

Articles, Views and Comments

To join the European or the International Society of surgery or if you would like to contribute to the next issue, your articles, views and comments would be welcome.

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European

Society of

Cryosurgery

CRYOSURGERY

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Welcome to the fourth issue of CRYOSURGERY, the publication of the European Society of Cryosurgery. This issue includes a report of the successful congress held in San Sebastian, Spain in the early part of this year. The event was co-sponsored by the International Institute of Refrigeration (IIR). The programme prepared by the Scientific Committee of the Congress provided good coverage of various applications in cryosurgery : cryobiology, dermatology, gynaecology, tracheo-bronchial, hepatic, urological and prostate cryosurgery. See page 6 for a more detailed report.

The next triennial International Conference of Cryosurgery is to be held in the historic city of Lisbon, Portugal and will include technical paper sessions, poster presentations, workshops, a bursary award for junior doctors, official ceremonies as well as the opportunity to explore this fascinating part of the world. The conference will bring together the International and European Societies of Cryosurgery in one meeting.

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European Society

GENERAL ASSEMBLY OF THE EUROPEAN SOCIETY OF CRYOSURGERY

San Sebastian, Spain. April 1st 2000



The assembly commenced with the election of a new president, Mr Omar Maiwand after the current president expressed his wish to stand down. The Board recorded its gratitude to Dr Jean-Paul Homasson for all his hard work as President of the European Society for the last four years and proposed that Dr Homasson should be made an honorary member of the society.

The board also conveyed its appreciation to the Cryosurgery Department at Harefield for the production of CRYOSURGERY, the twice yearly publication of the society, which has been carried out with no financial support from the society. Grateful thanks were extended to Dr Daniel Luna Sabaté for his hard work in organising the meeting in San Sebastian.

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Proposals

- The next meeting of the ESC should be combined with the International Society meeting to be held in Lisbon, Portugal in October 2001.
- The following meeting in 2003 should be held in either Dresden, Germany, Trieste, Italy or Vienna, Austria.
- It was proposed that there should be an annual membership fee for the European Society of 25€
- The Board proposed the formation of a library of cryosurgery publications, preferably in electronic form. This would probably be sited at Harefield Hospital or

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Photograph courtesy of Prof J-M Vergnon

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International and European Conference of Cryosurgery



Lisbon, Portugal October 5th-7th 2001



Lisbon is a beautiful capital city, rich in maritime history and culture. The city is built on a series of seven hills around a natural harbour on the river Tagus and retains much of its old character. There is a large selection of restaurants and bars serving local and international cuisine with fish and seafood particular specialities



HISTOLOGICAL AND CLINICAL STUDY ASSESSING THE EFFECTS OF CRYOANALGESIA ON INTERCOSTAL NERVE LESIONS

N Moorjani,* F Zhao, Y Tian, C Liang, J Kaluba, MO Maiwala
China-Japan Friendship Hospital, Beijing, China.
Harefield Hospital, UK.*

Objective: The choice of analgesia in the management of thoracotomy pain remains controversial. Although several native forms of post-thoracotomy analgesia exist, all have disadvantages. Cryoanalgesia, localised freezing of intercostal nerves, has been reported to have variable effectiveness and an incidence of long-term cutaneous sensory changes. This study examined the reversibility of histological changes induced by localised freezing of the intercostal nerves in an animal model and a prospective randomised trial at the China-Japan Friendship hospital, to compare the effectiveness of cryoanalgesia with conventional analgesia (parenteral opiates).

Experimental Study: Six hybrid dogs, average weight 17 kg, 3 male and 2 female, were anaesthetised and a standard thoracotomy was performed to gain access to the 3rd to 10th intercostal nerves. Each nerve was frozen using a probe temperature of -50 °C (CO₂ cryogen) for 60 or 120 seconds. A sequence of nerves bilateral to the lesion were then biopsied on the 3rd, 14th day and 1st, 3rd & 6th month postoperatively. The neuropathology was examined histologically, using routine Haematoxylin Eosin stains and immunochemical techniques, which specifically identify axons and myelin sheaths.

