

LAPAROSCOPIC LIVER RESECTION PROCEDURE
PERFORMED LIVE FROM THE UNIVERSITY
HOSPITAL IN CINCINNATI, OHIO.
Broadcast May 27, 2004

INTRODUCTION:

Welcome to the live internet broadcast of a laparoscopic liver resection procedure from the University Hospital in Cincinnati, Ohio. Today, surgeon Steven M. Rudich and Joseph F. Buell will demonstrate two innovative procedures to treat liver tumors: a radiofrequency ablation and laparoscopic liver resection. A liver resection is the surgical removal of a portion of the liver and is performed to remove various types of liver tumors. Depending on the size, location and type of tumor, a resection is the best treatment option for some patients. However for those patients that are unable to tolerate a removal, radiofrequency ablation is another treatment option. RFA is also done laparoscopically and uses alternating current radiofrequency that heats and destroys tumors.

SURGEON

After laparoscopic surgery, much as in laparoscopic cholecystectomy or laparoscopic colectomy, our patients return back to a normal activity. There are no restrictions whatsoever. We even believe that their overall activities increase and are improved over someone that has had conventional open surgery.

INTRODUCTION CONTINUED:

Dr. Joseph F. Buell, Assistant Professor of Surgery at the University of Cincinnati College of Medicine, Division of Transplantation, will be demonstrating the procedure. Dr. Steven M. Rudich, Associate Professor of Surgery at the University of Cincinnati College of Medicine, Director of Liver Transplant Service, will be moderating the live event.

SURGEON

We see a lot of patients that are cerotic, that have bad liver disease, advanced liver disease already. If you could perturbate them in a more gentle fashion and invade them in a less violent way I am convinced, and I think we are convincing a lot of people, that the patients do better.

INTRODUCTION CONTINUED:

Viewers can send in their questions via email by clicking the button below. And here is your host Dr. Steven M. Rudich.

DR. STEVEN M. RUDICH

Good evening. Welcome to the University of Cincinnati. We are in operating room Number 6 in which we are watching the beginning of a laparoscopic live resection. My name is Dr. Steve Rudich. I am Director of Liver Transplantation Services at The University of Cincinnati and I welcome you. In the operating room with me is one of my partners and colleagues, Dr. Joe Buell as well as Dr. Mark Thomas. Dr. Buell will you please introduce the people in the operating room.

DR. JOSEPH F. BUELL

Welcome to the operating room. This is my partner Dr. Thomas. Our fellow Dr. Tivar. We have our anesthesiologist Dr. Lind up here. And we have our nurses. We have Selina. We have Dan and Terry here. As you can see Dr. Thomas is going ahead and doing a laparoscopic ultrasound at this point looking at the liver lesion in the left lateral. We have three-port technique laparoscope which is angled with a laparoscopic hand-assist device which we have already mobilized the liver (and if you would back out your ultrasound), we actually mobilize the entire left lateral segment and we have a fairly sizable lesion here, probably about 9.5-10 cm greatest diameter. We have mobilized the left side of the liver down to the vena cava here and we have significant mobility so we can do transection so I am going to feed it back to you Steve so that we can talk about our RFA patient.

DR. STEVEN M. RUDICH

Yes, first of all I would like to tell you something about this patient. This patient is a 45-year old male who was found to have a 10 cm hemangioma in the left lateral segment of his liver; If we could come here to his CT scan, you can see here is one of the cuts of his liver taken on a biphasic CT, the outline of the patient's liver and you can see it shows up on our arterial phase as well as staying on the portal phase. We see a relatively large, approximately 10 cm hemangioma that is impinging upon the patient's stomach. He has a relatively normal-looking spleen and some of the hepatic venous architecture. This patient was having some early satiety as well as some continued pain. Nothing being seen in our multidisciplinary liver clinic, it was decided that he might be a very good candidate for laparoscopic liver resection. And is such is in the operating room now after clearance undergoing this procedure. We would also like to remind the viewers that if they have any emails, any questions, they can email us and I believe that the email address is on the website. In addition, prior to this, as a prelude to this we also performed the laparoscopic radiofrequency ablation which is something that we have done quite a long time, and quite frequently here at University of Cincinnati as part of our multidisciplinary liver disease program as well as part of our liver transplant service. I would like to now take some time and look at some presentation that we have put together, while Dr. Buell and Dr. Thomas go along with the laparoscopic resection.

