ENDOSCOPIC LASER THERAPY IN MALIGNANT UPPER GASTROINTESTINAL STENOSIS

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The term laser is acronym for "Light Amplification by Stimulated Emission of Radiation". Laser light is intense, monochromatic light and is easily focused (1). The medium which is used to generate the laser beam,gives its name to the laser. The most commonly usedlasers are argon, Nd : YAG (neodymium , yttrium aluminium garnet) and CO_2 lasers. It was not until the early 1970's that it became possible to transmit laser beams through thin, flexible quartz fibers, which could be passed through the channels of endoscopes. This technical improvement made it possible to apply endoscopic laser therapy to lesions within the gastrointestinal (GI) tract. Nd : YAG laser is most commonly used in gastroenterology because the tissue penetration is deeper and can coagulate vessels up to 4 mm. in diameter.

After the first application in 1975 in patients suffering from upper GI bleeding, laser therapy has become very popular in the field of therapeutic endoscopy (2). In 1982 Fleischer et. al. first used laser therapy for the palliative treatment of esophageal carcinoma (3).

If laser energy is delivered in such a fashion as to cause tissue necrosis, destruction and vaporization of tumor tissue can occur. Neoplasms of the esophagus, stomach, duodenum, rectum and colon have been treated by endoscopic laser therapy.

Because esophageal carcinoma usually extends outside the esophagus and metastasises, only 1/3 of patients are suitable for surgical resection at the time of diagnosis (4). Esophageal and gastric carcinomas are diseases of the elderly and many patients are poor surgical candidetes. For the most part the therapy is palliative. Palliative measures are radiotherapy, bougienage, endoprostheses placed endoscopically or surgically and gastrostomy. Randomised trials have demonstrated that in palliative treatment of esophageal carcinoma, a combined course of chemotherapy, radiotherapy and surgery was no more effective than a combined course of chemoth erapy and radiotherapy alone (5, 6). Most recently the Nd: YAG laser has been used endoscopically in the palliative treatment of obstructing esophageal and gastric tumors. Endoscopic laser treatment of gastrointestinal cancer has several advantages (7): 1) surgery and general anesthesia are not necessary and morbidity from these causes is averted; 2) it diminishes systemic side effects; 3) it is performed under direct visikon; 4) unlike radiotherapy, there is no maximum dose, so that if the tumor recurrs in thebale area, treatment can be repeated. Disadvantages are: 1) it does not affect the tumor outside thegastrointestinal lumen and in this regard it is palliative; 2) the cost of laser therapy is high; 3) when endoscopic laser therapy is applied, the goal is to relieve obstruction or to reduce blood loss and it is unsuccessful in eliminating pain which is related to spread of the tumor outside the gastrointestinal lumen. Bleeding may either be stopped by coagulating the bleeding site on the tumor or by destroying the tumor itself and eliminating the bleeding vasculature. Treatment for bleeding is generally not effective for excessively large tumors (7). Laser therapy is not indicated for esophago-mediastinal or esophago-bronchial fistulae and for tumors invading the esophagus from the outside (e.g. lung cancer) (8).

TECHNIQUE

Nd: YAG laser (wavelength 1064 nm) has been generally accepted as the best energy source. The energy output required for the treatment of upper gastrointestinal tumors is 60-100 watts. The laser is usually directed without touching the tissue, and the distance between the light wave-guide and the tumor should be between 5-10 mm. Because Nd: YAG laser wave-guide and the tumor should be between 5-10 mm. Because Nd: YAG laser beam is invisible, an aiming beam (helium neon laser of low energy) is used to aim accurately. Endoscopes with two channels are usually preferred, but single channel endoscopes can also bu used. The tip of the light guide is cooled and cleansed of blood and tissue debris with a constant flow of CO_2.A disadvantage of this constant flow is meteorism, which can occasionally be a problem for the patient.

Some centers employ a contact technique using lightguide tips made of thermostable artificial spphire. The output of the laser in this method is between 10 and 25 watts. Higher outputs lead to burning out of the lightguide tips. In the contact technique the amount of energy applied to the tumor can

not be estimated accurately and no advantage of this proedure has been shown over the no-contact method. In this method however water may be used for cooling and the side effects of gas flow disappear (9).

The laser application may be started from either the proximal or distal margin of the tumor. The problem with starting from the proximal end is that the natural course of the lumen can not always be predicted and edema produced by laser treatment can make orientation even more difficult and cause complications. If the lumen is wide enough to allow passage of the instrument, treatment may be started at the distal end. The advantage of this method is that the lumen is always visualized, and the perforatikon riskis reduced (8). If the tumor ise endoscopically impassable a laser-resistant guide wire is advanced through the stenosis. Clearance of the tumor is commenced at the proximal margin and continued distally using the laser-resistant wire as a guide.

Subsequent laser treatments are carried out approximately every other day until the goals of laser therapy are achieved. This is usually when the patient can swallow solid foods or when the lumen is wide enough to pass the endoscope. At the beginning of each session the previously treated necrotic neoplastic tissue must be removed either by aspiration or by pushing it distally with the endoscope or a cleaning brush.

FACTORS AFFECTING THE RESULTS

TYPE OF TUMOR : Laser treatment is dependent upon thermal destruction of the tumor and histologic type does not affect the result (10). Vascular, polypoid, pink and soft tumors absorb most of the laser light and vaporize easily. Hard and white tumors reflect the light and require the application of higher energy (9).

