PERCUTANEOUS THERMOABLATION IN PATIENTS WITH PRIMARY AND SECONDARY LIVER CANCER – EARLY RESULTS

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Liver is common place where the cancer occurs primary as well as secondary. Liver resection as a potentially healing method can be performed only in about 20% of patients. Prognosis in group of patients treated non-invasively is bad. Using high frequency thermal ablation which damages the neoplastic tissue in liver may lead to prolongation of life expectancy.

The aim of the study was to assess the early results of using the high frequency thermal ablation in patients with primary or secondary cancer.

Material and methods. During years of 2001-2007 371 patients underwent the 520 procedures of percutaneous RF thermal ablation under US control. Mean age of patients was 62.47 (19-85 ± 11.63). 175 women and 196 men were treated using this method.

Results. There were 10 early complications after thermal ablation (1.92% of procedures, 2.7% of patients). Two of them ended fatal (0.38% of procedures, 0.54% of patients). In seven cases abscess formation were observed, one of them was the cause of death due to Clostridium perfringens infection. Cholerrhagia from damaged bile duct in cirrhotic liver caused the peritonitis and subsequent death of patient. Two patients suffered from sub-capsular hematoma of liver. 14 patients also suffered from long lasting pain (more than 14 days).

Conclusions. Percutaneous thermal ablation in primary or secondary liver tumors is safe and efficient procedure. Long term follow up will give the knowledge about the real value of the procedure.

Key words: thermal ablation, liver tumor, liver metastasis
cally there have been concepts for palliative
treatment, for example percutaneous alcohol
injection (PEI) of the tumor. Alcoholization is
quite efficient method in case of HCC - espe-
cially in cirrhotic liver - however the method is
not efficient in metastases (8, 12, 13). In some
kinds of digestive tract cancers metastasis to
liver are frequent and have significant impact
of the patient life expectancy, on other hand in
majority of cases (up to 38% for colorectal car-
cinoma) its occurrence is limited to the liver
only (4, 9, 14, 15). Therefore it can be stated
that complete destruction of cancer foci may
lead to improvement of patient’s chance for
healing.

Many methods such as PEI and cryoabla-
tion were used in order to destroy liver cance-
rous lesions in the past (7, 12, 13, 16, 17). No-
wadays thermal ablation is preferred as a me-
thod which can lead to destruction of tumor in
a quite safe way. Most spread technique world-
wide for this reason is thermal ablation using
radiofrequency ablation (RFTA). This particu-
lar method uses the alternating current (A/C)
with the frequency of 300-500 KHz which in-
creases the temperature locally without stimu-
lating the patient’s nervous system. A/C gene-
rated by the machine induces ions agitation
close to the active electrode – the movement of
ions increases the temperature above the cell’s
ability to survive. It is proven, that tempera-
ture above 60 degrees of Celsius causes death
of every neoplastic cell. The main aspect of
thermal ablation is to increase the temperatu-
re in whole three-dimensional space in a pre-
dictable manner.

The aim of the study is to show the results
of primary and secondary malignant tumor
treatment using RFTA.

**MATERIAL AND METHODS**

In the period from April 2001 till February
2007 in the Department of General, Endocri-
ne Surgery and Transplantation of Medical
University Gdańsk 371 patients were treated.
All of them had malignant tumor. 520 percu-
taneous thermal ablations using RFTA were
performed. The average age of the patient was
62.47, 175 women and 196 men were treated.
Retrospectively patients medical histories as
well as complications after thermal ablation
were examined.

All patients fulfilled the following criteria’s:
1. The primary or secondary tumor was pre-
sent
2. The number of liver lesions less than 8
3. The diameter of lesion less than 8 cm for
metastases, for HCC - without limits
4. The lack of possibility of surgical treatment,
with the exception of people who were abla-
ted during pre-transplantation period (bridge
to transplantation)
5. The lack of non resectable extrahepatic le-
sions, exceptions were patients with ovarian
cancer (cytoreductive ablation).

