many Iron Age female burials in Italy, in neolithic burials in France and Switzerland, in Egypt and in medieval burials in Spain (Capasso, 2005).

In Europe, only two cases of carcinoma (dating to 16th century AD) of prostate or rectum and naso-orbital cancer are reported from Naples, Italy (Fornaciari, 1994). The earliest known cases of metastatic carcinoma of breast are reported from Mokrin (Yugoslavia), dating to about 1900 BC and from Russia dating to 15th century (Capasso, 2005). The metastatic colonic adenocarcinoma was reported by David and Zimmerman (2004) in mummified remains. Additional cases ranging from Bronze Age to Middle Ages have been reported from Czech Republic, Denmark (Moller and Moller-Christensen, 1952), Hungary, the former Yugoslavia, England (Brothwell, 1967), Switzerland ( Ortner and Putshar, 1981) and Poland (Gladykowska-Rzeczycka, 1982). More cases of multiple lithic skeletal lesions due to metastasis have been reported in Pre-Columbian American populations including cases from pre-historic California (Hollimon, 1981) and Kentucky, pre-Hispanic Peru and St. Lawrence Island, Alaska (Ortner, 1981). Only a few
cases of skeletal metastasis have been reported in the human material from ancient Egypt.

The prevalence of primary and metastatic cancers was low everywhere throughout the pre-medieval time. Only a few cases of neoplasms have been documented in Central and South American mummies. The case of lipoma (12-13\textsuperscript{th} century) and rhabdomyosarcoma (4-7\textsuperscript{th} century AD) have been reported among two children in Chile (Gerszten and Ellison, 1991). Only 44 cases of neoplastic diseases have been reported in a recent review of thousands of Ancient Egyptian mummies (Capasso, 2005). Evidence of Hand-Schuller-Christian disease has been found in 2,900 year old mummy from an Egyptian site (PTI, 2012b).

2.4 CANCER IN ANCIENT TEXTS

Ancient texts and artistic representations help us to trace the antiquity of cancer back to several millennia (Aufderheide and Rodriguez-Martin, 1998). The analysis of ancient texts falls within the remit of palaeopathology, although most palaeopathologists today largely obtain their evidences about the ancient diseases from primary sources i.e., skeletal and mummified remains. The best place to look for the evidence of disease in the past is the texts written by doctors at that time. It is important to note that analysis of ancient texts is useful only when the researcher understands the language and cultural context in which the texts are written. Only then, the researcher will be able to understand which conditions most closely matches the symptoms and signs described in the text. Mitchell (2011) suggests that there can be twelve pitfalls in analysing the ancient texts that might lead to mistakes. These include:

- Insufficient information preserved in written sources to make a diagnosis.
- Sources consulted unrepresentative of original body of texts produced.
- Failure to realise an apparently eye witness record was copied from older texts.
• Insufficient understanding of cultural context by researcher to use sources.
• Using inadequate translations by others, instead of reading original sources.
• Insufficient knowledge of disease symptoms by researcher to diagnose.
• Placing undue weight on aspects of the evidence fitting pre-existing theory.
• Ignoring inconvenient symptoms to fit the modern understanding of disease.
• Failure to consider that multiple concurrent diagnoses were present.
• Failure to consider that diseases may evolve and change over the centuries.
• Presuming the diagnosis must be disease that still exists today.
• Overstating the likelihood of a diagnosis being correct.

To trace the antiquity of cancer, the texts from India, Greek and Roman, Unani, Egypt, and other texts such as Arabic, Bible, Jewish and Byzantine are discussed. In ayurvedic text, the term *arbuda* and in Unani text, the term *sartan* is used to describe cancer.

2.4.1 Indian texts

The first recorded description of tumours and their treatment is found in the Ramayana (2000 BC). The treatment included cutting of tumours surgically or applying healing ointments containing arsenic. The Sanskrit scriptures, known as four Vedas, date back to 2000 BC describes the disturbances in three known humours (*doshās*) - the *vayu* (wind), *pittam* (bile) and *kapham* (phlegm) which led to imbalances in *rakta* (blood) and led to diseases. During the 7th century BC, Atreya and Dhanwantari used herbal medicines for treating the early stages of cancer and surgery in advanced cases. In the 8th century AD, Vagbhata, a Buddhist physician composed two texts: “Ashtanghridya” and “Ashtangasangraha” where new methods for cancer treatment were introduced. Other ayurvedic texts of internal medicine, viz., “Chakradatta” composed by Chakrapani (10th century AD), the
“Sarangadhara Samhita” by Sarangadhara (14th century AD), the “Bhavaprakasha Samhita” by Bhavamisra (15th century AD), the “Satmya Darpan Samhita” by Viswanath (16th century AD), the “Vaisajya Ratnabali” by Binoda Lala Sen Gupta (18th Century AD), the “Rasatarangini” by Sadananda Sharma (19th century AD), etc. explain numerous remedies to treat internal and external neoplasms.

Ayurvedic literature defines three body-control systems, viz., the nervous system (Vāta or air), the venous system (Pitta or fire), and the arterial system (Kapha or water) which mutually coordinate to perform the normal function of the body. In benign neoplasm (Vātaja, Pittaja or Kaphaja) one or two of the three bodily systems are out of control and is not too harmful because the body is still trying to coordinate among these systems. Malignant tumours (Tri-dosaja) are very harmful because all the three major bodily systems lose mutual coordination and thus cannot prevent tissue damage, resulting in a deadly morbid condition. The factors responsible for the vitiation of doshās include:

(a) Vāta aggravating factors: These includes excessive intake of bitter, pungent, astringent, dry foods and stressful conditions.

(b) Pitta aggravating factors: These includes excessive intake of sour, salty, fried foods and excessive anger.

(c) Kapha aggravating factors: These includes excessive intake of sweet, oily food and sedentary nature.

(d) Rakta aggravating factors: These includes excessive intake of acid or alkali containing foods. Fried and roasted foods, alcoholic beverages, sour fruits are some of the examples. Excessive anger or severe emotional stress, sunbathing or working under scorching sun or near fire are some of the causes.

(e) Mamsa aggravating factors: These include excessive use of exudative foods like meat, fish, yoghurt, milk and cream. Behaviours leading to exudation like sleeping during the day and overeating are some of the causes of pathogens invading the fatty tissue.

(f) Medo aggravating factors: These includes excessive intake of oily foods, sweets, alcohol and lazy attitude.
The ayurvedic classification of neoplasm depends on various clinical symptoms in relation to tridoshas (Balachandran and Govindarajan, 2005):

**Group I:** Diseases that can be named as clear malignancy, which includes *arbuda* and *granthi*. Example, *mamsarbuda* (melanoma), *raktarbuda* (leukaemia), *mukharbuda* (oral cancer), etc.

