ANAESTHETIC MANAGEMENT OF RADIOFREQUENCY TUMOR ABLATION: OUR EXPERIENCE

Dr. Nupur Chakravorty¹  Dr. Shweta Jaiswal²  Dr. Devashish Chakravarty³
Dr. Rajnish K. Jain⁴  Dr. R. C. Agarwal⁵

SUMMARY

Percutaneous radiofrequency (RF) ablation is a novel minimally invasive technique of tumor destruction by heat in hepatic malignancies. The factors that influence the anaesthetic technique for percutaneous radiofrequency tumor ablation for secondary metastatic malignancies of the liver are analyzed in this retrospective study at our institute. 22 patients with secondary hepatic tumors, and 2 patients having locally inoperable pancreatic tumors, who underwent percutaneous RF ablation between February 2001 and September 2004, were retrospectively analyzed with respect to the anaesthetic technique employed. The clinical, radiological and anaesthetic data of individual patients stored in the hospital’s computerized database was collated and analyzed. Factors that dictated the choice of anaesthetic technique were studied. 22 ASA physical status II and III patients (15 males, mean age 54 years) had a total of 73 of lesions in liver, with each patient having 2–8 metastatic lesions. Mean diameter of the lesions was 25 mm (range 10 mm–60 mm). 43 lesions were located superficially and 30 were situated deep in the parenchyma. 13 lesions were sub-diaphragmatic. 2 patients had locally inoperable pancreatic tumor. 8 patients underwent the procedure under sedation analgesia comfortably, 16 had to be converted to general anaesthesia mid procedure. The chief causes of conversion to general anaesthesia were pain (56.25%), for respiratory standstill and controlled apnea during lesion location (18.75%), to prevent injury to the diaphragm or pleura (12.5%), and in pancreatic lesions (12.5%). Index tumors less than 3 cm in size and situated away from the diaphragm could be ablated completely under sedation. The index tumors measuring 3 – 5 cm had a higher incidence of incomplete ablation under sedation analgesia, as compared to the general anaesthesia group (45.45% vs. 15.9%). None of the large index tumors more than 5 cm in size showed curative ablation after a single session in both the groups. There was no treatment related mortality. Discharge time from hospital was prolonged in 2 patients due to surgical morbidity (ascites, haemothorax). Remaining patients were discharged within 24 hours. However postprocedural pain was more in the patients who underwent general anaesthesia (5 patients vs 2 patients). Postoperative nausea and vomiting was more in the general anaesthesia group (5 patients vs 1 patient). It inferred that the anaesthetic techniques have to be modified according to the site, size, and number of lesions, so as to provide maximum patient comfort and ensure technical success.

Keywords: Image guided therapy, Tumor ablation, Radiofrequency ablation, Minimally invasive therapy.

Introduction

Radiofrequency (RF) tumor ablation refers to the direct application of radiofrequency energy therapy to a specific focal tumor (or tumors) in an attempt to achieve eradication, or substantial tumor destruction. This technique is one of the many ablative techniques developed for treatment of those hepatic tumors which are unsuited for surgical resection at the time of diagnosis, either because of the size, number, and distribution of tumor deposits, poor general condition of patient, or limited hepatic reserve. Though the technique was described as early as 1891 for ablation of neurosurgical tumors,¹ Rossi et al² described the percutaneous ablation of hepatic tumors by radiofrequency current in 1993. Radiofrequency ablation can be used percutaneously to treat liver tumors as well as applied laparoscopically or at laparotomy, where it can be combined with resection or utilized as the sole treatment modality.

We report our initial experience with the anaesthetic management of RF ablation of hepatic tumors for ablation of metastatic hepatic tumors. Patient information was analyzed retrospectively, and the aim of this analysis was to define the factors that influenced the periprocedural anaesthetic management and identify complications, and morbidity associated with the procedure.