Contraindications to surgery were dissemina-
ted cancer and severe coagulation disorders.
Patients with cardiac stimulator were consul-
ted by cardiologist. The basis for radiologic
examination was computed tomography with
the 5 mm layer. Patients with contradictions
to CT were examined using magnetic resona-
ce tomography (above 1T). The ultrasonogra-
phy of abdominal cavity was performed in all
cases in order to estimate the possibility to per-
form percutaneous thermal ablation.

HCC were diagnosed using histopathologi-
cal or EASL (Barcelona) criteria. In cirrhotic
livers tumor larger than 2 cm in diameter was
recognized as HCC if radiological (picture typ-
ical for HCC in two separate investigations)
or mixed criteria (image typical for HCC and
AFP level more than 400 ng/ml) were met.
Biopsy was not considered to be necessary in
case of patients with typical metastasis lesions.
Dubious tumors were biopsied using 14G or
16G needle under the control of US or CT.

The qualification to surgery was performed
jointly by two surgeons experienced in liver
surgery and at least one radiologist and onco-
logist. Patients with potentially resectable le-
sions were directed the surgery or transplan-
tation.

The criteria of non-resectability was lack of
possibility to remove tumor with margin of
healthy tissue. The reason for disqualification
from the resection surgery could have been also
poor general condition (in ASA score) and pa-
tient’s refusal.

**Technique of procedure**

All patients examined in this study under-
went the percutaneous ablation. The procedure
was performed in total intravenous anesthesia
(TIVA) or in the deep sedation combined with
local anesthesia of skin and liver capsule. The
Percutaneus thermoablation in patients with primary and secondary liver cancer – early results

Way of anesthesia depended on the size, number and localization of tumors and general condition of the patient. The indication for local anesthesia and sedation were contradictions to general anesthesia and at least 2 cm distance from capsule, major bile ducts and hilus of liver. In particular situations (when visualization of lesions demanded cooperation with the patient) insertion of electrode was performed in local anesthesia and the process of ablation was continued in TIVA. During the operation all necessary data of patients condition were monitored. There was possibility to change the way of anesthesia to general anesthesia.

The thermal ablation was performed with the usage of Radionics Cool-Tip®, Radionics Inc., Burlington, MA, USA. Alternating current generator and one of two types of electrode cooled by a water of 4 degree of Celsius. Tumors with diameter up to 3 cm were ablated using single electrode (length 15-25 cm with active part 3 cm long), larger lesions were ablated using combined (“cluster”) electrodes. If the use of cluster electrodes was not possible (e.g. due to intercostals access only) tumors were treated with single electrode using “overlapping technique”. The insertion of electrode into a tumor was monitored in real time with the usage of US with head-s frequency of 3.5-5 MHz. Siemens Sonoline Prima and Aloka 1700S were used.

The increase of temperature nearby the tumor was observed as a hyperechogenic area with tendency to enlarge. Thermal ablation was considered as successful when the hyperechogenic zone completely covered the tumor with a 5 mm overlap. In case of treating HCC usually the ablation zone did not exceed the tumor borders. It is so because of tumors character, which is well hydrated and as a result it conducts current very well in contrary to fibrotic, cirrhotic liver tissue. In the literature this phenomenon is called “oven effect”. Single session of thermal ablation lasted 12 minutes. In case of big lesions time needed to ablate was prolonged up to 72 minutes (6 x 12 minutes) per lesion. After finishing the process internal temperature was examined. The ablation was accepted as successful ablation when the temperature reached over 60 degrees of Celsius. Removal of electrode was under constant US control and the coagulation of needle path (“track ablation”) was done. Control US investigation after few minutes was done to obtain an information about potential bleeding from the liver surface. Patients were discharged next day after surgery with the exception of people among whom complications occurred.

RESULTS

Among 371 patients treated with thermal ablation method 106 were done because of HCC, 3 due to cholangiocarcinoma (CCC) and 262 because of metastases (tab. 1 and 2).