Clinical Study: Two hundred patients (144 male and 56 female, mean age 52.3) undergoing elective thoracotomy were included in the study. Those taking non-steroidal anti-inflammatory drugs or opiates preoperatively, with chest wall deformities or neurological conditions were excluded. Patients were randomly allocated to group **A**, conventional analgesia or group **B**, cryoanalgesia. All patients received standard anaesthesia with one-lung ventilation via an endobronchial tube. A posterolateral incision was used to gain access to the thorax for either pneumonectomy, lobectomy, pleurectomy or oesophagectomy.

Patients in the conventional analgesia group received parenteral dolantin, an opiate, four times a day for seven days. For patients in the cryoanalgesia group, before closing the thorax, the intercostal nerves (at the level of the incision)

BOC Gases

BOC is the UK's leading supplier of Medical Gases, with a long history that stretches back over 100 years.

In that time we have supported the development of Cryosurgery in the UK, providing cryogens such as Liquid Nitrogen, Liquid Carbon Dioxide and Liquid Nitrous Oxide. We have also invested a great deal of energy into developing new and innovative ways to distribute extremely cold gases. BOC's Cryospeedä service, was specifically designed to support applications such as Cryosurgery.

In recent times BOC has been working on new packaging and delivery systems. These systems have to be able to cope with the extremely high pressures associated with the requirements of cryosurgery that relies on the Joule Thomson effect.

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Future Events

Original Articles



Advances in Airway Endoscopy

November 22-24 2000
Paris, France

This forum will bring together lung and ENT specialists with an interest in endoscopy. The forum will include a large number of international speakers and will cover diagnostic and therapeutic endoscopy.
For further information contact

Michel Febvre
33, rue de L'Abbé Groult
75015, Paris, France
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9th Congress of the European Academy of Dermatology and Venerology

October 11-15, 2000
Geneva, Switzerland

DERMATOLOGY IN 2000- STATE OF THE ART

Symporg SA, Congress Organisers, 7 Avenue Krieg, CH11 Geneva, Switzerland.
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one cranial and two caudal) were identified and exposed by peeling off the parietal pleura. The cryoprobe (-50 °C, CO₂ gas) was applied to each nerve at a point proximal to the trunk of the collateral branch for 60s, causing localised freezing. After 10s thaw was allowed prior to the removal of the probe to prevent adherence to the tissues. The chest was closed in routine fashion, with drains placed within the anaesthetised area. Parenteral Dolantin (50mg) was administered when required.

Postoperatively, the degree of chest pain, use of additional analgesia, respiratory function (FEV₁ and FVC) and complications were recorded. Postoperative pain was assessed using the Visual Analogue Scale, (0=no pain, 10=worst pain imaginable) and recorded 4 times a day for 7 days postoperatively. Further requirements of additional analgesia for breakthrough pain and complications were also documented.

Histological Results:

60s: At day 1 & 3 post-cryo, the histological sections showed evidence of axonal swelling and fragmentation. These changes were diffuse and affect all visible axons. The surrounding endoneurial and perineurial structures remained intact. Capillary stasis is also evident.

120s: Severe changes, oedema, degeneration, rupture, and transection of axon.

Cryoanalgesia induces a second degree nerve lesion (axonotmesis) and complete histological regeneration of the intercostal nerve occurred within 30 days. The nerves from 120s took longer for complete regeneration to occur.

Clinical Results: Postoperative pain scores and the use of additional analgesia were significantly lower for patients in the cryoanalgesia group. Patients in the control group required higher doses of additional analgesia for a longer period (control 7 days, cryoanalgesia 3 days, p<0.05). Patients in the cryoanalgesia group achieved higher FEV₁ and FVC scores, though this was not significant.

Complications: There were no episodes of respiratory failure, wound infection in either group. Three patients in the control group had radiological and clinical evidence of atelectasis which required vigorous physiotherapy for full lung expansion. There were no cases of atelectasis in the cryoanalgesia group. All the patients in the cryoanalgesia group experienced no

ness around the incision and the upper abdomen dermatome for 1-3 months, the longest for 6 months. The previously suggested cutaneous sensory changes all resolved within months with complete restoration of function.