Methods

After approval from the hospital ethics committee, 22 patients with liver tumors and 2 patients having locally inoperable pancreatic tumors who underwent percutaneous RF tumor ablation between February 2001 and September 2004 were retrospectively assessed with respect to the anaesthetic technique employed and postprocedure outcomes. The clinical, radiological, and
anaesthetic data of individual patients stored in the hospital’s computerized database was collated and analyzed. All patients underwent routine haematological, biochemical, and coagulation investigations as well as ultrasonography, and CT scan for tumor localization and estimation of tumor volume. All patients were treated at our institute by the same clinical team. The procedure was performed by a hepatobiliary surgeon, usually with an interventional radiologist in attendance. Patients were treated using a Berchtold (Tuttlingen, Germany) radiofrequency generator system having a power output of 10-50 RF watts and continuous low volume isotonic saline perfusion monopolar RF needle of 1-2 mm diameter, of varying lengths (15-25 cm) with conducting tip (10-20 mm). The needle formed the active electrode, while a large plate attached to the patients thigh or back formed the neutral electrode. Needle was inserted under ultrasound guidance through intercostal, subcostal or direct puncture access, and throughout the procedure monitoring was undertaken with ultrasound probe (3.5 to 5 MHz probe). Amount of radio energy (watts/sec) to be delivered was calculated according to the volume of the tumor. Complete treatment was defined as thermal destruction of the tumor and a 1 cm margin of surrounding liver.3

A standard anaesthetic and surgical protocol was employed in all the patients. Initially, all the patients were sedated by giving IV Midazolam 1 – 2 mg, IV Fentanyl 25 – 50 µg, and IV Propofol 25 – 100 mg. This was followed by Propofol infusion at the rate of 25 – 75 µgkg⁻¹min⁻¹. The surgeon infiltrated the site of puncture with 2% Lidocaine Hydrochloride (Xylocaine) 3 mgkg⁻¹ prior to insertion of radiofrequency needle, which was done under ultrasound guidance. All aseptic and antiseptic precautions were taken and antibiotic prophylaxis was given. Following treatment all patients were observed to detect side effects or complications arising from the procedure. IV Fentanyl and IV Tramadol were given for post procedural pain. IV Ondasetron 4 mg IV was given in patients who complained of nausea. Patients were subjected to CT imaging within seven days of treatment to detect any areas representative of viable tumor. If suspicious viable tumor remained, retreatment was undertaken.

Results

Patient demographics (table 1)

The total number of patients included in the analysis was 24 (15 males and 9 females). The age of the patients was between 18 to 73 years (mean age 54 ±11.7 years). All the patients were of ASA physical status II and III.

<table>
<thead>
<tr>
<th>Table - 1 : Patient demographics.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total no. of patients</td>
</tr>
<tr>
<td>Male:Female</td>
</tr>
<tr>
<td>Mean age (years)</td>
</tr>
<tr>
<td>Liver tumors</td>
</tr>
<tr>
<td>Pancreatic tumors</td>
</tr>
</tbody>
</table>

(mean ± SD)

22 patients had metastatic tumors of the liver (gall bladder- 7, colorectal-8, breast- 6 and carcinoid tumor of bronchus- 1). 2 patients had locally advanced inoperable carcinoma of pancreas.

Radiological data (table 2)

Total number of lesions in liver were 73, with each patient having 2 – 8 metastatic lesions. 15 lesions were less than 3 cm diameter, 44 lesions were 3 – 5 cm, and 14 lesions were larger than 5 cm. 43 lesions were located superficially, 30 were deep, and 13 lesions were subdiaphragmatic.

<table>
<thead>
<tr>
<th>Table - 2 : Radiological data.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total lesions in liver</td>
</tr>
<tr>
<td>Size of lesions</td>
</tr>
<tr>
<td>&lt; 3 cm.</td>
</tr>
<tr>
<td>3 – 5 cm.</td>
</tr>
<tr>
<td>&gt; 5 cm.</td>
</tr>
<tr>
<td>Site of lesion</td>
</tr>
<tr>
<td>superficial</td>
</tr>
<tr>
<td>deep</td>
</tr>
<tr>
<td>subdiaphragmatic</td>
</tr>
</tbody>
</table>

Procedural details

In 8 patients the procedure was conducted comfortably under sedation analgesia with local anaesthesia. 16 patients required general anaesthesia. Sedation analgesia was successful in cases where:

- lesions were located deep in the parenchyma and were < 3 cm in size.
- The lesions were not subdiaphragmatic in location.