There were no intraoperative complications noticed. In two cases bleeding from liver capsule was observed just after the operation. Both patients with this complication were treated due to HCC in cirrhotic liver and they suffered from thrombocytopenia. In both cases watchful waiting using US and blood examinations was used. There was no need to re-operate any patient.

There were two deaths in the perioperative period. Biliary peritonitis due to puncture of intrahepatic bile duct in cirrhotic liver (Child-Pugh C patient) was the main cause of liver insufficiency and death in one patient. This patient was re-operated during 48 hours, gallstone blocking the common bile duct was removed. Fulminant Clostridium perfingens infection was the cause of death of second patient with 12 cm HCC. After first – incomplete ablation, abscess formation was observed. The abscess was drained and after 4 weeks of antibiotic therapy, second attempt to obtain complete ablation was performed. This patient died in the 5th postoperative day after second ablation. In six other cases of abscess creations were observed. In one case unintended burn of colon adjacent to 6 cm liver metastasis was the cause of this complication. In four further patients abscess formation was connected with previous pancreatoduodenectomy.

Table 1. Description of non-resectable group of patients with hepatocellular carcinoma treated by percutaneous thermal ablation

<table>
<thead>
<tr>
<th>Hepatocellular carcinoma</th>
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</thead>
<tbody>
<tr>
<td>Number of patients</td>
</tr>
<tr>
<td>Mean age</td>
</tr>
<tr>
<td>Sex (W:M)</td>
</tr>
<tr>
<td>Number of changes</td>
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<tr>
<td>Size of changes</td>
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<td>Number of thermoablations</td>
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Percutaneous drainage was the method of choice in these cases and all patients were cured on this way. In the majority of patients thermal ablation caused increase of body temperature up to 38 degree of Celsius for up to 2 weeks. We consider this phenomenon as a “postablation syndrome” and treated the patient palliative only.

In 14 cases prolonged (above 3 days) pain after thermal ablation was noticed. It demanded the narcotic drugs administration. In the majority of cases it was connected with subcapsular tumor location. In one case the intercostal nerves block was needed.

**DISCUSSION**

Treatment of tumors located in liver is still a challenge for modern medicine. The diagnosis of liver metastases significantly worsened the prognosis. Patient’s cure is possible only if all cancerous tumors are destroyed or resected. Palliative resection of tumor does not influence on prognosis. The resection with healthy tissue margin remains a method of choice (“gold standard”) for treatment. At least 1 cm margin should be preserved. Complicated liver anatomy and tumor biology makes resection possible in only 20% of patients with colorectal cancer liver metastases, which is the most common cause for liver surgery. About 50% of all patients suffered from colorectal cancer will become liver metastasis. In about 35% of these patients liver metastases will be the single place of metastatic disease which significantly reduces life expectancy. In this group local tumor destruction may lead to radical prognosis improvement. HCC in European countries develops mainly on the basis of liver cirrhosis. The function of the liver is decreased due to cirrhosis and “big” resections of liver tissue are contradicted. The solution to this problem has been searched for many years on two ways. On the one side improving the surgical methods (segmental and sub-segmental resections) and on other hand the more improved technology of local ablation.

Physical or chemical methods are used in order to destroy tumors. Alcohol injection improves the prognosis among patients with cirrhosis and HCC. Due to different tumor biology this method should be not recommended for solid metastases, due to unpredictable results - movement of alcohol along the liver tissue which may cause the unintended damage. Cryoablation was widely applied from the sixties.
of the previous century. This method which uses very low temperatures gives a predictable effects of tissue destruction. The disadvantage of this method is the need to open the abdominal cavity and the costs. The advantage of cryoablation is the possibility to apply it in addition to resections in case when the 1 cm margin cannot be achieved (3, 16, 18, 19, 20).

The technique of high temperature cancerous tissue destruction is based on presumption that in the temperature above 60 degree of Celsius the life processes of every cells stops immediately (21). Nowadays three main methods of thermal destruction are applied:

1. LITT = Laser Interstitial ThermoTherapy.
2. MCT = Microwave Coagulation Therapy.
3. RFA = RadioFrequency Ablation.

The advantage of LITT is its compatibility with magnetic resonance tomography which allows very precise “on-line” temperature localization so very low rate of recurrences can be obtained (22). The disadvantage of this method is small (less than 2 cm) destruction zone for single optical fibre and the costs of laser equipment and long-term MR use.