**Group II:** Diseases that can be considered as cancer, such as incurable ulcers. Example *tridosaj gumas* (abdominal tumours like carcinomas of stomach and liver or lymphomas).

**Group III:** Diseases with the possibility of malignancy. Example, *visarpa* (erysipelas), *asadhya kamala* (incurable jaundice) and *nadi vrana* (sinusitis).

Charaka and Sushruta, two well known ayurvedic classics describe cancer as inflammatory or non-inflammatory swelling and mention them either *granthi* which is a minor neoplasm or *arbuda* which is a major neoplasm (Balachandran and Govindarajan, 2005). *Granthi* has been described as a round, hard, and bulging swelling, produced owing to the aggravation of *vāta* and *kapha* vitiating the muscle, blood, and fatty tissues. *Arbuda* has been described as a round, large, muscular, immovable, deeply rooted, slowly growing swelling produced owing to aggravation of *vāta* and *kapha* vitiating the muscle, blood, and fatty tissues. Both types of swelling can be inflammatory or non-inflammatory based on the *doshas* involved. Tridoshic tumours are usually malignant because all the three major body humours lose mutual coordination, resulting in a morbid condition (Garodia et al., 2007). A lethal oral lesion was recorded by Sushruta in his Samhita among the betel-nut chewing population (Suraiya, 1973). The “Sushruta Samhita” also mentioned tumours of nose, rectal, urinary passages, vagina and skin.

2.4.1.1 Characteristics of cancer (*arbuda*): The XI chapter of Nidanasthana of “Sushruta Samhita” deals with *granthi* (cyst), *apaci* (scrofula), *arbuda* (tumour) *galaganda* (goitre). This section of the book deals with the description of the characteristics of *arbuda*.
In this verse, it is described that in some of the parts of the body aggravated *dosha* vitiate muscle and thus, produce a round, firm, with mild pain, large, deep-rooted, slowly developing, non-suppurating and swollen fleshy mass. This is known as *arbuda* (tumour).

*Arbuda* is of six types as caused by *vata*, *pitta*, *kapha*, *medas*, *rakta* and *mamsa*. The first four have the same features as of cyst. The cyst is described as a round, protruded and knotty swelling produced by vitiated *vata*.
Aggravated dosha, after pressing and constricting blood vessels vitiates blood and thus a fleshy lump slightly suppurating, discharging, galloping and covered with fleshy sprouts occurs discharging vitiated blood constantly. This tumour raktarbuda is caused by blood and is incurable. The patient, being afflicted with loss of blood and other complications, becomes pale.

Mustiprahārdihirarditeange
Mānasam pradustam prakaroti shopham II17II
Avedanam sinaghmananyavarṇa-
mapākamashmopamamaprachāyam II
Pradustamansasya narasya bāda-
metadabhenmansaparāyanasya II18II

(Sushruta Samhita, Nidanasthana, Chapter XI, p. 76)

When a body part is inflicted with blow of fist etc., the muscle is vitiated and causes swollen growth which is painless, glossy, of the same colour, non-suppurating, stone-like and immovable. This is found mostly in those whose muscle are vitiated and who indulge in meat-eating. This mamsarbuda is incurable.

Mānsārbudam tvēdasādhyamuktam
Sādhyesvāpimānī vivarjayettu II
Saprastrutam marmani yachcha jatam
Srotāḥsvā yachcha bhavedachālyam II19II
Yajjāyateanyat khalu pūrvajāte
Jneyam tatadhyarbudamarbudajnaiḥ II
Yadavndavjātam yugapat kramādavā
Dvirarbudam tachcha bhavedasādhyam II20II

(Sushruta Samhita, Nidanasthana, Chapter XI, p. 76)

Even among curables, the following should be rejected - that with excessive discharge, located in vital spot or channels and which is
immovable. When another tumour is superimposed on the previous one, it is known as adhyarbuda (superimposed tumour) by experts of tumours. When two tumours appear simultaneously or one after the other it is known as dvirarbuda (double tumour) which is incurable. Adhyarbuda also is dvirarbuda (double tumour), the differences being that the former is superimposed while the latter grows side by side.

Na pākamāyānti kaphādhikatvā-
nmedobahutvāchcha vishesatastu II
Dosasthiratvādgrathnāchcha teśām
Sarvārbudānyeva nisargatastu II21II

(Sushruta Samhita, Nidanastana, Chapter XI, p. 76-77)

The verse suggests that not all types of arbuda suppurate because of particular abundance of kapha and medas, firmness of growth, their knottiness and also by nature.

2.4.1.2 Cancer at specific sites: In this section, cancer of lips, cancer of alveolus, cancer of tongue, cancer of palate, cancer of throat, cancer of thyroid and cancer of penis are discussed.

(A) Cancers of lips: The chapter XVI of “Sushruta Samhita” deals with the mukharoga (diseases of mouth). The diseases of lips according to the “Sushruta Samhita” include those caused by vāta, pitta, kapha, sannipāta, rakta, mamsa, medas and trauma.

Māṃsamduṣṭau gurū sthūlaau mansapindavadudgatau II
Jantavashrachātra mūrchhānti srikkasyobhayato mūkhāt II10II

(Sushruta Samhita, Nidanasthana, Chapter XVI, p. 104)

Lips vitiated by mamsa (muscle) are heavy, thick protruded like lump of meat with organisms flourishing in mouth at both ends of lips. This condition is considered incurable as all the three doshās are disturbed.
(B) **Cancer of alveolus:** The disorders located in gums are *sitada, dantapupputuka, dantavestaka, sausira, mahasausira, paridara, upakusa, dantavaidarbha, vardhana, adhimamsa* and five sinuses.

\[
\begin{align*}
Dantāshrachili & \text{ vestebhyastalu chāpyavadīryate} \text{ II} \\
Dantamānsāni & \text{ pachyante mukham cha paripidayte} \text{ II19II} \\
Yasmin & \text{ sa sarvajo vyadhirmahāshausirasanjnakah} \text{ II} \\
Dantamānsani & \text{ shiryante yasmin śhivati chāpyasrik} \text{ II24II}
\end{align*}
\]

(Sushruta Samhita, Nidanasthana, Chapter XVI, p. 105)

*Mahasausira* is the disease caused by all *doshās* in which the teeth become loose, palate is cracked, gums are suppurated and there is pain in mouth. When gums get necrosed and the patient spits blood, the disease is known as *paridara* caused by *pitta* and *kapha*. Again, this condition is considered incurable in the section on therapeutics.

