New ideas - Thoracic general

A method for video-assisted thoracoscopic photodynamic therapy (VAT-PDT)

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Abstract

A technique is described for application of photodynamic therapy (PDT) to peripheral pulmonary and other intrathoracic malignant tumours. For video-assisted thoracoscopic-PDT we advocate the use of the flexible fibreoptic bronchoscope through an appropriately placed port. This, together with the standard thoracoscope and attached monitor can provide three-dimensional visualisation of the intrathoracic lesion and more importantly allow the accurate delivery of laser light to the tumour. At the present time we have successfully used this method without complication in three patients with advanced inoperable disease.

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1. Introduction

Photodynamic therapy (PDT) is based on the principle of pre-sensitisation of tissue by a chemical photosensitising agent followed by exposure of the sensitised tissue to light of an appropriate wavelength. The light activated chemical in the presence of oxygen has cytotoxic effects which bring about necrosis of the target tissue. PDT is shown to be effective in the treatment of a wide variety of human cancers [1]. Because of its high incidence and low resectability rate lung cancer has been one of the first malignant tumours to be targeted for PDT [2,3]. Thus far, the focus of PDT in lung cancer has been its application to endo bronchial and bronchoscopically visible inoperable advanced or early tumours [4–7]. In practice a photosensitiser is first administered intravenously to the patient then, after an interval (24–72 h), exposure to light is undertaken via a bronchoscope to target the tumour. There are two methods of illumination:

- superficial: when the delivery fibre has an end ‘micro lens’ with forward emitting light onto the surface of the tumour;
- interstitial: when the delivery fibre has a cylindrical diffuser at its end which is inserted into the tumour mass.

At present only central cancers with endobronchial presentation which are accessible bronchoscopically are treated; peripheral tumours cannot be accessed bronchoscopically. Some patients with such tumours may be selected to receive PDT bronchoscopically. Nevertheless for thoracoscopic PDT (video-assisted thoracoscopic, VAT-PDT) for peripheral lung tumour one of the problems relates to the delivery of the laser light (which is non-thermal laser) to the precise location within the parenchyma. This is difficult, cumbersome and involves variable ‘manipulation’ for access by existing instrumentation. We have now devised a technique using a flexible fibreoptic bronchoscope thoracoscopically for localisation of the tumour and laser light delivery. This presentation describes the technique and shows the feasibility of VAT-PDT. So far, this method has been used in three patients with inoperable, peripheral lung cancer.

2. Technique

Prior to PDT the selected candidate would have had standard clinical radiological and bronchoscopic work up
and the staging procedure. The patient is injected intravenously with the appropriate dose of a photosensitiser, (we use 2 mg/kg per bw Photofrin (Porfimer sodium)).

Thoracoscopic illumination is then carried out 24–72 h after administration of the photosensitiser with the patient under general anaesthesia using a double lumen tube tracheal intubation. The patient is placed in the lateral decubitus and the lung on the operated side is deflated. Two ports (10 mm) are used; one is placed below and just anterior to the angle of the scapula and the other either anteriorly in the mid axillary line or posteriorly between the vertebral border of the scapula and spine (spinal process of vertebrae). Placement of the second port, whether anterior or posterior, depends on the location of the lesion to be targeted within the lung in relation to the chest cavity as indicated on a lateral view chest X-ray or computed tomography (CT) scan. Either of the ports can be used for visual exploration or instrumentation. After initial visualisation and the required division of adhesions using standard thoracoscope and instrumentation, the topography of the tumour is evaluated and the flexible fibreoptic bronchoscope is then introduced through the most appropriate port into the pleural space to access the tumour for illumination. At this stage both the standard thoracoscope and fibreoptic bronchoscope are in the pleural space and provide a three dimensional view, subject to the availability of two cameras each with a separate monitor. Illumination is undertaken by introducing the laser light delivery fibre via the biopsy channel of the bronchoscope. The delivery fibre is directed towards the tumour under bronchoscopic vision within the thoracic cavity and its diffuser end is inserted into the tumour for interstitial therapy (Figs. 1 and 2). For illumination the light dose is usually calculated in consultation with the technical staff to provide 100–200 jules/cm² of the tumour which means laser power setting of 200–400 mw for a duration of 500 s. We use a Diode laser emitting light at 630 nm. Treatment is undertaken using interstitial illumination. The number of placements, i.e. insertion of delivery cylindrical diffuser into the tumour will depend on the chosen diffuser length (range 0.5–2.5 cm) and the size of the tumour to be irradiated. After illumination the diffuser is withdrawn and testing for air leaks is made by expansion of the lung and introduction of warm saline into the pleura. Routine closure is carried out leaving a single drainage tube in the pleural space. The drain can usually be removed after a few hours.

In the three patients so far treated, post-operative progress was uneventful and the patients were discharged on days 2–3 post-operatively. Patients were followed-up until their death; survival was 4–18 months (mean 9 months).

3. Comments

We are unaware of previous publication on VAT-PDT. The efficacy of the method related to peripheral lung cancer needs further evaluation. There is, however, little doubt regarding the efficacy since PDT has been shown to be effective in lung cancer when bronchoscopically accessed. Thus far we have carried out VAT-PDT in three patients with advanced inoperable disease with no complication. One patient had bronchoscopically visible (central) tumour with expansion in the parenchyma. He was treated by combined bronchoscopic and thoracoscopic PDT as one operation. We believe the flexible fibreoptic bronchoscope is an ideal instrument for VAT-PDT.

The use of this technique can be extended to PDT application to other intrathoracic tumours such as pleural and mediastinal malignancies. It should be emphasised that
PDT generally, and specifically VAT-PDT, should be performed by specialist teams in selected centres.

References