Since eighties of the previous century usage of microwave diodes to obtain high temperature has been used. The microwaves application leads to fast increase of temperature (in seconds). Simultaneous usage of multiple electrodes allows extension of the destruction area. Very fast increasing of temperature leads to destruction of vessels and bile ducts and high complication rate (up to 20 percent) (22).

Thermal ablation using RFT allows to obtaining large ablation area with the limited percentage of complications. In order to achieve 3 cm ablation zone there is a need for long time – several minutes. Ablation of larger lesions demands longer time.

The rate of complications after RFTA is from 0 to 9 percent (23, 24). The most common complications after thermal ablation are abscesses (25, 26). They might appear between eight day even to five months after the procedure.

Rare appearance of complications after thermal ablation are:
1. Thrombosis of big vessels (portal vein).
2. Movement of tumor cells along the electrode (track seeding).
3. Damage of nearby placed organs.
4. Occlusion of vessels and bile ducts.
5. The burn of the skin in place where the needle is inserted (27, 28, 29).
6. Bile duct damage.

The experience of the team has undoubted the impact on the success of the procedure. The burning of the skin (by neutral electrode) occurred once, in the case when big tumor was ablated during laparotomy. The other issue is the pain felt by patients after the surgery. In few cases the pain might be intensive, demanding prolonged treatment. The majority of patients has good tolerance to percutaneous RFTA, which allows to treat them in one day surgery mode.

CONCLUSIONS

Percutaneous thermal ablation is one of the safest ways to destroy the cancerous tissue with low rate of perioperative mortality and morbidity. The further follow up of patients should show the usefulness of thermal ablation in the treatment of primary and secondary liver tumors.

REFERENCES

Thermoablation is one of the local methods of treating hepatic tumors. Qualification criteria towards the procedure have not yet been explicitly determined. Thus, different centers perform the procedure, although indications vary. The Authors of the study qualified patients towards thermoablation, both with isolated and numerous hepatic lesions (eight) metastasized from colon cancer. The size of the lesions ranged between 0.9 and 7 cm. Similarly significant size and number differences were observed in case of primary and secondary tumors from other organs. Therefore, how can one compare the efficacy of the method in case of a 0.9 and 7 cm lesion? Another observation is the large differentiation of the character of the metastatic lesions. Most metastatic lesions were derived from colon cancer, although thermoablation was also performed in case of pancreatic and sarcoma metastases. Pancreatic metastases to the liver are a questionable indication towards any procedure, due to the biology of the tumor. Similar reservations concern sarcomas. Technically, the procedure can be performed. However, is it oncologically justified?

Unfortunately, the Authors of the study did not present early treatment results (after three months for example). The technique of the procedure and direct complications, such as liver abscesses were mentioned. It’s too bad that the Authors did not mention the efficacy of treatment, based on CEA (colon cancer) and AFP (hepatocellular carcinoma) values. Nowadays, criteria of the efficacy of thermoablation on the basis of postoperative CT or ultrasound exami-
nations are well-known. Distant results require several years of observations, which is not easy. However, if controlled investigations will not be undertaken a clear answer concerning whether the presented method is objectively beneficial, will be missing.

The center where the author of the study is Head of department performs thermoablation as a supplementary method, or as the bridge to transplantation. Based on our experience 50-60% of patients and not 20% are qualified towards resection. The above-mentioned is connected with the vast experience of the team and aggressive approach towards surgery. Many patients after thermoablation are directed to our center. The above-mentioned is not a contraindication towards resection, although it is technically more difficult.

In conclusion, thermoablation is a supplementary method of treating patients with hepatocellular carcinoma. In case of metastases one should consider, whether in view of the oncological non-radicality the patient be exposed to the procedure, which is not fully safe.

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