Hepatocellular carcinoma as most people know is one of the ten most common lethal cancers in the world. Cedivadate co-morbidities in Western countries include alcohol related cirrhosis as well as chronic Hepatitis B and C infection. Only about 10-15% of newly diagnosed cancers are potentially resectable. About 20-30 years ago there was a very high mortality with liver resection, upwards of 10-30% in most series. A lot of this was due to perioperative hemorrhage. In about the past 20 years this mortality has decreased markedly. Most likely secondary to modern anesthesia, critical care as well as probably the better segmental anatomy that we now have. This shows the system of Couinaud in which we see in the slide the liver is divided into eight segments. This is well known to us. The left lateral segment which Dr. Buell and Dr. Thomas are resecting today would be considered Couinaud segment two and three. The right lobe of the liver is considered to be segments five, six, seven, eight. The small Caudate lobe is segment one. Also shown on the bottom of this slide is some of the typical, topical anatomy which we teach our residents and medical students. Traditional open resection which this slide shows, is a large 23 cm hepatocellular tumor, entails a relatively large operation usually commonly known as a Mercedes Benz type incision. Relatively prolonged hospital stay. Pain issues as well as the complications of potential hernias. This is the classic way in which we still do many types of liver resections. This slide shows in segment "A" what would be considered to be a classical right lumpectomy. Segment "B" would be a classical left hepatic lumpectomy. Segment "C" would be a right sided tri-segmentectomy, segment "D" would be a left lateral segmentectomy, and segment "E" would be a left tri-segmentectomy. This is some data which is commonly known. It shows some of the survivals that we have gotten to know from liver resections. Bismuth, Whisocki as well as Bolgetti are some very well known and very well published liver surgeons. You can see that over all hepatic surgical resections generally give a one year survival of upwards of 70% depending upon the disease state. Three year survivals or less most likely due to recurrent disease. Dr. Buell, Dr. Thomas and myself have been some of the leaders in this part of the country in determining and looking at minimally invasive procedures to perform liver resections. Some of the things that we have done in the past, and we will show you, will be radiofrequency ablation, which we do laparoscopically. You will see here the continuation of a left lateral segmentectomy done with laparoscopic techniques. We are also one of the few centers in the country which do isolated hepatic profusion for patients that have un-resectable cancers that are non-metastatic. And we are one of the largest centers in this area for liver transplantation.

RFA produces local heating, generally above 100 degrees centigrade. It is done by ionic agitation of a series of tines that is set up to a computer that oscillates very rapidly with alternating current. Tumor cell death occurs as tissue temperature exceeds generally 45-50% centigrade. This thermal agitation and treatment results in protein denaturation, DNA clumping and fracture. (could we roll the beginning part of the tape please?) There are various array sizes and probe points that are used. The device that we use is made by Boston Scientific, and if you look down on the further end you see the tines that are released which encompass the tumor. There is now actually a 5 cm probe and upwards and down to a 2 cm probe. And if you look at the video on the right you are looking at an ultrasound in which we gain access and target the lesion. The probe, which is coming in from the left-hand side enters into the lesion. The tines are then extended, and we document this with the ultrasound probe which you see is being moved. And once we document that the tines are underneath the mass, the current is turned on and there is generally two cycles of thermal ablation that we perform. You see here the tines, this is from a 3.5 cm probe – this is on the PowerPoint presentation on the left. The RFA source, and there are different devices that are used. We have been very happy with the Boston Scientific product.

