

# **TECHNOLOGICAL ADVANCES IN SURGICAL MANAGEMENT OF CANCER RELEVANCE TO INDIAN SCENARIO**

**R. K. Karwasara and Sanjeev Prashad**

## **Introduction**

Surgery has been the oldest mode to treat cancer. Earliest discussions on the surgical treatment of tumors are found in the Edwin Smith papyrus from Egyptian Middle Kingdom (Circa 1600 BC). Elective surgery for cancer in modern day practice started when Ephrain Macdowell removed a 22-pound ovarian tumor in 1809. William Halsted elucidated the principals of enbloc resection for cancer in 1890's. Concept of orderly spread of cancer lead to wide excision of tumors, which was aimed at achieving the cure by eradicating all the diseased tissue. However cancer surgery during this era had limitations of high mortality, high morbidity and low cure rate and therefore the research continued for alternative non-surgical techniques for treatment of cancer.

The last century saw the advent of Radiotherapy in the beginning and discovery of chemotherapy after Second World War but even these modalities could not replace the role of surgery in cancer management. Almost all patients undergo some or other form of surgical intervention, which include diagnostic procedures, radical resections, reconstructions and palliative procedures. Due to technological advances in all these areas the cancer surgery has now become less morbid & gives high cure rates with minimal mortality.

## **Advances in diagnostic tools**

Surgeon is primarily responsible for the diagnosis and staging of cancer, which was, in the past, based mainly on clinical examination. Delay in diagnosis of cancer leading ultimately to treatment in late stage of disease giving poor results was the problem. Due to technological advances surgeons now have access to various diagnostic tools like sonography, mammography, CT, MRI, Endoscopy,

ERCP, Nuclear medicine and tumor markers etc. which helps in diagnosis of cancer in early stage.

Mammography is a newer X-ray technique to diagnose the breast cancer even in pre-clinical stage and therefore useful for cancer screening. Ultrasonography (USG) was devised in the 7th decade and now it is freely available even in developing countries. It is so commonly used by the surgeons that they call it surgical stethoscope. USG is a non-invasive and non-hazardous technique, which is very useful to detect abdominal tumors. Intracavitary probes (transrectal/transvaginal and transoesophageal) have now made it possible to stage accurately even the deep-seated tumors. This can also be used intra-operatively to demonstrate the tumor.

CT scan has revolutionized the surgical management of tumors located in body cavities i.e. skull, thorax and abdomen. It was a boon to the brain tumors for which no other diagnostic tool was available. Surgeons can now diagnose and stage the tumors accurately and plan the therapy accordingly. CT continues to evolve with spiral (Helical CT) multiphase imaging and multi-detector scanning being the notable recent innovations. Newer techniques centered on three dimensional (3D) and virtual CT imaging are being refined. Real time 3D imaging may move it from a diagnostic to a therapeutic modality.

Magnetic resonance imaging (MRI) is based on the effect of large magnetic fields on the spinning motion of certain nuclei within biologic tissues. MRI has excellent imaging qualities for bone and soft tissue tumors where CT has limitations. It is also very useful and superior to the CT scan for brain and other neurological tumors. Functional imaging using a positron emission tomography (PET) and magnetic resonance spectroscopy (MRS) is now used in clinical practice. Optical coherence tomography (OCT) is already being applied to microsurgery and cervical cancer.

Radionuclide imaging is promising newer technology which offers great help in tumor localisation e.g. MIBG scan for localisation of pheochromocytoma. Various radiolabelled colloids are used for localisation of sentinel nodes, follow-up of patients and even cure of certain tumors.

Tumors of hollow viscera can be directly visualized and accessed by endoscopy. Rigid endoscopes were available in the past but discovery of fibreoptics revolutionised the field of endoscopy. Today we can view almost any hollow viscera by endoscopy for taking biopsy & instituting therapy.