Discussion: Thoracotomy is one of the most painful surgical procedures currently used and the balance between adequate analgesia and potential side effects may be difficult to achieve. Thoracotomy pain may cause alterations in respiratory physiology and respiratory sputum retention, atelectasis, chest infections and other respiratory operative complications. By providing adequate analgesia it is possible to prevent post operative complications by allowing maximum patient compliance with intensive physiotherapy and to improve respiratory function.



The treatment of post-thoracotomy pain remains controversial. Conventional methods involve opiate analgesia administered through parenteral routes. These methods are not completely effective and are associated with a number of side effects, including respiratory depression. Epidural analgesia is a commonly used form of post-thoracotomy pain control and although effective, often necessitates the use of urinary catheters and keeps the patient in bed whilst the epidural is in situ. Other techniques include intercostal nerve blocks for immediate post-operative pain control.

Cryoanalgesia, localised freezing of intercostal nerves, provides both short and long-term analgesia. When the cryoprobe is applied to peripheral nerves, localised freezing induces changes consistent with a second-degree nerve lesion (axonotmesis). The effects are directly related to the formation of intra- and extracellular ice crystals, which result in microvascular changes, alteration of cellular osmolality and permeability, causing disruption of nerve conduction.

The use of cold as a form of analgesia has been around for many years although it was Lloyd¹ in 1976 who first introduced the concept of cryoanalgesia. The technique was further developed by Maiwand², who carried out a large clinical trial demonstrating the effectiveness of cryoanalgesia in the control of thoracotomy pain.

Several studies have compared the use of cryoanalgesia against other forms of post-thoracotomy analgesia, with varying results. Brichon³ and Miguel⁴ showed that epidural analgesia provided more effective analgesia, whereas both Orr⁵ and



ABIC 2000

1st December 2000

Royal Brompton Hospital, Sydney Street, London

The annual meeting of the Association of British and Irish Cryosurgeons (ABIC)

The day will include a, short communications and workshops sessions covering all aspects of cryosurgery and cryobiology

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14th Annual Meeting

The European Association for Cardio-thoracic Surgeons

7-11 October 2000

Frankfurt, Germany

Scientific Secretariat, Registration.
EACTS Executive Secretariat
Heart Centre, University Hospital
Umea, 901 85 Sweden
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Email eacts.secretary@mailbox.calypso.net
Web: <http://www.eacts.org>

Cryogenics 2000

October 10-13 2000

Prague, Czech Republic

Contact V.Chrz email :vchr@ferox.cz

Conference Reports

Original Articles



Association of British and Irish Cryosurgery - ABIC 2000



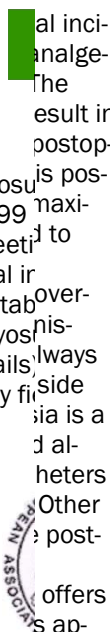
Dr Arthur Jackson
 GP Dermatological Cryosurgeon and member of the ABIC Steering Group
 May 2000

Following the successful study day "Advances in Cryosurgery" organised by Mr MO Maiwand in December 1999 which led to the formation of ABIC 2000 a further meeting the steering committee was held at Harefield Hospital in April. The aims and objectives of the society were established and the decision made to organise another cryosurgery meeting in December 2000 (see page 4 for details), a view to inviting larger numbers from the cryosurgery field and to include a keynote speaker, a programme of short individual presentations and practical workshops for the different specialties. It is hoped that at this meeting or "General Assembly" the "Association of British and Irish Cryosurgery" will be officially launched.

The aims and objectives of the association are:-

- to share multidisciplinary experiences in the field of cryosurgery in Britain and Ireland
- to encourage research in cryosurgery and so to advance its use in patient care.
- To build up good communications between primary and secondary care to make best use of cryosurgery skills.
- to encourage participation of members in the International Society of Cryosurgery.