There are other products out there who used slightly different means of obtaining thermal ablation. On the PowerPoint presentation is looking at what some of the tumors look like. This is on an animal model that had been thermally ablated. They achieved coagulation necrosis and then often times when we transplant these patients we then look at the explants and we try to make a measurement of the degree of tumor killed with tumor necrosis. We generally look to achieve a 90-95% kill rate. We also see work in other people we start looking ptosis of these lesions and we see a marked degree of cellular ptosis. There are multiple ways in which you need to position the patient, depending upon where the tumor is. If the tumor is on the lateral segments of the liver, that would be segments 6 and 7, we generally put the patient on the right sided-up position. And sometimes in fact we need to use the harmonic scalpel to take away some of the right triangle attachments of the liver, to let the liver drop to be a mid line structure, and that gains us access to the lesion. And you see here on this PowerPoint presentation what the post operative result looks like. It becomes a cystic type of a mass or lesion and often times the radiologist get very upset when they see this postoperatively; they don't know that the patient had thermal ablation. For lesions that are in the left segments, left medial segment as well as the anterior segments of the liver, that would be segments 5 and 8, we often times can just do a supine approach. As shown in the PowerPoint presentation we use an Argon beam coagulator as well as intraoperative laparoscopic ultrasound at length. We found out with experience with this that you look for different densities of echogenicity and sometimes it is quite difficult to see these lesions with the ultrasound probe. And in fact when the lesions get to be small enough, .about 5 - .75 cm, it is hard to see them and sometimes we just have to take good guesses and do correlations with the CT scans. We use intraoperative ultrasound exclusively. We found it to be extremely important and one in fact one the main workups that we have for liver transplantation. This is about staging using laparoscopic ultrasound. You can see on this slide over here you can see an echogenic tumor mass and this is what we are trying to target.

The placement of the RF probe does not need to be totally in the liver and often times if the lesions are big enough and too big we often times will do two or three separate burns of them. And we have been very successful with this. The finished ablation site looks like the liver is actually heated up and we see a lot of coagulation and necrosis in there. The tumor changes that we see afterwards, we look for increased echogenicity in the lesion, and that shows us that we had a good thermal ablation injury. So far we have done about one hundred lesions in nearly sixty patients. We have done nearly all of them in a laparoscopic manner. We have treated an average of about two lesions with a size of nearly five centimeters. Our outcomes have been very good. Most of our practice entails cirrhotic patients that have been referred to us for liver transplant evaluation. This has been a very good and safe modality for this. Our major complications have included increased ascites, some wound infections and we had one death in a patient that was probably stretching the limits too much in terms of the magnitude of his cirrhosis. Now I would like to turn the table back to Dr. Buell who will let us know where he is in the procedure in terms of his laparoscopic resection of a hemangioma in the left lateral segment.

DR. JOSEPH F. BUELL

Well, welcome back to the operating room. Dr. Thomas here is going ahead using the tissue link here, which is a coagulation device to open up our transection plane. You will see that it produces concentrated heat by water and electrocautery. It is a simple and easy device that allows us access into the parenchyma. Once we have opened it up, and we can slow the water

down just a little bit, we will then use the harmonic scalpel to narrow the tissue. The harmonic scalpel will allow dissection into the liver parenchyma whether it be normal or cirrhotic and will allow us to place the endo-reticulating vascular load staplers in. The staplers allow compression sealing of the liver substance. In the earlier devices such as ultrasonic dissectors we have significant problems with bile leaks. We find by the application of stapling devices we have decreased our incidence. Normal incidence of bile leak is somewhere around seven percent. When we initially used a harmonic scalpel as our only sole device for division this reached nearly twenty percent. This lead us to question whether or not we could perform laparoscopic liver resection. By using the application of the reticulating old staplers we have decreased this incidence down to approximately five to six percent, much like open procedures. And usually in surgery we try to use our normal open techniques and translate them into laparoscopic techniques. However with the development of the laparoscopic stapling devices, we have now moved our open practice to use with staplers. So here, we have done the opposite of what normally occurs in general surgery and transplant surgery. So you can see that Dr. Thomas is doing a good job coming through with the parenchyma right now. Why don't we go over to the tissue hook. You can see that we have opened up the liver parenchyma, and on the back side we will again trace out the area and get into the parenchyma and then we will be able to apply our staplers. The biggest consideration in laparoscopic liver surgery is the size and the location of your lesions. Initially Dr. Thomas used the laparoscopic ultrasound, which indicated the extent and size of our lesion, and the proximity in which it was located to the portal vein and hepatic veins. When we come across the hepatic vein, there has always been a consideration of CO₂ air embolism. What we found in our instances and in our experience with our urology colleagues performing laparoscopic prostates, if we get into bleeding we can actually increase the CO₂ pneumoperitoneum and this eliminates or decreases the amount of bleeding. We have not had any instance of CO₂ air embolism in forty patients which we performed nearly fifty resections on thus far. So Dr. Thomas is slowly going through the parenchyma and soon we will be able to apply the reticulating load staplers. We are changing our ultrasound dissector currently so that we can proceed with the harmonic scalpel. (Shall we give that a try again now?) Alright. (Why don't you back up and we will switch devices).