(C) **Cancer of tongue:** The disorders of tongue as described in Nidanasthana of “Sushruta Samhita” are: three types of thorny appearances caused by three *doshās*, *alāsa* and *upajihvikā*.

\[
\begin{align*}
\text{Jihavātale} & \text{ yah shravyathuh pragāthah} \\
\text{Soalāsasamjnah} & \text{ kapharaktamūrtih} \text{ II} \\
\text{Jihavā} & \text{ sa tu stambhayati pravridho} \\
\text{Mūle} & \text{ tu jihvā bhrishameṭṭī pākam} \text{ II38II}
\end{align*}
\]

(Sushruta Samhita, Nidanasthana, Chapter XVI, p. 108)

*Alāsa* is described as a severe swelling under the tongue caused by *kapha* and *rakta* which, if advanced, stiffens the tongue and produces intense suppuration at its root. This condition is also described as incurable.

(D) **Cancer of palate:** The diseases of palate are *galasundika, tundikeri, adhrusa, kacchapa, arbuda, mamsasanghata, talupupputa, talusosa* and *talupaka.*
A lotus like growth that occurs in the center of palate is ulcerated and covered with rakta and kapha. It is known as arbuda. Suraiya (1973) describes that alāsa from among the diseases of tongue and arbuda from among the diseases of palate are incurable.

(E) Cancer of throat: The diseases of throat are five types of rohini, kanthasaluka, adhijihva, valaya, balasa, ekavinda, sataghni, gilayu, galavidradhi, galaugha, svaraghna, mamsatana and vidari.

Galeanilaḥ pittakaphau cha mūrchichhatau
Prathak samastashrach tathaiva shonitam II
Pradūsyā mānsam galarodhinoanrikuran
Srījanti yān saasuhara hi rohini II47II
Jīhvām samantādbhriṣhavedan̤h ye
Mānsāṅkurah kanṭhanirodhinaḥ sayuh II
Tām rohinīṁ vatakritām vadanti
Vātātmakopadravāgātayuktām II48II

(Sushruta Samhita, Nidanasthana, Chapter XVI, p. 110)

The aggravated vāta, pitta and kapha, separately and jointly and also blood vitiate mamsa and thus produce sprouty growth obstructing throat. This is rohini which is fatal. When fleshy sprouts appear around tongue intensively painful and obstructing throat, it is known as rohini caused by vāta and associated with severe complication of the same. Suraiya (1973) mentions that this disease takes away the life of patient and is fatal.

Gale tu shopham kurutah pravridahau
Shleśmāṇilau shṛāchasarujopapannam II
Marmachichhadam dustarametadāhu-
rbalasasamjnam nipunā vikāram II54II

(Sushruta Samhita, Nidanasthana, Chapter XVI, p. 112)
Aggravated *kapha* and *vāta* produce swelling in throat with dyspnoea and pain. This is known as *balasa* which afflicts vital spots. This disease is fatal and is difficult to cure.

\[\text{Vartirghanā kanthanirodhīnī yā}
\]
\[\text{Chiṭātinātram pishitaprarohaih II}
\]
\[\text{Nānārujochchrāyakaṭ tridosa-}
\]
\[\text{jineyā shatadhrīva shatadhnyasādhyā II57II}
\]

(Sushruta Samhita, Nidanasthana, Chapter XVI, p. 112)

Wick-like solid swelling obstructing throat covered excessively with fleshy sprouts, exacerbating various types of pain and caused by three *doshās* jointly is known as *sataghni*. This disease is incurable. *Sataghni* is a term used for a stony weapon covered with thorns of iron.

\[\text{Pratānavān yāḥ shravyathuḥ sukaśto}
\]
\[\text{Galoparodham kurute krameṇa II}
\]
\[\text{Sa mānsatānāḥ kathitoavalambi}
\]
\[\text{Prānapraṇut sarvakrito vikāraḥ II62II}
\]

(Sushruta Samhita, Nidanasthana, Chapter XVI, p. 113)

Severe extensive swelling obstructing throat gradually, hanging and fatal is known as *mamsatana*. It is caused by all the *doshās* jointly and is described as an incurable disease.

\[\text{Balāsa evāyamatunnatam cha}
\]
\[\text{Shopham karotyannagatim nivārya II}
\]
\[\text{Tam sarvathaivāprativāravyam}
\]
\[\text{Vivarjaniyam valayam vadanti II53II}
\]

(Sushruta Samhita, Nidanasthana, Chapter XVI, p. 111)
Kapha itself produces large and elevated swelling obstructing passage of food. It is known as valaya which is almost untreatable and as such should be rejected.

_Shopho mahānannajalāvarodhī_  
_Tivrājvaro vātagaternihantā_  
_Kaphena jāto rudhirānvitena_  
_Gale galaughaḥ pankitrtyateasau_ II60II  
_Yoa tipratāmyan shravṣiti prasakatam_  
_Bhinnasvarah shuskavimuktakanthah_ II  
_Kaphopadigdhesvanilayanesu_  
_neyah sa rogah shravanat svaraghnaḥ_ II61II

(Sushruta Samhita, Nidanasthana, Chapter XVI, p. 113)

Severe inflammation obstructing intake of food and drinks with high fever and dyspnoea and caused by kapha associated with rakta is known as galaugha. One who pants continuously feeling darkness, with hoarseness of voice, dry and inactive throat and air passage being obstructed with mucus should be diagnosed as suffering from svarghna caused by vāta. Both these diseases are included in the list of incurable diseases by Sushruta.

(F) Cancer of thyroid: The cancer of thyroid seems to be mixed up in the description of goiters in “Sushruta Samhita”.

_Nibadah shvayathuryasya muskavallambate gale_ II  
_Mahān vā tadi vā hrāsvo galaganḍam tamādisheṭ_ II29II

(Sushruta Samhita, Nidanasthana, Chapter XI, p. 78)

The swollen mass, large or small, which hangs down like scrotum in neck is known as galaganda (goitre).

The following clinical description of an advanced case of cancer of thyroid in “Sushruta Samhita” is very striking.
The patients of galaganda who inspires with difficulty, has all the body parts flaccid, has crossed one year, is afflicted with anorexia, wasting and hoarseness of voice. The physicians should give up these goiter patients.

(G) **Cancer of penis:** The chapter XIX of “Sushruta Samhita” deals with the treatment of Vṛddhi (scrotal enlargement), upadamsa (soft chancre) and slipada (elephantiasis).