The Association welcomes all clinicians, scientists and nurses in the UK and Ireland who share and support their aims to join its membership. From the work and research undertaken by its members and associates, it is hoped that



Other post-operative analgesia is a d al-heters offers s ap- ges is). The xtra- s and disrupt- d for duced level- mon- if post-

tor⁶ demonstrated a significant improvement in respiratory function and pain relief using a 60s application of the cryoprobe in comparison to parenteral opiates. Our study demonstrates the benefits of cryoanalgesia with respect to pain and respiratory function when compared to systemic opiates. This also confirms that the prolonged numbness suggested by previous studies all resolved within six months, with restoration of normal sensation.

Cryoanalgesia, however, is not able to provide complete pain relief post thoracotomy. Stretching of the dorsal spinal ligaments, which are supplied by the posterior spinal rami, generates a considerable amount of pain. Pain signals are also transmitted via the phrenic, vagi and sympathetics as well as the intercostals and hence not affected by application of the cryoprobe. Cryoanalgesia is able to provide a therapy which reduces the postoperative analgesic requirement and facilitates control of post-thoracotomy pain. This improves respiratory function and hence reduces the incidence of any postoperative complications.

Conclusions : This study suggests cryoanalgesia of the intercostal nerves be considered as an economical, safe and effective to use technique for the long-term control of post-thoracotomy pain which does not cause any long-term histological damage to intercostal nerves.

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International Review

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THE TREATMENT OF EARLY CHILDHOOD HEMANGIOMAS USING CRYOTHERAPY

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TCAP
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Our study concerns the results of the use of cryotherapy in the treatment of 185 infants and babies with haemangiomas present from birth through to the first year of life. Of these, 109 were planus, 59 were plano-tuberous and 17 were tuberous haemangiomas.

Average contact times of 4-6 seconds were applied. A longer contact time was frequently associated with blisters and ulcers which delayed the necessary, repetition and future course of treatment. The cryotherapy treatment was repeated at intervals of 14 days, so long as the activity of the hemangioma was still visible in the form of red areas on the surface. Complete regression was achieved in 75% of cases after an average of 6 treatments.

After an average of 8 treatments, there was complete regression for 51% of cases of plano-tuberous hemangiomas and satisfactory results for 62% of tuberous hemangiomas.

The cryotherapy of early childhood hemangiomas is a cost-effective method, which also has the advantage of being simple to use and has good tolerance on the part of children and their parents.

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World Congress of Cryobiology

Marseille, France

July 12– 15 1999

The 36th annual meeting of the Society for Cryobiology was an opportunity for participants from 28 nations to exchange ideas ranging from basic sciences and engineering to clinical practice and industry.

Sessions during the congress included the following subjects: nucleation and anti nucleation, glass forming tendency, mathematical modelling applied to cryobiology, cryobiology of tissue structure and blood cell cryopreservation.

In a 4 hour session entitled "Cryosurgery", chaired by J-P Homasson and Ch Zouboulis, laboratory research, clinical research and new instrumentation were discussed. Research topics included cryosurgical treatment of bone tumours, efficacy of cryosurgery versus cryosurgery and intranasal corticosteroids.

In two interesting posters WM Fashi, Minneapolis, USA, confirmed the cell death parameters known in dermatological cryosurgery (rapid freezing and repetition of cycles with a short hold time) and NE Hoffman, Minneapolis, USA, did not succeed in showing any effect of the cryoimmunology phenomenon on tumour growth or histology in Copenhagen rats.

All participants enjoyed the well organised congress and the excellent social programme.

Prof. Ch. C. Zouboulis Berlin, Germany

Conference Reports

International Review

familiar with this new technique which he described as being the best and safest minimal invasive treatment for prostate cancer. TCAP is now accepted as a valid treatment for prostate cancer by FDA and Medicare in the USA after a long struggle by patients and urologists. It is a safe, minimal invasive and curative treatment for localized prostate cancer, with very low morbidity, extremely short hospital stay and quick restore of normal activities. In the late afternoon very promising results in renal cell carcinoma (video from Dr Lignin), uterine fibroids and BPH (lectures by Dr Chinn) were shown. Dr Chinn also explained excellent results in his centre on hepatocellular carcinoma (work by Dr Wanger) further exploring new fields of interest for the use of cryosurgery.