Now with laparoscopic liver surgery we have to make significant considerations for interoperative bleeding. We have on our set obviously and open set for conversion. We are also well aware that if we need to provide some form of hemostasis we have laparoscopic suturing devices and we are very familiar with suturing because of the performance and help that we provide to our urologic colleagues, and that we can suture a bleeder if necessary. There are two main mechanisms that we can use for hemostasis. One is the dissectors, either the harmonic or the tissue link which provides direct heat onto the parenchyma, or we can use the application of a stapler again leaning into the parenchyma. So there are two variable ways that we can control. I think that the majority of programs that are starting these types of procedures should rely heavily upon the hand-assist device, because if Dr. Thomas were to get into bleeding, which he won't obviously, we could apply pressure on the liver parenchyma, and then re-apply either a stapler or suturing; so that way there is complete control of the operation. I would say in about ninety percent of our cases we do employ the hand-assist device. Another thing that is important is that laparoscopic surgery, whether it be RFA or it be open resection techniques, I believe, has expanded the potential patients that can be operated on. So those patients that are a child's "B" or "C" classification are common patients in our practice. (Why don't you turn to the lateral aspect) So these patients because they are minimal incisions the incidence of ascites, leak or herniation or any of these complications are minimized compared to our open patients. Thus we believe

that we can provide better service to our patients by a laparoscopic route. I think that the commitment that the University of Cincinnati has been significant to provide us with insight and ability to do these procedures. (Are you ready to start transecting with staplers? Let's have the hook again, Why don't you take a little bit of the corner here)

DR. STEVEN M. RUDICH

As we are proceeding showing some staplers, we have also prepared a PowerPoint presentation looking at some aspects of our laparoscopic liver resection program. This slide over here shows a 3 cm lesion, hepatocellular carcinoma in the left lateral segment, in a cirrhotic liver and I think it is important to understand, as Dr. Buell mentioned, that these kinds of procedures, these minimally invasive procedures, are just perfect for patients that have cirrhosis. Particularly child class "B" and child class "C". This slide over here shows a large tumor as well as it also reviews a laparoscopic Babcock clamp being used with the harmonic scalpel. It is very important, as Dr. Buell mentioned, that we make a very concerted effort to do excellent positioning of these patients and we do strongly believe that experience with a hand-assist port is vital to be able to do this safely. We are able to put hemostatic agents into the abdomen through the hand-port, it gives you the ability to do hand compressions. And I think it also makes it much easier to do not only taking down the triangular ligaments on the left hand-side but also on the right.

DR. JOSEPH F. BUELL

Steve, we are going ahead with the transection with the stapling device. You will note that it is an articulating device. Dr. Thomas is slowly compressing. Liver substance will tend to bleed and can tear with the staplers. But if we perform it slowly and execute very cautiously usually these are very very reliable instrumentations. Again when he un-articulates and takes a staple load out that again will be a slow mechanism. There are several things that can occur: There can be some venous bleeding, back bleeding from either side. This can be controlled as an open liver surgery with a harmonic scalpel, or what we can do is we can use the application of the Argon beam, (Mark why don't you Argon beam that hemangioma area). Or we can use other types of devices. Such as Flo-Seal, this is a hemostatic agent which is much like the old cryo glues which will provided hemostasis and we will use it as an application once we have completed the transection on the residual tumor. Now, using the ultrasound and instances (that's good, let's go ahead with the stapler) where we have malignant tumors, we treat it much as an open procedure where we go ahead with a 1-3 cm resection margin. So we are as cautious as we are with open procedures as well and I think this kind of confirms that we can provided as much a transection margin over to the medial aspect as possible, and because this is a benign hemangioma previously known, we are not going to get overwhelmingly excited about getting a large margin in this situation. Steve back to you.

