The treatment of cancer is carried out with radiation therapy techniques whereas two types are available external beam radiotherapy and brachytherapy[30]. In the external beam radiation therapy, the dosimetric accuracy procedures are well established but in the HDR brachytherapy still there is scope of improvement in accurate dose delivery. The later technique is used where the localized dose delivery is possible and tumor volume is assessable. In the brachytherapy a small size sealed radioactive source such as Iridium-192 (Ir^{192}) is precisely placed either inside the tumor or very close to the tumor tissue which is to be irradiated. When a source is used for treatment in brachytherapy it follows the inverse square law by this property tumor volume received the dose maximum with dose minimal to nearby normal tissue. This rapid fall-off of dose feature of brachytherapy diminish radiation dose to healthy organs located away from source position. The source is positioned at the planned location whether the movement of the tumor occurs with catheter or applicator in place within the patient during treatment[21].

Endobronchial brachytherapy (EBBT) is useful in lung cancer patients with residual or recurrent disease as a salvage treatment whereas other treatment like chemotherapy, surgery and external beam radiotherapy were failed[10]. EBBT can be given as a definitive treatment after surgery of “non-small cell lung cancer” [NSCLC] for endobronchial metastasis[31]. In the condition where patient is not willing for surgery or stereotactic body irradiation therapy (SBRT) treatment then endobronchial HDR brachytherapy can be given safely for curative intent with excellent long-term outcome yield[32].

A remote afterloading brachytherapy unit is well established system which transfers a radioactive source accurately to the treatment position[22]. The dose calculation in treatment-planning-system at a point in high-dose-rate brachytherapy depends upon the “AAPM task Group 43 (TG-43U1)” which assumed homogeneous water medium around the source[33- 35].

In the treatment of carcinoma lung High dose rate brachytherapy is important treatment option. Measured Radiation dose value around the source showed that with rapid dose fall off property of the source, the gap increases between the source and measurement point result in decreases the dose. Transfer tube or catheter is used for safe movement of the source from shielding position in remote afterloading system to the treatment planned position within the patient in HDR brachytherapy[36].

Endobronchial brachytherapy is a treatment modality in carcinoma lung in between 50% to 100% response rate in symptoms relief reported[37, 38]. Bronchogenic carcinoma is treated with Endobronchial brachytherapy curatively either single or in association with external beam radiotherapy[39, 40].

“American Brachytherapy Society” (ABS) recommendation as guidelines is followed worldwide for the brachytherapy. According to the ABS guidelines for the palliative treatment in brachytherapy, the dose fractionation protocol is 7.5Gy per session with total 3 sessions, 10Gy per session with total 2 sessions and 6Gy per session with total 4 sessions used by a gap of one week in among the sessions[41].

Prescription dose for the treatment volume is done at 1cm distance from the source in EBBT [42].

Mucosa of the bronchial portion is one another method of dose prescription in the target by measuring trachea-bronchial airway[43]. In the tumor tissue mucosa layer, there is possibility of overdosing and under dosing on distal and proximal ends. The mucosa is chosen for dose prescription point and catheter gets in close contact with the mucosa then overdose risk arises at any point. As it is seen that the dosimetric detailed analysis on the plain radiograph is not possible therefore computed tomography (CT) gives the information about dosimetry in brachytherapy in some studies[27, 44].

Meigooni AS et al did a study to validate the assumption of uniform, homogeneous medium around the implanted source equivalent to water. They used the Monte Carlo (MC) method to calculate and measured the dose rate with cylindrical symmetry in heterogeneous and homogeneous medium for points along traverse axis of the Pd-103, I-125 and Am-241 brachytherapy sources. They made a solid water phantom of single source implant having a cylindrical shell of 1 or 2 cm thick replaced by a polystyrene shell for irradiation. They used CYLTRAN code of Monte Carlo integrated series. He found that the dose rate measured beyond the 2cm thick polystyrene heterogeneity was about 103%, 55% and 10% greater than homogeneous phantom made up of solid water for the Pd-103, I-125 and Am-241 sources respectively. This change in dose rate was observed higher by increasing heterogeneous size and decreasing energy. As per their study, formalism for dose calculation was developed to calculate the dose rate with cylindrical symmetry in heterogeneous phantom[45].

NP Patel et. al. did a study "to achieve dose uniformity for Intraluminal implants by assessment of dose distributions for single catheter generated by using various combinations of source stopping spacing and optimization mode." They used a HDR Ir-192 source in a straight single catheter of a set length to generate dose distribution for Intraluminal brachytherapy. They used 0.2, 0.5, 1.0, 1.4, 2.0, 2.5, 3.0 and 3.3 cm combination of spacing between the positions of source and mode of optimization.

Three optimization modes used to evaluate the distribution of dose to get dwell time in the catheter. Three parameters, doses to reference point's statistical analysis, ratio of dose non-uniformity and area underneath the natural DVH were used to assess the dose distributions. The result of the study showed that no combination of optimization mode and spacing between the source positions was capable to produce the dose distribution which was preferred. Though, comparatively they found better homogeneous distribution of dose for two sources spacing (i) short (0.2cm) and (ii) longer (1.5 to 2.0 cm) [46].