We are very grateful to all the speakers and the organizers for this very interesting meeting.



The XXth International Congress of Refrigeration

Sydney
September 1999

The congress was well attended with 905 participants from 57 countries and 467 high-quality papers were presented. 34 in the cryophysics and cryobiology section, including applications of cryosurgery, cryoablation of porcine kidney impedance for monitoring cryosurgery in a brain model. The president of the Cryobiology and medicine section is now Pavel Mericka (Czech Rep) and the director François Billard. The next congress will be held in Washington DC in 2001.

CRYOSURGERY OF RECTUM AND ANUS ADVANCED CANCER.

Delbello, F. Sasso, A. Mattiussi, S. Rovedo
Istituto di Chirurgia Generale
Universita degli Studi di Trieste (Italy).

Cryosurgery of advanced neoplasia of rectum and anus has the aim of reducing symptoms associated with the disease and avoiding or delaying the need for a colostomy. The surgical approach has been employed for patients relapsing after a low anterior resection and unsuitable for a surgical approach.

We followed 12 elderly patients (average age 88) in our Surgical University Institute; 9 were affected by substenosant cancer of the lower rectum and anus and 3 had a local relapsing colonic neoplasm plus distant locations.

All the patients (7 male and 5 female) were not in sufficient good health for surgical treatment. Cryosurgery needs no general anaesthesia, can be applied in outpatients and can be repeated frequently.

Symptoms presented in 11 patients were tenesmus in 7 cases, muchorrea in 8 cases, pain and hypertonus in 3 cases and perineal pain in 3 cases. No patients received general anaesthesia, we performed 29 sessions of cryosurgery (1 per patient) with a time interval of 30 days and we employed both liquid nitrogen and nitrous oxide. Intracavitary US was employed intraoperatively with the use of thermocouples in the perineus. All patients were checked every 4 months and usually treated again.

No patients received a colostomy. Patients improved or reduced symptoms in 73% of cases for 4 to 55 months, tenesmus improved in 2 patients out of 7 and disappeared in 3. Haemorrhage stopped in 6 out of 7 patients, muchorrea improved in 5 of 8 patients. Anus pain and hypertonus improved in the 50% of cases. Five patients died of multiorgan failure. Morbidity of cryosurgical treatment was in 2 cases urinary retention, pain in the first 24 hours (4 patients needed analgesic therapy), gas incontinence in 1 case. There were no major complications such as perforation of the bowel, stenosis

haemorrhage.

We consider Cryosurgery as a valid choice to treat patient with advanced cancer of the anus or lower rectum because improves quality of life for these patients who cannot tolerate surgical treatment. The advantages have been lack of colostomy, improvement in symptoms in 73% of patients and a small incidence of complications.

A major benefit of cryosurgery is also the possibility of controlling haemorrhage because of its capability of inducing tissue necrosis and deep thrombosis of the tumoral vessels.

CRYOTHERAPY IN THE TREATMENT OF INTRALUMINAL CARCINOIDS

JM Vergnon

Department of Chest Diseases and Thoracic Oncology,
University Hospital, Saint-Etienne, France.

According to Travis's classification, typical carcinoids are identified as benign tumours with a good prognosis. Surgery is gold standard treatment but in cases of intraluminal local bronchoscopic treatment with curative intent is now an accepted alternative. Good results have been published both with laser or electrocautery. Cryotherapy is an efficient method to destroy both vascular and cell components of a tumour. Carcinoid has been described as a "cryosensitive tumour" and deep action of cryotherapy in the bronchial wall, without perforation risks, could allow a great and safe efficiency on focal residual tumour into the bronchial wall, foci untreated with laser assisted resection.

We have started a prospective protocol to treat carcinoid with cryotherapy. Only typical, intraluminal carcinoids were selected. Patients selected for cryotherapy had a strict follow-up (2 bronchoscopies per year for 5 years) rather than surgery. Seven patients were enrolled (5 females). Under general anaesthesia, a laser treatment was performed first on the protruding part of the tumour in 4 of the 7 patients followed by cryotherapy on the remaining part of the tumour using a

results in curative treatment of carcinoid tumours.