In the disease caused by all doshas, symptoms of all appear along with necrosis of penis and emergence of organisms leading to death. The treatment of this condition is mentioned in Chikitsasthana of “Sushruta Samhita”.

It is mentioned that the measures as prescribed for vitiated wounds should be employed; the slounged portion of penis should be excised and the remaining should be cauterised with red hot jambavaustha (a stony wick);
after it is cauterised well, honey and ghee (clarified butter) should be applied and when cleansed, healing paste and oil should be used.

2.4.1.3 **Treatment of cancer:** The different modes of treatment of cancer such as surgery (chapter VIII), application of caustic alkali (chapter XI) and cauterisation (chapter XII) are discussed in Sutrasthana of “Sushruta Samhita”.

\[ Kṣārdagnirgarāyān kriyāsu vyākhyaṭaḥ, \\
Taddagdhanāṃ rogānāmapunarbhāvādebhasajashastrak-
śārairasādhyānāṃ Tatsādhyatvāchcha II3II \\
\]

(Sushruta Samhita, Sutrasthana, Chapter XII, p. 124)

The cauterisation is described as more important than application of caustic alkali in operations because of non-recurrence of diseases burnt therewith and its success in diseases incurable by drugs, instruments and caustic alkali.

\[ Tatra valaya-bindu-vileksā-pratisāranānīti dahanavishesāḥ II19II \\
\]

(Sushruta Samhita, Sutrasthana, Chapter XII, p. 127)

There are a number of ways by which cauterisation can be applied. These include circular, pointed, variously linear and flat ways.

\[ Rogasya sansthānamavekṣhya samyannarasya \\
Marmāṇi balābalam cha II \\
Vyāḍhim tathartum cha samikshya samyak \\
Tato adhyasyedibḥṣagnikarma II12II \\
\]

(Sushruta Samhita, Sutrasthana, Chapter XII, p. 127)

It is also mentioned that the physician should perform cauterisation after considering well the shape and size of the lesion, vital spots and strength or otherwise of the patient, disorder and season.
In proper burning, the part should be anointed with honey and ghee. The application of honey and ghee is meant for pacification of rakta-pitta vitiated by cauterisation and also for alleviation of pain.

The XI chapter of “Sushruta Samhita” also deals with the treatment of granthi (cyst), apaci (scrofula), arbuda (tumour) galaganda (goitre).

In vatika tumour, hot poultice of the powders of the seeds of karkārūka (Cucurbita maxima), ervārūka (Cucumis utilissimus), narikela (Cocos nucifera), priyāla (Buchanania latifolia) and eranda (Ricinus communis) cooked with milk, ghee and water, and mixed with oil should be applied; besides, poultice should be applied with cooked meat and vesavāra (leguminous grain). The expert physician should administer sudation with tube and also perform blood-letting with horn frequently; or oil cooked hundred times with decoction of vāta-alleviating drug, milk and sour gruel should be taken or three (ghee, oil and fat) processed in the same way should be used.
In *paittika* tumour, mild fomentation and poultices should be applied and also purgative drugs; after rubbing the part with leaves of *udumbara* (*Ficus racemosa*), *sākā* (*Verbenaceae*) and *goji* (*Lycium barbarum*), the paste of finely powdered *sarjarasa*, *priyangu* (*Aglaia odoratissima*), *pattanga* (*Caesaipinia sappan*), *rodhra* (sweetleaf, sapphire berry), *anjana* (black and white kohl) and *madhuyasti* (*Glycyrrhiza glabra*) mixed with honey should be applied after blood-letting; the paste of *aragavadha* (*Buchanania lanzan*), *goji*, *soma* (*Vernonia anthelmintica*) and *syama* (*Aglaia odoratissima*) should be applied. Ghee cooked with juices of *syāmā*, *girikarnikā* (*Clitoria ternatea*), *anjanaki* (*Strychnos colubrina*), *drāksā* (*Vitis vinifera*) and *saptalikā* along with the paste of *yastimadhu* should by one suffering from *paittika* tumour and undararoga.

Mild fomentation - with liquid; mild poultice - prepared with mild drugs such as *kākolyadi* group pounded with mild and sour gruel and not very hot.

_Sushruta Samhita, Chikitsasthana, Chapter XVIII, p. 442-443_
In Kaphaja tumour, the patient should be evacuated (with emesis) first followed by blood-letting. Then the paste of drugs which eliminate impurities from both upward and downward passages should be applied. It should be pasted with bhasma (ash) of bell-metal, suka (parrot), kalihari (Gloriosa superba) and kākādani (Abrus precatorius) mixed with excreta of pigeon and dove and also with urine; or urine mixed with alkali should be applied as paste.

Nispāvapinyākakulathaḥalkair-māsapragāthairadhimastuyukataih
Lepam vidadhyāt krimayo yatātra
Mūṛchhanita mushrachntyatha maksikāshrach II37II
Alpāvahiste krimibhaksīte cha
Likhettoagnim vidadhīta pashrāchat II
Yadalpamulam traputamrasīsa-pattaiḥ samavestrya tadāyasainvā II38II
Ksārāgnihastraṇyasakridvidadhhyāt
Prāṇānahinsan bhisagapramattaḥ II
Āsphotajāṭikaravirapatraiḥ
Kaṣāyamistam vraṇashodhanārtham II39II
Shuddhe cha tailam vidadhīta bhārgī-vidngapāṭiphitāvīpakvam II
Yadrichchhayā chopagatāni pākam
Pākakramenopacharedvidhijnāh II40II

(Sushruta Samhita, Chikitsasthana, Chapter XVIII, p. 444)

The paste of nispāvā, oil-cake and horse gram added with plenty of meat and curd-water should be applied so that organisms grow therein while flies leave away. When it is eaten away by organisms remaining a little, it should be scraped and then cauterised. Whatever is left with small base, should be covered with sheets of tin, copper and lead or iron and then the careful surgeon should apply frequently caustic alkali, cautery and sharp instrument without affecting the patient’s life. For cleaning, decoction of the leaves of āsphota (Calotropis gigantea), jāti (Jasminum officinale) and
karavira (Neirum indicum) is useful. When cleansed oil cooked with bhārgi (Premna integrifolia), vidanga (Embelia ribes), pāthā (Menispermaceae) and triphalā (Emblica officinalis, Terminalia chebula and Terminalia bellerica) should be applied. If, by chance, they get suppurated, the expert should treat them with the measure prescribed for suppuration.