Nikoofar A et al. did study to determine the dose to OARs like parotids, eyes, thyroid gland, trachea, sub-mandibular, spinalcord, and sternum within an anthropomorphic phantom irradiated in HDR brachytherapy. Radiation doses to OAR's were measured in the anthropomorphic body phantom by the use of Thermoluminiscence dosimeters (TLDs). Target volume (TV) of around 23cm^3 was taken in thoracic cavity (upper side) and phantom was scanned in CT. After the planning, phantom was exposed to the HDR remote after-loading machine. The doses (in cGy) were measured with TLDs calibrated for the dose range. In the region greater than 16 cm from target, the dose measured was found in between the value 1.65cGy to 5.5cGy and at closer region lesser than 16 cm the dose was found high as 113cGy. So, the study showed in the closer region, surface dose and depth dose were changed because of high dose gradient and difference among planned and measured doses because of the tissue inhomogeneity[47].

Hiroyuki Okamoto et. al. did study to evaluate dosimetric influence of air passage on carcinoma of bronchus brachytherapy by TPS calculated and Monte Carlo simulation method. They analyzed patient CT data information that had gone for

Intraluminal brachytherapy (ILRT) HDR brachytherapy to check the air passage geometry. They developed a system of measurement which is capable to measure exterior dose with air cavity or without air cavity around catheter by ionization chamber. They modeled 5 (five) cavities of air with radii of 0.3cm, 0.5cm, 0.75cm, 1.25cm and 1.5cm by cylindrical tubes around the catheter. Dosimetric effect of the air-cavity was estimated by GEANT4 Monte Carlo (MC) code method. Measured dose in water and calculated in GEANT4 were compared which showed maximum overdose of 5% to 8% near the air cavity surface in maximum radii 1.5cm. On the other hand, they showed a minimum overdose in the region 3cm to 5cm from surface of the cavity is ~1% for 0.3cm radii. The air passage distance, size and length of treatment effects the dosimetry Overdose of 3-5% for a 0.75cm mean radii was found for the bronchus carcinoma ILRT brachytherapy depend upon the dose calculation in TPS and water. This research work showed the requirement for development in accuracy of dose calculation in ILRT for carcinoma bronchus [48].

Barlanka Ravikumar et. al. did study to find the correction of tissue inhomogeneity for HDR Ir-192 source in HDR brachytherapy. They used 0.015 cc ion chamber to measure and quantify the impact of inhomogeneities caused by different tissues. Ir-192 HDR brachytherapy source and wax phantom were used for the measurement of heterogeneities. The dose reduction caused by tissue inhomogeneities was measured for different distances as the dose with inhomogeneity divided by the dose without inhomogeneity/ with homogeneous medium. The result was that the different tissue attenuate dose in a different way, maximum with bone and for lung minimum attenuation values showed by tissues. The result showed that for shorter distances inhomogeneity was more effective than for larger distances [21].

Akbar Adelnia and Daryoush Fatehi et. al. did a theoretical analysis to find the effect of dimensions of phantom and heterogeneities of tissue on dose distribution in interstitial brachytherapy. They used Gaf-chromic film for dosimetric measurement and Monte Carlo simulation for Iridium-192 HDR source. The result of their study was 8.2% dose underestimated for lung and 9% overestimated for bone in the TPS system which was affected by the depth, and distance parameters from source. Therefore, TPS cannot include the effect of tissue heterogeneity on dose distribution in brachytherapy [49].

Chang Heon Choi et. al. carried out study “to evaluation of Dosimetric Effect and Treatment Time by Plan Parameters for Endobronchial Brachytherapy”. They analyzed distribution of dose and treatment time with alternating the source step-size and source dwell-position in the endobronchial brachytherapy. In the treatment plan they used a catheter of Intraluminal and a phantom of solid water to generate a plan for 3, 5, 7, and 10cm length of treatment with step size of the source position 2.5, 5 and 10mm for each length of treatment. They set three reference points at 1cm apart from the axis of catheter for homogeneous dose distribution. To find out the dosimetric effect a volumetric dose distribution was calculated. They estimated total time of radiation delivery and total dwell-time which increased with step size position. So they concluded that the endobronchial brachytherapy with 2.5 mm step size position can be used to reduce the total treatment time [50].

Antony Palmer et. al. study presents “a review on the physics aspect of dosimetric accuracy in high dose rate brachytherapy”. The key plan was to review recent method of practical and process in use for the dosimetry of HDR brachytherapy.

They included (i) the dose rate assessment around the field of brachytherapy sources, (ii) the TPS capabilities, (iii) the treatment machine performance and (iv) the dose delivery verification method. They highlight the determinants of HDR dosimetry accuracy and treatment dose delivery. They define paper selection, relevant to research area and development related to the article in last five years. There is no clarity on most beneficial techniques used to assure accurate dosimetry in all the process in HDR brachytherapy treatment except from source dosimetry through Monte-Carlo modeling. A small activity on dosimetric audit reported in literature when verification with EBRT compared by exception of ESTRO mail dosimetry services [51].