DR. STEVEN M. RUDICH

Yes, we want to continue with the presentation here and as Dr. Buell was saying, there are multiple toys and tools that we have to cut through the liver parenchyma and I think it is important to gain experience with these prior to really doing these kinds of advance procedures. As Dr. Buell mentioned, we use a tissue link device and we have found it to be very good in going through parenchyma. It takes a little bit sometimes to get use to in terms of a flow of the saline but it works well. We also house the harmonic scalpel and basically we use this to just cut

through the capsule of the parenchyma to get our transection margin set up. The approach to do a right lobectomy is again, notice the hand-porting here. The importance of putting the hand inside, it enables you to get a good traction on the liver and again we think this is very key. We use the harmonic scalpel to take down the right triangular ligament as well as the left one. The parenchymal transection which Dr. Buell is doing right now is often times done with the stapling devices. We have been very happy with them. There are several different manufacturers that supply them and we have been pleased. In addition, we also used the hot cautery as well as again the tissue link, and you see here on this slide we did a right lobectomy and you can see the enormity of what was done laparoscopically. We have also taken away and also resected symptomatic hepatic cysts. You see on this slide over here a large cyst occupying a great deal of anterior segments of the liver. It was very easy to take this down with the laparoscopic staple, you get a good seal along the epithelium and we have done several large hepatic cysts that were symptomatic very simply and easily and safely using laparoscopic technique. As Dr. Buell mentioned, hemostatic agents are very important. We use Flo-Seal quite liberally. We use TSeal, New-Net surgical as well as the harmonic scalpel and again I think experience using these in open procedures is very important to getting your confidence for when you start doing these advanced laparoscopic procedures. You can see on this slide over here where we used TSeal. This comes as a spray as well as a drip and also when you have your hand inside, this also enables you to further direct it to seal towards your resection margin. In addition, we of course use the Argon Beam. So in conclusion, thus far hepatic surgery is the process of undergoing a minimally invasive revolution, that is quite clear. Emerging technological advances both in instrumentation as well as agents to promote hemostasis will allow surgeons to further push the envelope insofar as safe and effective hepatic resections. We believe that this type of surgery should be performed by surgeons that are intimately familiar with both hepatic anatomy as in transplant surgeons are those that have special hepatobiliary training as well as those that are familiar with advanced laparoscopic techniques.

DR. JOSEPH F. BUELL

So Steve, it looks like we have already finished a transection. We are trying up here for a minute. Mark is using his Argon beam. I would like to go ahead and get the Flo-Seal, that's a hemostatic agent, and I will show you the application with laparoscopic device soon and then we will remove the specimen. Let's go ahead and clean our camera. I am going to remove our specimen currently

DR. STEVEN M. RUDICH

And you can see the utility of the hand-port, the hand-port is used to extract the specimen. We generally do not use bag retractor on these but depending upon the type of cancer and some other issues, we can put a laparoscopic bag inside to take out the specimen. In this case, since this is a non-malignant lesion, we have decided to just take it out routinely through the hand-port as you see an overhead shot, the specimen has been taken out. I believe that Dr. Buell will show you the size of this hemangioma that was just removed.

At this point we would like to address some questions that came in by email.

DR. JOSEPH F. BUELL

So obviously this is a fairly significant size hemangioma. You can see the breadth of this. This is probably about 30% of his overall liver size. We have lost maybe about 50-75cc of blood. I think this has gone rather smoothly. Once Steve takes some questions, I would like to address the enormity of the size of the lesions that we can approach, and those lesions that we are a little hesitant still to approach. Go ahead Steve.