For benign obstructive lesions, cryotherapy as discussed by Mr Asimakopoulos / Mr Maiwand showed good results for symptom relief (dyspnoea, haemoptysis and cough).

In coloproctology cryotherapy gives good palliative results for colorectal adenocarcinoma. It is used as a curative treatment for villosous tumours, condylomata, fistula, pylonidal cysts, haemorrhoids. It offers a minimally invasive, well tolerated, effective and economical treatment with little blood loss. For liver tumours cryotherapy is seen as an excellent palliative treatment for hepatocellular carcinoma and liver metastasis. More liver tissue can be saved and blood loss minimal. There is a significant gain in survival and in some cases the treatment is curative (2 years).

On day 3 the excellent results of cryotherapy in dermatology were discussed. It has been used successfully in the treatment of basal cell carcinoma, haemangioma, melanomas, colloids and cosmetic applications.

Promising preliminary results were shown in the gynaecology session with the use of cryotherapy in the palliative treatment of cancer of the vulva.

A concurrent session on urology was introduced by Dr D'Amico (Belgium) who reviewed current treatment options for prostate cancer including the introduction of cryoprobes transurethrally under transrectal ultrasound guidance and freezing the entire prostate gland with Argon/Helium to achieve at least -40°C in the tumour area.

Dr Prokhorov (Russia) presented his results on temperature isotherms within the ice-ball and the killing effect of cryotherapy in prostate cancer.

Dr Bahn & Dr Chinn (USA) highlighted the scientific basis of the technique of safe and curative TCAP (targeted cryoablation of the prostate) for prostate cancer. A live video demonstration of TCAP by Dr Chinn and Dr Wong (USA) was shown, and the excellent results from both centres were discussed.

Prof. Usón made some critical remarks on new technologies in urology and the importance of careful patient selection and urologist training. He urged all young urologists to become

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International Review



European Congress of Cryosurgery

Palacio Miramar, Donostia-San Sebastian, Spain
March 30th - April 2nd, 2000

Meeting report by Dr. Chris D'Hont M.D. – Chairman of the Urology session

The European Congress on Cryosurgery took place with the support of the European Society of Cryosurgery, the International Society of Cryosurgery and the International Institute of Refrigeration. It turned out to be a very interesting meeting which brought together the cryo experiences of many different specialists and in a variety of disciplines.



Photograph courtesy of Prof J-M Vergnon

Day 1 was dedicated to basic science in the use of cryoagents both for tissue preservation (transplantation) and tissue destruction (cancer treatment). Dr Hertzog highlighted the developments in oral and maxillofacial surgery, Dr Gusev and Dr Grischenko discussed the use of cryopreservation in clinical transplantology.

Day 2 included sessions on the use of cryosurgery in endobronchial benign and malignant lesions. In conclusion, for endobronchial tumours Nd YAG laser or electro-coagulation is used for debulking and immediate symptom relief, while cryotherapy is used to successfully treat the base and the infiltrating tumour. Cryotherapy for lung tumours is a palliative treatment and is better and safer than other treatment options for infiltrating tumours.

Prof Vergnon, Mr Maiwand and Dr Moraitis also showed g

cryoprobe.

Results: The tumour was destroyed in each case without any side effects or residual stricture. In one case, a recurrence was recorded in the follow-up at 18 months on biopsies but never found on the surgical specimen. In other cases, after a mean follow-up of 4 years, the curative action of cryotherapy remains complete. These results confirm first data published by D. Luna Sabaté.

In conclusion, we confirm that cryotherapy can cure typical intraluminal carcinoids without complications or residual stricture. In these cases, we believe that an endoscopic treatment could be the first choice. Among these techniques cryotherapy gives probably the best risk/benefit ratio.

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THERMOPHYSICAL BORDER OF CRYOSURGICAL TREATMENT OF THE LARGE METASTASIS IN A LIVER.

Prokhorov G, Morosova S, Litvinov O, Prokhorov D, Andreev A, Vlasova A.