Medoarbudam svinnamato vidārya
Vishodhya sīvvedaratarkatamāshu II
Tato haridrāgrihadhūmarodhrapatangachūrnaih samanah shilalai II41II
Vranam pratigrahyā madhupragāthaṁ
Karanjatailam vidadhītā shudhe II
Sashesadosāṁ hi yoarbudāṁ
Karoli tasyāśu punarbhavanti II42II
Tasmādashesāṁ samudharettu
Hanuyuh sashesani yatha hi vahirvih II

(Sushruta Samhita, Chikitsasthana, Chapter XVIII, p. 444-445)

It is suggested that the tumour caused by fat (lipoma) should be fomented and then incised, cleansed and sutured quickly when blood is drained out, thereafter paste of the powders of haridrā (Curcuma longa), soot (Bengali equivalent for ginger), pattanga (Caesalpinia sappan), realgar (arsenic sulphide mineral) and orpiment mixed with plenty of honey be applied to the wound; when cleansed, karanja-taila (Pongamia pinnata) should be applied. If affected portion of tumours remain, they should be eliminated completely as with remnants kills the patient like fire.

It is clear that Sushruta considered surgical excision to be the best treatment in case of cancer However, he was also aware of the recurrences in case of incomplete removal which holds true even today.

The reference of term arbuda comes in different texts of ayurvedic system of medicine (Table 2.1).
Table 2.1: *Arbuda* in different texts of ayurvedic system of medicine

<table>
<thead>
<tr>
<th>Name of text</th>
<th>Chapter</th>
<th>Chapter Number</th>
<th>Sloka No.</th>
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<td>6</td>
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<td>Sharirsthana</td>
<td>6</td>
<td>18</td>
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<tr>
<td>Uttarsthana</td>
<td>17</td>
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<td>10</td>
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<td>45</td>
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<tr>
<td>Uttarsthana</td>
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<td>Chikitsasthana</td>
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<td>87</td>
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<td>Sutrasthana</td>
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<td>9</td>
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<tr>
<td></td>
<td></td>
<td>42</td>
<td>10 (1)</td>
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Source: Prabhakar, 2004 (modified form)

2.4.2 Greek and Roman texts

The ancient Greeks were the first to recognise cancer as a distinct disease. The Greek literary sources provide considerable information on the existence of various malignant tumours in the classical periods.

2.4.2.1 Hippocrates (460-370 BC): Hippocrates of Cos is believed to be the first Greek physician to devote special attention to the treatment of cancer. There are about eleven separate sections in the Hippocratic corpus of varying length, in which inferences are made as to the pathogenesis and the
treatment of the disease. It was in the time of Hippocrates, around 400 BC that a word for cancer first appeared in the medical literature i.e., karkinos, Greek word for 'crab'. Hippocrates’ karkinos were mostly large, superficial tumours that were easily visible to the eyes such as cancers of the breast, skin, jaw, neck and tongue. The Greeks had no microscopes and never imagined an entity called as cell. The human body, as Hippocrates proposed, is composed of four cardinal fluids called humours: blood, black bile, yellow bile and phlegm. Each of these fluids has a specific colour, viscosity and essential character. In the normal body, these four fluids are in perfect and in case of illness, this balance is upset by the excess of one fluid. Another Greek word – onkos, a word used occasionally to describe tumours, from which the discipline of oncology got its modern name. Onkos, is a Greek term for a mass or a load, or more commonly a burden. Cancer is imagined by him as a burden carried by the body. The other terms like Cacoethes referring to early stages of cancer also emerged.

In his sprawling “Histories”, written around 440 BC, the Greek historian Herodotus cited the case the Persian Queen Atossa, daughter of Cyrus and wife of Darius, who had a breast tumour and described how she was cured by democedes of Croton (Karpozilos and Pavlidi, 2004). Atossa was described to isolate herself in a self-imposed quarantine. Darius’ doctors tried to treat her but she refused. At last, a Greek slave named Democedes persuaded her to allow him to excise the tumour and she survived (Mukherjee, 2011). Hippocrates also described the case history of a woman of Abdere who had a carcinoma of the breast with bloody discharge from her nipple. He associated the cessation of menstrual bleeding with breast cancer and sought to restore menstruation in the young sufferers. He mentioned that tumours appear in the breast become increasingly firm, contain no pus, and spread to other parts of the body. As the disease progresses, the patient develop bitter taste, refuses food, develops pain that shoots from the breast to the neck and shoulder blades, complains of thirst, and becomes emanciated. He added, from this point, the death is certain and he advised no treatment for the hidden breast cancers (Donegan, 2002).
2.4.2.2 Treatment in post-Hippocratic period (1-3rd Century AD): The other Greek scholar who worked on cancer and its treatment include Soranos of Ephesos, physician and prominent gynaecologist, who taught in Rome and Alexandria under Trajan and Hadrian (98-138 AD). Soranos had classified the various types of tumours under categories, distinguishing them according to their susceptibility to cures. In his books, he included a discussion of operable and non-operable tumours (Karpozilos and Pavlidis, 2004). Pedanius Dioscurides of Anazarbus (65 AD) in his “De Material Medica” described about 600 plants and 100 animals, and mineral drugs in about 100 recipes. Some of his remedies refer specifically to the treatment of cancer and were extracted from various plants, such as chickpea (*Cicer arietinum*), added-wort (*Arum drancunculus*), stinging-nettle, brownwort (*Scrofularia peregrina*). He also prescribed herbal drugs derived from terebinth oil and frankincense, while for the treatment of hidden carcinoma and indurations, he proposed a plaster based on hedge-mustard mixed with honey. Another plaster for cancerous growth is based on a mixture made of the ash of crabs boiled in honey. Alexander of Aphrodisias, who lived about the 3rd century AD, described that breast cancer occurs due to accumulation of black bile. He further described that the cancer which the bile creates in the breast is corrosive, whereas in led it produces malignant sores. Furthermore, the round ulcers are hard to cure because of the bile they gather.

Around 30 AD, the Roman physician Aulus Cornelius Celsus noted that the breasts of women are a frequent site of cancer. In his manuscript “De Medicina”, he described breast cancer in four stages. The first is cacoethes, followed by carcinoma without skin ulceration, carcinoma with ulceration, and finally thymium, an advanced exophytic and sometimes bleeding lesion, the appearance of which suggested to him the flowers of thyme. Celsus recommended excision for the cacoethes but no treatment for other stages. In the situations of uncertainty, he preferred the treatment first with the caustics, and if the symptoms improved, it was a cacoethes; if they worsened, it was a carcinoma (Donegan, 2002). According to Celsus’s classical description, cancer is characterised by pain, redness, heat and swelling. Cato the Elder (234-149 BC), the proposed cabbage as a panacea for illnesses, claimed that
a cabbage poultice can heal all kinds of ulcers and swellings, and in particular a carcinoma of the breast.