The chief causes for conversion to general anaesthesia were:

- Pain during passage of radiofrequency current in 9 patients (56.25%).
- For respiratory standstill and controlled apnea during tumor mass location in 3 patients (18.75%).
c. For lesions adjacent to diaphragm in 2 patients (12.5%).

d. For pancreatic lesions in 2 patients (12.5%).

There was a mean rise in systolic blood pressure by 19.5 mm Hg (18.8%) from the baseline and a rise in mean heart rate by 20 beats/min (19%) from the baseline during passage of radiofrequency current in patients under conscious sedation. In patients under general anaesthesia the mean rise in systolic blood pressure was 5.68 mmHg (5.38%) from the baseline and the mean heart rate increased by 8.12 beats/min (27%) from the baseline.

Outcome: CT imaging 7 days post procedure revealed that:

a. All index tumors measuring less than 3 cm diameter showed complete ablation in both groups.

b. Incidence of incomplete ablation was more in larger tumors (3-5 cm) under sedation analgesia as compared to general anaesthesia group (20 (74.07%) vs. 7 (25.92%).

c. No lesion measuring > 5 cm in both the groups showed complete ablation after a single session.

Post procedural pain at ablation site (grade 2) was present in 2 patients in the sedation analgesia group. Response to IV Ondansetron was good and all the patients in the sedation analgesia group resumed normal oral intake within 5 hours post procedure. 2 patients in the general anaesthesia group started oral intake only after 9 hours due to persistent nausea. Mean hospital stay for both groups of patients was 24 hours. There was no procedure related mortality or major morbidity. 2 patients were discharged after 7 days due to surgical morbidity (one had developed ascites and the other had developed self limiting pleural effusion).

Discussion

The term radiofrequency ablation with reference to focal malignancies applies to coagulation induction from all electromagnetic energy sources less than 900 KHz, although most currently available devices function in the 375-500 KHz range.4

RF ablation works by converting radiofrequency energy into heat. Alternating current is passed from an electrode tip into surrounding tissues and generates sequential changes in the direction of locally charged ions. This in turn causes frictional heating, which causes tissue desiccation and produces a localized area of coagulative necrosis.5 The procedure is believed to be a revolution in the treatment of cancer by minimally invasive technique, having a good technical efficacy, low morbidity and good outcomes in terms of patient survival, quality of life and palliation. Anaesthetic literature regarding the procedure is not well defined. However mention has been made in surgical and radiological literature of conscious sedation with local anaesthesia being given.6 Conscious sedation has been defined by the American Dental Society of Anaesthesiology as “a minimally depressed level of consciousness, that retains the patients ability to maintain the airway independently and continuously and to respond appropriately to physical stimulation and verbal command; produced by pharmacologic and nonpharmacologic methods, alone or in combination”.7 In 66% of our patients, we observed that we had to convert to general anaesthesia. This decision to convert was based on the observation that patients discomfort was interfering with the procedure and the maximum recommended dose of the drug was already given, so it was deemed inappropriate to further increase the dose which might cause airway depression and cardiorespiratory compromise. Even with appropriate conscious sedation techniques, patients may experience pain during ablation procedures.8 Pain during passage of radiofrequency current was found to be the most common indication for conversion to general anaesthesia in our study as has been reported by another study also.9

The change in heart rate and blood pressure by 20% during passage of radiofrequency current seen under conscious sedation was not seen under general anaesthesia. We attribute this to the attenuation of the noxious painful stimulus under anaesthesia.