DR. STEVEN M. RUDICH

Thank you very much Joe, good job, good work.

DR. JOSEPH F. BUELL

Thanks buddy.

DR. STEVEN M. RUDICH

First question comes in, once healed, does the liver fully function like new or is its function inhibited? This is a very good question. Most people know from experience we have gained through live liver donors, the liver regenerates quite quickly and so using these laparoscopic techniques and the laparoscopic staplers, we have seen no inhibition of liver function whatsoever. We should also add for those of you that are security conscious, you do not go off in airport security devices.

Second question comes is, as patient with cirrhosis and portal hypertension and esophageal varices and has a diagnosis of autoimmune hepatitis, the patient wants to know would he be a candidate for such a procedure?

Again, patients that are best made for these types of procedures are those that have cirrhosis, that do not have a marked amount of portal hypertension and that we have been relatively generous with patients who we can offer this type of procedure. Again, we operate for patients that have certain types of malignancies and no, not extremely large ones, a lot for benign diseases such as hepatic adenomas, fibronodular hyperplasia, as well as for hepatic cysts. I think it is still a bit unclear in terms of for large tumors whether laparoscopic techniques are somewhat advantageous.

A patient would also like to know how aggressive can you be with this type of operation? This is a question coming in from Florida. We have performed upwards of right-sided tri-segmentectomies as well as significant right lobectomies using laparoscopic techniques and you see with familiarity with the stapling devices, with familiarity with the hand-assist port and the good use of harmonic scalpels as well as the use of hemostatic agents, I think that once you gain experience with this type of procedure, you can really be relatively aggressive. You cannot do everything you can do open such as high dissections of the porta. You cannot do obviously very fine bile duct work, but in terms of parenchymal lesions, I think that outside of relatively few things and very large tumors, laparoscopic techniques will soon become the gold standard. Dr. Buell back to you, can you tell us where you are.

DR. JOSEPH F. BUELL

Yes Steve, it looks as if we have got the lesion taken care of (put that on). Dr. Thomas has Flo-Seal in this hand, which is the hemostatic agent, once we get our camera back in we will take a look at the edge of the liver, see if we need Argon beamage, the Flo-Seal get applied as almost a glue-type. Once we are sure that hemostasis is accomplished here, then we will use another instrumentation called T-Seal. TSeal is much like a glue, that glue will be placed over the liver edge and make a seal. I think that has also helped us decrease the incidence of...(and here we go) Dr. Tivar has placed the scope back in and you can see that we are fairly hemostatic here in this situation. Let's go ahead and beam this little lateral corner up here. The most significant bleeding can occur from this area right here, which is where the hepatic vein comes out of, but you can see there is no active bleeding, there is just a little bit of ooze here, Dr. Thomas will go ahead and beam this down and then we will place the Flo-Seal and TSeal. As Dr. Rudich as mentioned, we have approached significant size lesions, the largest tumors that we have removed are 20-30cm. These are cystic lesions but the largest solid lesions we have removed are up to 10 cm as well. We are slowly learning with the techniques and the development to approach lesions that are central as well. We believe in the next year or so we should be able to do laparoscopic biliary surgery as well. There is one group currently doing live donation of the left lateral segment in transplantation. So taking this part of the liver out and giving it to another individual, we hope within the year to two years we will be able to provide a right-sided resection for donation as well; so I think this is a technique in evolution. Once we adapt to even using robotic surgery, that is are next step. Currently we are doing robotic surgery on kidneys and we are planning to move on to robotic liver surgery. We have done some preliminary experimentation and lab work and we are ready to start taking on patients that have biliary tumors and need bypasses performed for biliary cancers, so these are the things that we are working on.