In the same period, Archigenes of Apameia and Leonides of Alexandria wrote important treatises on the treatment of cancer of which only a few excerpts survive in the medical encyclopaedia of Aetios of Amida. The Syrian surgeon Archigenes wrote profusely about cancer of both breast and uterus around 125 AD (Benedek and Kiple, 1993). He distinguished between two types of malignant cancers: the ulcerated, black or livid in colour and the hidden ones. The Alexandrian surgeon Leonides not only recognised but incised and cauterised malignant breast lesions. According to him, the affected part is first removed, then the healthy tissue is cauterised until the bleeding has stopped altogether. The patient is then brought to a warm place because the cold could hinder the recuperation. The plaster is applied to the wound made from plantain (Plantago major) or from knot-grass (Polygonum aviculare) or even the sesame plant. After the removal of the bandage, the wound is cleansed with warm water and a new plaster is applied over it made from boiled lentils mixed with honey. The plaster is covered from the outside with vine leaves or with lettuce and this procedure is continued until the scabs falls off. At this point, only mild remedies are applied on the wound such as ass or women's milk mixed with rose oil, king's clover combined with the same ingredients, or with cadmean earth and the like (Karpozilos and Pavlidis, 2004).

2.4.2.3 Galen of Pergamon (129-201 AD): The physician Claudius Galen, a prolific writer and a Greek doctor, who practiced among the Romans around 160 AD brought Hippocrates' humoral theory to its apogee. Galen made his observations on cancer, publishing his principles on anatomy, physiology, and pathology in voluminous works. He attributed cancer causation to black bile. He suggested the cancer lesion represent a coagulum of black bile. He proposed that cancer is 'trapped' black bile - the static bile unable to escape from a site and thus, congealed into the matted mass. The Galenic theory suggested that cancer is a result of internal overdose of black bile (Benedek
There are few other scholars who made significant contributions to the understanding of cancer. Soranus (2nd century AD) quotes Herophilus (3rd century BC) stating that abscesses and tumours in the pelvis may obstruct labour. Dioscorides (1st century AD) and Aegina (7th century) were the other physicians who contributed to the understanding of cancer through their writings.

### 2.4.3 Unani Texts

In Unani texts, the term sartan meaning crab is used to describe cancer. The knowledge of sartan in the Unani (Greco-Arabian) systems of medicine can be traced to ancient times (131-200 AD). The Unani system of medicine employs drugs which are of mineral origin (Table 2.3), animal origin (Tables 2.4a and 2.4b) or plant origin (Tables 2.5a, 2.5b and 2.5c).

<table>
<thead>
<tr>
<th>Unani name</th>
<th>English equivalent/Composition</th>
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<tbody>
<tr>
<td>Geru</td>
<td>Red earth</td>
</tr>
<tr>
<td>Gil-i-Armani*</td>
<td>Armonian bole (silicate of alumina)</td>
</tr>
<tr>
<td>Gil-i-Makhtoom*</td>
<td>A kind of red coloured earth</td>
</tr>
<tr>
<td>Gil-i-Romi*</td>
<td>A kind of clay</td>
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<tr>
<td>Murdar Sang</td>
<td>Lead oxide</td>
</tr>
<tr>
<td>Philkari</td>
<td>Alum</td>
</tr>
<tr>
<td>Qalai</td>
<td>Tin</td>
</tr>
<tr>
<td>Safaida Jast</td>
<td>Zinc oxide</td>
</tr>
<tr>
<td>Sammulfar Sufaid</td>
<td>Arsenic (white variety)</td>
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<tr>
<td>Seemab</td>
<td>Mercury</td>
</tr>
<tr>
<td>Seesa Ka Safaid</td>
<td>Lead carbonate</td>
</tr>
<tr>
<td>Shangaraf</td>
<td>A compound of mercury and sulphur</td>
</tr>
<tr>
<td>Sindur</td>
<td>Lead peroxide (red)</td>
</tr>
<tr>
<td>Sirka</td>
<td>Acetic acid</td>
</tr>
<tr>
<td>Sufaida*</td>
<td>Zinc oxide</td>
</tr>
<tr>
<td>Tootiya-i-Maqsool</td>
<td>Washed ferrous sulphate</td>
</tr>
<tr>
<td>Tootiya*</td>
<td>Copper sulphate (blue and green* varieties)</td>
</tr>
<tr>
<td>Zangar</td>
<td>Copper sub-acetate</td>
</tr>
</tbody>
</table>

Source: Aslam et al., 1981
Most of the mineral based drugs are used externally except for those marked with (*) which are also used orally.

Like all other diseases its etiology has been attributed to the combustion and imbalance of certain humours in the body. This system of medicine believes in the perfect balance of four humors viz: (a) *Khoon* (blood); (b) *Balgham* (phlegm); (c) *Safra* (bile); and (d) *Sauda* (melano or black bile). Of these, blood does not figure in the causation of cancer. The imbalance and combustion of *balgham*, *safra* and *sauda* is believed to cause cancer (Aslam et al., 1981). The treatment described in Unani text includes drugs and surgical measures. The drugs in Unani system are used to keep the cancer in a dormant stage, to check its further growth, to dissolve it and finally to eradicate it.

### Table 2.4a: Animal origin drugs used for treatment of cancer (administered externally)

<table>
<thead>
<tr>
<th>Unani name (English equivalent)</th>
<th>Scientific name</th>
<th>Part used</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Bail</em> (ox)</td>
<td><em>Bos taurus</em></td>
<td>Fat</td>
</tr>
<tr>
<td><em>Baraseenga</em> (antelope)</td>
<td><em>Cervus ducacuceli</em></td>
<td>Ash of horns</td>
</tr>
<tr>
<td><em>Batak</em> (duck)</td>
<td><em>Anseres</em>, many species</td>
<td>Ash of feathers</td>
</tr>
<tr>
<td><em>Cheel</em> (pariah kite)</td>
<td><em>Milvus migrans</em></td>
<td>Ash of feathers</td>
</tr>
<tr>
<td><em>Chhachhooonder</em> (mole/shrew)</td>
<td><em>Talpa micrura</em></td>
<td>Flesh</td>
</tr>
<tr>
<td><em>Chhipkali</em> (house lizard)</td>
<td><em>Gecko verticillatus</em></td>
<td>Lizard burnt in rape oil</td>
</tr>
<tr>
<td><em>Chooha</em> (rat/mouse)</td>
<td><em>Mus rattus</em></td>
<td>Warm flesh</td>
</tr>
<tr>
<td><em>Gai</em> (cow)</td>
<td><em>Bos taurus</em></td>
<td>Excreta with vinegar</td>
</tr>
<tr>
<td><em>Kacchua</em> (tortoise)</td>
<td><em>Tetudo elegans</em></td>
<td>Ash of eviscerated animal</td>
</tr>
<tr>
<td><em>Kekra/Sartan</em> (crab)</td>
<td><em>Scilla serrata</em></td>
<td>Ash of whole organism</td>
</tr>
<tr>
<td><em>Kutta</em> (dog)</td>
<td><em>Canis familiaris</em></td>
<td>Fat</td>
</tr>
<tr>
<td><em>Saap</em> (snake)</td>
<td>-</td>
<td>Live black snake ash in an earthen pot and mixed with olive oil</td>
</tr>
<tr>
<td><em>Sri bhagga</em> (an insect resembling a crab, found in moist sand near ponds and canals)</td>
<td>-</td>
<td>Whole insect burnt in oil</td>
</tr>
</tbody>
</table>