In cases of subdiaphragmatic lesions where intercostal or subcostal punctures are done, there is the risk of diaphragmatic or pleural injury. To prevent this, a period of controlled apnoea and respiratory standstill with partial pulmonary inflation is normally required.10 In our experience this also helps the physician performing the procedure to accurately localize the lesion by ultrasound probe and facilitates correct placement of the needle.

The assessment of complete ablation of the index tumor is difficult. Most investigators rely on cross sectional imaging with ultrasound immediately after the procedure and CT scanning or MRI later on. However, once the process of ablation begins, the transient hyperechoic zone that develops within and around the tumor makes it difficult to judge the margins of treatment.11 In our patients, monitoring was done using ultrasonography intraoperatively while follow up was done with intravenous contrast enhanced CT scan, which clearly demarcated the necrosed area. We observed that patients who underwent the procedure under general anaesthesia showed a significantly increased zone
of ablation. Also in moderately large tumors of 3-5 cms, the incidence of incomplete ablation of index tumor after a single setting was more under conscious sedation than in patients under general anaesthesia. This may be attributed to better control of needle placement as well as a relaxed patient, which allows better dispersion of current and increased volume of coagulation. This has been reported in another study also where volume indexes of lesions treated under general anaesthesia were significantly larger than those treated under sedation analgesia. Of interest is the fact that this difference in tumor ablation was not seen in sizes less than 3 cm diameter.

In our institute, the services of the anaesthesia department are called upon for the successful conduction of the procedure. We have found that a good evaluation prior to the anaesthetic is a must, with emphasis on the medical history, lab investigations, and cardiovascular status, since these patients usually present with associated co morbidity. Once the plan of anaesthesia is decided upon, the procedure should be performed with complete monitoring of blood pressure, pulse, respiration, and peripheral oxygenation. Deep conscious sedation with local anaesthesia may be adequate in many cases, however McGahan et al quote that in patients with chronic pain due to cancer who are on routine analgesics, those with a history of alcohol or drug abuse or those with a low tolerance for pain may not tolerate the procedure under sedation. General anaesthesia is also to be preferred if the treatment is going to be extensive and the procedure is expected to last for 3 hours or longer. Choy et al report that general anaesthesia was required in patients because of pain related to ablation of superficial tumors or those adjacent to the diaphragm. This factor was observed in our study also. We suggest that a prior knowledge about the site and location of the lesion is also a factor that will influence the choice of anaesthetic.

Complications following the procedure may be related to the needle placement like bleeding, infection, tumor seeding along the needle tract, or damage to the duct, vessel or hollow viscera. They may be related to the thermal therapy like non-target thermal damage, grounding pad burns or in patients with pacemakers. General and systemic complications like electrolyte imbalance or hypotension due to the underlying medical condition is sometimes present.

A substantial minority of patients experience pain at the ablation site or shoulder tip pain with the decrease of the anaesthetic in the immediate recovery period for several days, occasionally lasting one to two weeks following an ablation procedure. In our case also pain (grade 1) was experienced in 2 patients, which however had no impact on the discharge time. The incidence of post procedure nausea and vomiting in our patients was 20% more in the General anaesthesia group where inhalation agents were given. This correlates with another study where the incidence of postoperative nausea was found to be reduced after total intravenous compared with inhalation anaesthesia. Based on our experience we recommend the routine use of IV Fentanyl and IV Ondansetron in the immediate post procedure period in all patients. Post ablation syndrome, a transient self limiting symptom/sign complex represented by fever, nausea, vomiting, arthralgia, headache, and loose stools are not infrequent and may persist for weeks.

Conclusion

Radiofrequency tumor ablation is a safe minimally invasive procedure having a low peri interventional morbidity and mortality. Choice of the anaesthetic technique depends on both patient factors and the site, and size of the tumor. Good anaesthetic support ensures both maximum patient comfort and technical success of the procedure.