Clinical Hospital of Russian Academy of Sciences
St Petersburg, Russia.

Cryosurgical intervention in patients with large unresectable tumours has a high risk of the development of cryogenic shock. We used a cryosurgical system, the "Candela CryoLCS-3000" for destruction of large colorectal metastasis in the liver for a group of 8 patients. One patient died on the first day after operation from cryogenic shock, in two cases serious coagulopathy developed which has required a haemo-transfusion. These clinical observations have forced us to search for criteria for definition of extreme allowable volumes of cryogenic intervention.

The work included realization of thermometric researches, experiments and control measurements of temperature at different positions within an iceball and also in tissues. The probes used had a diameter of 3.85 mm. Both single and multiple positions of a cryoprobe were used. During operations we carried out a control thermometry in a zone of a cryoablation using standard thermocouples of the cryosurgical system. The body temperature of patients was recorded

continuously during operation and on the following day. The results of these measurements formed the basis for the subsequent accounts of parameters of thermo-exchange between the probes and the body of the patient, on the basis of the known thermo-physics laws. The results of this research have shown, that the greatest influence on thermal balance of the patient is related to the duration and intensity of cryoablation, feature of a mutual locating of probes. Thus the interrelation of parameters were complex in character. The comparison of settlement shifts and real changes of temperature has revealed their sufficient concurrence. The continuous use of five cryoprobes, simultaneously, within 30 minutes results in a decrease in general temperature of the patient's body (weighing 75 kg) from 37°C down to dangerous values of 34°C. The simultaneous use of three probes, can cause a fall of patient temperature of 3°C within four hours. The single cryoprobe does not render appreciable influence on thermal balance of the patient during an operation. More powerful cryogenic equipment has the advantage of allowing a reduction in the duration of general cryogenic influence and the treatment of larger size tumours. The discontinuation of blood circulation in the liver for the period of cryogenic influence by a prelum of the hepatic artery and portal vein also are represented expedient from the point of view of reduction of general time of hypothermal influence. The comparison of physical accounts to the results of clinical application of cryogenic engineering allows for the determination of border at a rate of a tumour for its radical double freezing as 0.7 % of the body mass of the patient. In cases where the general mass of tumoral tissue exceeds this volume, it is necessary to apply effective methods of cryoprotection to the patient.

CRYOSURGERY FOR LARGE LIVER METASTASES

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Background: Hepatic cryosurgery (HC), using liquid nitrogen at -196 °C was explored for treating liver metastases in an experimental study and in a clinical investigation of patients with unresectable liver tumours.

Objective: To evaluate *in situ* ablation of large liver metastases (LLM) using cryosurgery as a treatment for surface liver malignancies.

Method: Thirty-one patients who had undergone curative hepatic cryosurgery for treatment of liver metastases made up the study population. HC was considered when unresectability of liver metastases was related to technical considerations: large, multiple, bilateral lesions, cirrhotic liver. LLM were synchronous in all cases. HC was performed with the universal cryosurgical system Cryotronic and "Freeze Power1 (Cryotechnological Company, Pulse, Kiyv, Ukraine; Cryomed International Inc, Bellmore, NY, USA) designed for different tumours including HC to deliver liquid N₂ to the tip of a probe approximately 5, 10, 15, 20, 35, 45, and 55 mm. The temperature range for cryoexposure was -180 °C to -190 °C in contact with tumour tissue with temperature stabilisation ± 1%. Two freeze-thaw cycles per lesion were carried out.

Results: There was no intra or postoperative mortality or notable technical difficulty in performing HC in any patient considered for this treatment. Cryosurgical treated lesions appeared as hypoechogenic or hypodense areas, sometimes with a calcification in the centre. A complete response was observed in thirty patients (96.8%), and a partial response in one patient (3.2%). The follow-up period in patients with LLM ranged from 3 months to 14 years.

Conclusion: The results of our study suggest that a curative benefit exists with HC for *in situ* ablation of large liver metastases under following condition - the selectable temperature range for cryoexposure must be available from -170 °C to -190 °C in contact with tumour tissue by temperature stabilisation ± 1%.