Source: Aslam et al., 1981
Table 2.4b: Animal origin drugs used for treatment of cancer (administered orally)

<table>
<thead>
<tr>
<th>Unani name (English equivalent)</th>
<th>Scientific name</th>
<th>Part used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Khargosh (rabbit)</td>
<td>Oryctolagus cuniculus</td>
<td>Ash of bones</td>
</tr>
<tr>
<td>Moonga (coral)</td>
<td>Corallium rubrum</td>
<td>Powder</td>
</tr>
<tr>
<td>Sehi (Indian porcupine)</td>
<td>Hysterix indica</td>
<td>Flesh</td>
</tr>
</tbody>
</table>

Source: Aslam et al., 1981

Table 2.5a: Plant origin drugs used for treatment of cancer (administered orally)

<table>
<thead>
<tr>
<th>Unani name</th>
<th>Botanical name</th>
<th>Part used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aftimoon</td>
<td>Cuscuta reflexa</td>
<td>Whole plant</td>
</tr>
<tr>
<td>Anjbar</td>
<td>Polygonum viviparum</td>
<td>Bark</td>
</tr>
<tr>
<td>Banslochan</td>
<td>Bambusa arundinacea</td>
<td>Gum</td>
</tr>
<tr>
<td>Bartang</td>
<td>Plantago major</td>
<td>Juice of seeds</td>
</tr>
<tr>
<td>Elva</td>
<td>Aloe barbadensis</td>
<td>Resin</td>
</tr>
<tr>
<td>Franjmushk</td>
<td>Ocimum gratissimum</td>
<td>Seeds</td>
</tr>
<tr>
<td>Gari Qoon</td>
<td>Polyborus officinalis</td>
<td>Whole plant</td>
</tr>
<tr>
<td>Habul-Neel</td>
<td>Ipomoea hederacea</td>
<td>Seeds</td>
</tr>
<tr>
<td>Hanzal</td>
<td>Citrullus colocynthsis</td>
<td>Seeds</td>
</tr>
<tr>
<td>Kateera</td>
<td>Cocholeospermum religiosum</td>
<td>Gum</td>
</tr>
<tr>
<td>Khashkhas</td>
<td>Papaver somniferum</td>
<td>Seeds</td>
</tr>
<tr>
<td>Nibu</td>
<td>Citrus limon</td>
<td>Fruit</td>
</tr>
<tr>
<td>Nilofer</td>
<td>Nymphaea alba</td>
<td>Flower</td>
</tr>
<tr>
<td>Odas</td>
<td>Lens culinaris</td>
<td>Flower</td>
</tr>
<tr>
<td>Saqmonia</td>
<td>Convovulus scammonia</td>
<td>Root</td>
</tr>
<tr>
<td>Soeti</td>
<td>Chrysanthemum coronarium</td>
<td>Flower</td>
</tr>
<tr>
<td>Tezpat</td>
<td>Cinnamomum cassia</td>
<td>Leaves</td>
</tr>
<tr>
<td>Zafran</td>
<td>Crocus sativus</td>
<td>Stigma</td>
</tr>
</tbody>
</table>

Source: Aslam et al., 1981
Table 2.5b: Plant origin drugs used for treatment of cancer  
(administered externally)

<table>
<thead>
<tr>
<th>Unani name</th>
<th>Botanical name</th>
<th>Part used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afsantin</td>
<td>Artemisia absinthium</td>
<td>Whole plant</td>
</tr>
<tr>
<td>Alsi</td>
<td>Linum usitatissimum</td>
<td>Seeds</td>
</tr>
<tr>
<td>Amla</td>
<td>Emblica officinalis</td>
<td>Fruit</td>
</tr>
<tr>
<td>Anar</td>
<td>Punica granatum</td>
<td>Bark</td>
</tr>
<tr>
<td>Anjeer</td>
<td>Ficus carica</td>
<td>Fruit</td>
</tr>
<tr>
<td>Ashaq</td>
<td>Dorema ammoniacum</td>
<td>Resin</td>
</tr>
<tr>
<td>Azkhar</td>
<td>Cymbopogon jwarancusa</td>
<td>Leaves, flowers</td>
</tr>
<tr>
<td>Babul</td>
<td>Acacia arabica</td>
<td>Gum</td>
</tr>
<tr>
<td>Badam talkh</td>
<td>Prunus amyglalus batsch</td>
<td>Fruit</td>
</tr>
<tr>
<td>Badranboya</td>
<td>Nepeta hindostana</td>
<td>Leaves</td>
</tr>
<tr>
<td>Behi</td>
<td>Cydonia vulgaris</td>
<td>Leaves</td>
</tr>
<tr>
<td>Chameli</td>
<td>Jasminium officinale</td>
<td>Oil</td>
</tr>
<tr>
<td>Chaulai såg</td>
<td>Amaranthus mangostanus</td>
<td>Leaves</td>
</tr>
<tr>
<td>Gandha behroza</td>
<td>Ferula galbaniflua</td>
<td>Resin</td>
</tr>
<tr>
<td>Guggul</td>
<td>Balsamodendron mukul</td>
<td>Gum</td>
</tr>
<tr>
<td>Gul-e-Surkh</td>
<td>Rosa damascena</td>
<td>Flower</td>
</tr>
<tr>
<td>Jao</td>
<td>Hordeum vulgare</td>
<td>Fruit</td>
</tr>
<tr>
<td>Kahu</td>
<td>Cucurbita maxima</td>
<td>Juice of fruit</td>
</tr>
<tr>
<td>Karamkalla</td>
<td>Brassia oleracea</td>
<td>Fruit</td>
</tr>
<tr>
<td>Kashnneez</td>
<td>Coriandrum sativum</td>
<td>Leaves</td>
</tr>
<tr>
<td>Kathha</td>
<td>Acacia cetechu</td>
<td>Bark</td>
</tr>
<tr>
<td>Khatmi</td>
<td>Althaea officinalis</td>
<td>Seed, flower, fruit</td>
</tr>
<tr>
<td>Khiaren</td>
<td>Cucumis melo</td>
<td>Juice of fruit</td>
</tr>
<tr>
<td>Khubazi</td>
<td>Malva rotundifolia</td>
<td>Fruit</td>
</tr>
<tr>
<td>Khurfa</td>
<td>Portulaca oleracea</td>
<td>Seeds, leaves</td>
</tr>
<tr>
<td>Kunder</td>
<td>Boswellia glabra</td>
<td>Gum</td>
</tr>
<tr>
<td>Luban</td>
<td>Boswellia serrata</td>
<td>Gum, resin</td>
</tr>
<tr>
<td>Mirch siah</td>
<td>Piper nigrum</td>
<td>Leaves</td>
</tr>
<tr>
<td>Murmakkki</td>
<td>Balsamodendron myrrha</td>
<td>Gum, resin</td>
</tr>
<tr>
<td>Sadabahar</td>
<td>Catharanthas roseus</td>
<td>Leaves</td>
</tr>
<tr>
<td>Shabit</td>
<td>Anethum sowa</td>
<td>Leaves</td>
</tr>
<tr>
<td>Til or Kunjad</td>
<td>Sesamum indicum</td>
<td>Seeds</td>
</tr>
<tr>
<td>Tukhm supandan</td>
<td>Peganum harmala</td>
<td>Seeds</td>
</tr>
<tr>
<td>Zaitoon</td>
<td>Olea europaea</td>
<td>Oil</td>
</tr>
<tr>
<td>Zaravand</td>
<td>Aristolochia indica</td>
<td>Root</td>
</tr>
<tr>
<td>Zift</td>
<td>Pinus gerardiana</td>
<td>Resin</td>
</tr>
</tbody>
</table>