DR. JOSEPH F. BUELL

Very good Joe. We have several more questions and actually some good ones that we would like to address. The first question is what kind of anesthesia workup is needed to perform laparoscopic liver resection? This is a very good question. What we have done in our experience has been that we place in a central line for blood transfusion, the patients are also given a radial artery line and a nasogastric tube. The patients are of course typed and crossed with several units of blood. If the patient is extremely thrombocytopenic, generally less than 30-40,000, we will have platelets available and we often times will do that. Patients with end-stage liver disease that have relatively elevated INR upwards of approximately 1.5 or 1.6, we might give some prophylactic plasma. But generally speaking, these are not extremely intensive anesthesia cases

and we do not routinely float swans or other more invasive procedures. The second question comes is as, what do the patients have to look forward to after the surgery? Well, one of the reasons for doing this type of work is to get the patients out of the hospital much sooner than the standard open case. Our average length of stay is a little over two days. Most patients go home with relatively little pain. We send them home with of course Oxycodone and other narcotics but we have had relatively few severe complications from this. We see that with our cirrhotic child "B" as well as those that have high MELD scores, patients will develop more ascites. We have had several round complications that are relatively rare and again like anything else if experimenting doing something new and pushing forward, we have had one relatively poor patient selection, one gentleman who was a very end-stage cirrhotic with a very high MELD score, and he eventually did succumb to liver failure but that was in our early experience. Joe I would like to take it back to you, can you describe a little bit more about the hemostasis and sort of the final touching up that you are doing on this nice patient.

DR. JOSEPH F. BUELL

Sure, Dr. Thomas here is using Argon beam, Dr. Tivar is helping him see where we are going. You can see that the Flo-Seal has done a nice job obtaining hemostasis along the cut edge of the liver and it is a fine granular substance. So what we are going to do is go to the next substance which is TSeal which is basically a glue that over goes the entire surface which will decrease the risk of re-bleeding and also decrease the risk of bile leak. So once we do this, we will place a drain in the patient and we will call it quits for the day. As you mentioned Steve that (let's use a grasper if you can't get it so slide it) our workups for cardiac or much as open procedure, we do an echo, we do a cardiac workup if necessary. All of our patients do get a central line, that is merely to follow our CVP's, to bring them down so we can do these procedures safely and a lot of this is precaution more than anything else. Even though this is a new procedure probably only performed in a handful of places in the World on a routine basis, our hope is that this will be adapted in the next hopefully 5-10 years to most institutions around the United States because our patients definitely show a benefit. Instead of being in the hospital for 7-10 days for an open resection, we have patients that routinely go home the next day. So I think that this is the forefront of medicine and I think that we are at the right place to proceed with this.

DR. STEVEN M. RUDICH

Great Joe, we have a couple more questions. First of all, someone asked what is the routine postoperative surveillance on a patient undergoing for example an RFA or laparoscopic liver resection? For those patient's that are cirrhotic and are in our liver transplant program, we routinely will see the patient back again about a week after surgery, check on the wound and the first CT scan will be about 6 weeks after the procedure. After that, our surveillance as in most programs is every 6 months and the question is can you go back again and re-ablate the lesion? And the answer is yes you can. If we see some what are called "popcorn or satellite" lesions around the rim of the radiofrequency ablated site, we have on several patients gone back again, although it is a little bit more difficult, it is eminently doable and we have performed ablation of the rim of the previous RFA and we can do that and we have been successful. In terms of our followup for patients undergoing liver resection, we also get routine studies about 6 weeks afterwards. We oftentimes will see fluid collections in these areas like a lot of hepatobiliary patients and unless we see a high bilirubin or high white blood cell count, or other symptomology we watch these fluid collections resolve.

Another question was asked is if this procedure was performed because of disease, is this disease eradicated because of this procedure or do you see recurrence of disease down the line? Well, like anything else in which we do with liver surgery and the operating for cancer, we of course survey the patients and that's what we just mentioned with CT scans and again if someone did have a laparoscopic live resection and they had recurrent disease, we can certainly go back again laparoscopically and either thermally ablate or come back and perform either a laparoscopic or an open resection. We have certainly not burned any bridges by doing this procedure.

DR. JOSEPH F. BUELL

Steve, we are passing our drain up our port site so we do not have to make an additional hole. This will allow us to remove the port and have a drain in place.