ENDOSCOPIC APPEARANCE : The endoscopic is classified as predominantly mucosal or predominantly submucosal. If the tumor is mucosal, the patient will seldom experience pain during the treatment. Pain is common when the tumor is submucosal. Some of these patients benefit from local anesthetic injections with a sclerotherapy needle. Luminal narrowing with scar formation is more marked after laser treatment with submucosal tumors.

LOCATION OF THE TUMOR : Tumors located in the straight segment of the midesophagus and lower esophagus are technically the easiest to treat. The treatment of tumors in the cervical esophagus is very difficult. There is little room to maneuver the endoscope and the risk of aspiration is great. Additionally the endoscope may be damaged by the large quantities of heat and debris. If the tumor is located in the sharply angulated esophagogastric junction the technical difficulty and the risk of perforatikon and laser-related pneumoperitoneum is increased. Following treatment little or no improvement in swallowing can be achieved even when standard endosckopes can be passed through these tumors. This is because food must pass through a relatively horizontal and aperistaltic segment and will tend to obstruct at this point (9, 10).

RESULTS

It is difficult to interpret the results of endoscopic later treatment. This is because it is usually performed at the late stages of the disease and following attainment of luminal patency treatment is usually combined with radiotherapy or chemotherapy. Under these circumstances long term remission may be a result of a favourable tumor type, lasertherapy, or combination of laser therapy with radiotherapy and/or chemotherapy.

Fleischer and Sivak treated 35 patients with squamous cell carcinoma of the esophagus and 25 patients with adenocarcinoma of the gastric cardia (10). The results after endoscopic laser treatment were classified as good in 48 patients (could eat most or all food and developed no major complications), fair in 8 patients (could eat some solids), and poor in 4 (could ingest only liguids or less, or developed a major complication) All 4 patients with poor outcome suffered from squamous cell carcinoma. Three of these patients suffered perforation, whilst the fourth patient with a high cervical carcinoma of the esophagus showed no improvement in swallowing despite passage of the endoscope through the stricture. No other patients in the study group developed perforation during laser therapy. Of the 3 patients in which it was observed, two had previous radiotherapy. In one instance the patient remained asymptomatic and no perforation could be identified at laparotomy. A diagnosis of "benign pneumoperitoneum" was made, and was thought to have been caused by the coaxial gas jet passing through the necrotic tumor tissue into the peritoneal cavity.

Ell et. al. treated 62 patients with upper GI malignancy using laser treatment and 80 % of their patients were able to eat solid food following treatment (8). In 12 patients, the treatment was not succesful. Of these patients with poor results, three had a lesion in the cervical esophagus with laryngeal invasion, three developed complications, one was extremely debilitated, one refused further treatment after the first session, and four suffered from a functional transit disturbance, where despite passage of endoscope through the stricture they were only able to ingest fluids. One patient with a previous history of radiotherapy developed an esophago-me diastinal fistula. This fistula was closed in the same session with rapidly hardening aminoacid solution applied via the endoscope. One patient suffered a perforation into the abdominal cavity and required surgical repair and the third patient developed perforation with septic mediastinitis and died. More than two thirds of the patients in this study group developed recurrent stenosis 3-6 weeks after the treatment.

Bown however, claims that following a successful course of therapy half of the patients should not develop difficulty in swallowing until death occurs due to the malignancy (10).

Post mortem studies have demonstrated that in patients who have long term remission fibrosis develops in laser treated areas and this presumably prevents tumor growth (12).

In an international inquiry the results of endoscopic laser therapy on 1184 patients with upper GI system tumors were evaluated (8). Data was included for evaluation only from centers with experience gained in more than 15 patients. The average success rate for initial treatment was better than 80 % and the major complication rate was 4.1%. One half of these complications were either perforations or fistulae to other organs. In patients who had received radiotherapy prior to laser treatment, the complication rate was 9.2%, although in another study the perforation rate was 23 % in patients who had received radiotherapy before (12). In contrast patients who had received cytotoxic agents were not at increased risk of perforation. A small amount of bleeding is quite common with laser teatment but, serious bleeding occurs in less than 1 % of cases. Chest pain develops in 5-20 % of patients during or after the treatment, but it rarely lasts more than a few hours (7, 10). Fever and leucocytosis may occasionally develop after the procedure, and are due to tumor necrosis and resolve without treatment.

In spite of the wide spead use of laser treatment the following questions remain to be answered :

1. What are the long term effects of endoscopic laser therapy?
2. Is laser treatment the best treatment modality available for resectable but incurable disease?
3. Does combination of laser therapy with radiotherapy or chemotherapy have any further beneficial effect?
4. If more than one form of treatment is to be used in which order should they be applied?

CONCLUSION

In spite of high cost, with an average success rate of more than 80 %, laser therapy represents an excellent alternative to other palliative measures. Laser exerts its effect rapidly. It can be performed easily with low risk of complication and without surgery and general anesthesia. There is no maximum dose and therapy can be repeated as necessary. It can be carried out on an outpatient basis.

With the encouraging initial results and many advantages of endoscopic laser therapy for upper GI neoplasms it is likely that this modality will be come more widespread, but long term effects and the role of laser therapy in combination treatments remain to be determined.

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