Source: Aslam et al., 1981
Table 2.5c: Plant origin drugs used for treatment of cancer
(administered both externally and orally)

<table>
<thead>
<tr>
<th>Unani name</th>
<th>Botanical name</th>
<th>Part used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isabgol</td>
<td>Plantago ovata</td>
<td>Seeds husk</td>
</tr>
<tr>
<td>Mulethi</td>
<td>Glycyrrhiza glabra</td>
<td>Root</td>
</tr>
<tr>
<td>Ustukhuddus</td>
<td>Lavandula stoechas</td>
<td>Seeds</td>
</tr>
</tbody>
</table>

Source: Aslam et al., 1981

The most frequently occurring 9 ingredients in the Unani drugs are mom (wax), murdar sang (lead oxide), Gil-i-Armani (silicate of alumina), neela tootiya (copper sulphate), Roghan-i-Gul (Rosa damascena), Roghan-i-Zaitoon (Olea europaea), gandha behroza (Ferula galbaniflua), ashaq (Dorema ammoniacum) and zift (Pinus gerardiana). In Unani text, besides drug therapy, the measures such as an easily digestible but energy giving diet, purgatives, believed to remove the humour which is in excess and thus restore the balance, hot baths which may be medicated, surgical excision of tumour, cautery and venesection are recommended in cancer cases (Aslam et al., 1981).

2.4.4 Egyptian texts

The other oldest known written description indicating that cancer afflicted our early ancestors is found in seven Papyri dated around 1600 BC in which Edwin Smith Papyrus described tumour of the breast and surgery for the removal of same in which cancerous tissue is cauterised or burned in order to destroy. It is believed to be the first reference to the breast cancer. The Edwin Smith Papyrus is believed to contain the first reference to breast cancer. This surgical text, penned in hieratic script, is the incomplete and fragmented copy of an original document that probably dates back to the pyramid age of Egypt (3000-2500 AD) and was possibly written by Imhotep, the physician-architect who practiced medicine and designed the step pyramid in Egypt in 30th century BC (Donegan, 2002). It describes eight cases of tumours or ulcers of the breast. The document acknowledges that there is no treatment for the breast cancer if the tumour spreads over the breast, is
cool to touch and bulging. In such condition, cauterisation (the fire drill) is recommended as a palliative measure (Bozzone, 2009). Similarly, the George Ebers Papyrus mentioned tumours of the God Chonsu, the description of which is consistent with a diagnosis of osteolytic lesions of metastatic cancer, multiple myeloma and malignant lymphoma. He also outlined pharmaceutical, mechanical and magical treatments for cancer. During the Sumerian period (around 3000 BC) in Mesopotamia, Chaldean (Akkadian) cuneiform in cantations contained words and phrases that suggested the presence of cancer.

2.4.5 Other texts

The 9th century Arabic physician Rhazes (850-932 AD) warned that operating breast cancer not only makes it worse unless excision is complete and accompanied by cautery. In Bible, Titus is said to have experienced headaches for seven years after he destroyed a temple in Jerusalem. At autopsy, a tumour was found in his brain. Similarly, king Jehoram is said to have died two years after suffering from a bowel disease with symptoms consistent with colorectal cancer (Tu, 2010).

The other scholars who wrote profusely about cancer include Avicenna (980-1037 AD), the Jewish physician Maimonides (1135-1204 AD) and Albucasis (936-1013 AD). Avicenna borrowed his ideas from Galen and did not offer any new insights to the understanding of the disease. Albucasis in Spain favoured the cautery and caustic applications for the treatment of breast cancer but admitted that he had never cured any cases of cancer himself (Lyons and Petrucelli, 1978). Henri de Mondeville (1260-1320 AD), surgeon to the king of France, refined the Galen’s black bile theory with a distinction between black bile from the liver, which caused a hard tumour in the breast (a sclerosis), and twice combusted black bile from breakdown of the other three body humours, which caused a true cancer. He described true breast cancer as an ulcerated cancer with thick margins and having an offensive odour (Yalom, 1997).
The Byzantine physicians of the Emperor Julian, made the Galenic writings available to the ordinary practitioners, and as a result, Greek medicine spread throughout Syria and was carried by the Nestorians into Persia, where it became available to the Islamic World (El-Gammal, 1998).

In this chapter, the palaeopathological evidences regarding cancer from both the skeletal remains and mummified remains are discussed. The description of cancer in various ancient texts such as Indian, Greek and Roman, Unani, Egyptian, and other texts are also discussed in detail.