Needle cytology / biopsy has now replaced the need for open biopsy in almost all the tumors. Fine needle aspiration cytology (FNAC) is simple and quick way to confirm the diagnosis of cancer. The use of enzyme histochemistry, immuno histochemistry & and electron microscopy are helpful in correct histopathological diagnosis, while tumor markers are useful for diagnosis & follow up of patients.

### **Advances in Techniques of Tumor Resection**

Conventionally Oncosurgical resections are done with a knife. Loss of blood and poor delineation of the planes are the problems of this technique. Development of electrocautry brought a revolution in the operative technique of tumors, which causes minimum blood loss, better delineation of tissue planes and reduction in operating time. Harmonic scalpel based on vibration technique is further advancement in tissue dissection and avoids the hazards of electricity. Development of Cavitron Ultrasonic Surgical Aspirator (CUSA) which can cut & aspirate simultaneously has allowed the surgeon to operate on delicate tissue like liver and brain with minimal blood loss, and this translates into clean and precise dissection, which decreases the operative mortality.

Mohs micrographic surgery is a new technique of surgically removing the malignant lesion taking small increments of tissue until entire tumor is removed. Each slice is subjected to frozen section and therefore there is least sacrifice of uninvolved tissue. This technique is effective for treating carcinomas around the eyelids, nose and on glans penis where wide excisions are not possible. Use of microscopes in cancer surgery enables tissue dissection in correct planes with preservation of important structures e.g. recurrent laryngeal nerve in carcinoma thyroid.

### **Advances in Reconstructive Techniques**

Traditionally reconstruction of the organs was done manually but development of surgical staplers during last few decades have

not only made the reconstruction more quick and safe but also prevent major morbidity. It is now possible to maintain normal bowel continuity after resection of rectal cancer by using the circular staplers and this avoids the need of permanent colostomy. Various prosthetic materials are now available for reconstruction of Breast, Jaw and other organs. Developments in micro-vascular techniques have allowed the use of free flaps for reconstruction of almost any part of the body. These reconstructions take care of cosmetic factors & hence help in better acceptability of the cancer surgery.

### **Advances in surgical Palliation**

Technological advances have also improved the palliative procedures for advanced cancer. Newer techniques of endoscopic stenting and laser coring of the tumor can bypass Luminal obstruction. Self-expanding metal stents have low procedural morbidity and mortality and remain patent for a longer period than plastic tubes. These provide effective palliation of malignant dysphagia, malignant esophageal perforation, tracheo- esophageal fistulae & malignant obstructive jaundice.

### **Advances in the Organ Conservation**

Over the last few decade it has been realised that there is no single modality, which can cure the cancer, and therefore multiple modalities have to be used. Surgery, Radiotherapy and Chemotherapy are now used as an adjuvant to each other for almost all the tumors. Before 1970's childhood rhabdomyosarcoma was treated only surgically and 5-year survival rates were 10-20 % whereas use of combination chemotherapy (VAC) and radiotherapy along with surgery now give long-term cure rates in the range of 80%. Present day consensus is on multimodality approach for management of cancer.

Radical & supra radical surgeries of Halsted's era have now been replaced by modified radical surgeries. With better understanding of tumor biology and advent of neo-adjuvant and adjuvant therapies attempts have been made to do a less extensive, cosmetically acceptable, functional and organ preserving surgery without compromising the end result. Understanding of the concept of sentinel node has further reduced the need of block dissections. The nuclear medicine device called gamma probe can search the sentinel node

and lymph node dissection is done only if the node is positive. This change in concept is largely responsible for decreasing the morbidity of surgical procedures. Computers & video assistance (Laparoscopic Surgery) have minimised the extent of tissue dissection needed for adequate exposure. Similarly laser beam (Co2 laser, Nd YAG Laser etc.) can be used through endoscopes for precise and remote surgery. Use of gamma knife & x- knife can obviate the need of conventional surgery for brain tumors.