References


CONFERENCE CALENDER 2006-07

1) 45th Annual Conference of ISA Delhi Chapter
   15th – 16th April 2006
   Contact : Gp. Capt. R. Chaturvedi
   Dept of Anaesthesiology and Critical Care
   Army Hospital, Research and Referral, Delhi Cantt – 110010
   Tel : 011-23338260, Mob : 09313531970
   E-mail : ravinirachaturvedi@gmail.com

2) CME-2006 Theme : Update in Paediatric Anaesthesia hosted by ISA Belgaum City Branch and Dept. of Anaesthesiology, J.N.Medical College and KLE’S Hospital and MRC Belgaum.
   4th June 2006
   Contact : Dr. Sriram Sabade
   Organising Secretary, Department of Anaesthesiology,
   J.N.Medical College, Belgaum.
   E-mail : drprkotur@hotmail.com; isabelgaum@hotmail.com
   Ph : 0831-24091292/24091184,
   Mobile : 9845681424; 9448130159

3) Interactive Symposium on Clinical Monitoring
   2nd July 2006
   Contact : Dr. P. K. Dash
   Additional Prof. Dept. of Anaesthesiology,
   Sree Chitra Tirunal Institute for Medical Sciences and Technology, Trivandrum - 695011
   Ph : 0471-2524184, Mobile : 09349324672
   E-mail : aw2006@sctimst.ac.in

4) Indian Society of Anaesthesiologists Taminadu and Pondicherry Annual State Conference TANCON 2006
   8th and 9th July 2006
   Contact : Dr. AL.Meenakshisundaram
   Organising Secretary,TANCON-2006
   10, Phillomina Nagar, Thanjavur-613006
   Mobile : 9361616969
   E-mail : tanc2006@hotmail.com, Leosun_2000@yahoo.com

5) 10th National Conference of International Trauma Anaesthesia and Critical Care Society (Indian Chapter) TRAUMA CRITICARE 2006
   8th - 9th and 10th September 2006
   Contact : Dr. B. K. Singh,
   40, Khadani Colony, Main Plan Road,
   Agra – 282 002 Uttar Pradesh
   Mobile : + 91983704871
   E-mail : dr_bksingh2006@yahoo.co.in

6) XI Rajasthan State Conference of ISA
   RAJISACON 2006
   9th and 10th September 2006
   Contact : Dr. Rajan Nanda/ Dr. P. Bajaj
   Organising Secretary
   27 A, Amar Kutilya, Ambavagarth Marg,
   Near New Bridge, Udaipur - 313001
   Ph : 0294-2431722 / 0294-2560495
   Mobile : 9829040412 / 9441416049

7) 13th Maharashtra State Conference of I.S.A
   MISACON 2006
   6th, 7th and 8th October 2006
   Contact : Dr. Sameer V. Sohani,
   Org. Secretary
   Janaki Sadan, 117 B, Shukrawar Peth, Satara – 415002
   Mobile : 9822057562
   E-mail : miscacon2006@yahoo.co.in

8) 28th Annual Conference, I.S.A UPISACON-2006
   28th – 29th October 2006
   Contact : Dr. Aditya Kumar
   Org. Secretary/Assoc. Prof.
   Dept. of Anaesthesiology,
   S.N.Medical College, Agra.
   Phone : 91-562-2603185, Mobile : 91983738598
   E-mail : upisacon.2006agra@gmail.com

9) International Conference of Paediatric Anaesthesia
   4th - 5th November 2006
   Contact : Dr. Dilip Pawar
   Venue : AIIMS, New Delhi
   Ph : 09868397819,
   E-mail : dkpawar@hotmail.com
   paediatricanaesthesiacon@gmail.com

10) RSACP 2006
    10,11,12 November 2006
    Contact : Col. (Dr.) K. K.Upadhyay
    Department of Anaesthesiology and Critical Care
    Armed Forces Medical College, Pune
    Ph : 020-26300306, 26300274
    Email : rsacp2006@rediffmail.com, Website :www.rsacp.org

11) 54th ISACON Annual National Conferences
    of Indian Society of Anaesthesiologists
    ISACON - 2006 Refer page No : 135