DR. STEVEN M. RUDICH

And the question is I would want to ask, what is our indications for placing drains, what is our indications and how frequently do we do this?

DR. JOSEPH F. BUELL

Well I think for drainage, Steve, we like to drain anything over a segmental resection. Those resections that are done in the posterior sectors such as segments 7 or 5 or 6, particularly in the backside of the liver, I like to leave drains because sometimes those have the highest risk for re-bleed but with the new devices with the hemostatic agents that we use and the Argon beam and the hand-assist, this is a lesson we learned early on; if we can provide those the rate of re-bleed is extremely low. In our last 20 patients, we have had no re-bleeds, no returns to the operation. We had two early on cases of re-bleed, one was in a pregnant lady who had a ruptured adenoma in segment 6, so it was a significant problem but she did well after a laparoscopic re-exploration and did extremely well. So I think that those are some of the answers for you Steve.

DR. STEVEN M. RUDICH

I think it is also very important to note that we have liberally used RFA as well as laparoscopic techniques as part of our multidisciplinary liver transplant program and that clearly to perform a minimally invasive procedure on someone that may at some time come up for liver transplantation affords you as the transplant surgeon many obvious advantages of lack of adhesions, as well as a more pleasant abdomen to go to for liver replacement therapy and we certainly, as I mentioned previously it is almost part of our staging for anyone that has any sort of hypervascular lesions to the liver, we routinely use laparoscopy, RFA, intraoperative ultrasound to elicit this.

Joe, good job, good work and we very much appreciated having the ability of showing people out there what we are capable of doing here at the University of Cincinnati. We are happy to say that I think that we are one of the leaders in certainly this part of the Country and perhaps the Country in terms of laparoscopic surgery.

DR. JOSEPH F. BUELL

Do we have anymore questions coming in yet. It looks like we have another question coming over the line here. As far as it looks like they are asking if our patients that we are selecting to do these procedures are potentially not candidates in other facilities. And I think both Steve and I agree that the answer is yes. People who have tumors that are in Childs "A" cirrhotic are normally not accepted as the primary patients to be treated. However Childs "B" and Childs "C" patients are not. We have done approximately 6 or 7 resections on cirrhotic patients currently and we have almost 60 or 70 patients that we have done RFA and Childs "B" and "C", so I think that our willingness to go ahead and operate on these people and evaluate them for liver transplantation is significant. What would you say about that Steve?

DR. STEVEN M. RUDICH

I certainly agree with that, I think that especially maybe here in Ohio we are a bit conservative in terms of wherewithal and aggressiveness to list and workup for transplantation that we have had many patients that are cirrhotics that are in some instances thought to be non-operative candidates, even non-transplant candidates because of possible lesions and I think the ability to do laparoscopic surgery and laparoscopic RFA and to do this safely without spreading disease has certainly added a great deal of what we have to offer people here in Ohio and hopefully other places in the Country, absolutely.

DR. JOSEPH F. BUELL

And it looks like there is one more question over here. It looks as if they are asking if are we recommending this for cancer patients and who is the ideal patient? Well I think obviously as we have learned today, this patient would have gotten a large incision across his abdomen, he would have wound up in the hospital for at least a week, he would have taken 6 weeks for recovery. Here I think this young man will be discharged tomorrow, he will be driving his car by the end of the week and he will be in good shape. So people with benign tumors of the liver are the optimal candidates for this. They no longer have to undergo open operative surgery. They can undergo a laparoscopic minimally invasive surgery and really go back to their normal recovery very rapidly.

DR. STEVEN M. RUDICH

Well said. Another question comes is as to can radiofrequency ablation be used for several metastatic liver lesions in size and I think this is maybe something we did not address. The optimum size in which to do RFA would probably be about under 5 cm, there is now a 5 cm probe, there will probably be a longer probe and a wider probe. There is some problems with doing such a long, big RFA but we routinely do upwards of 4-4.5 cm and really the amount size and the amount of tumors in the liver is really determined upon the patients that you have waiting in the operating room. It oftentimes takes it could be 20 or 30 minutes to do each thermal ablation. There has to be done two cycles and we oftentimes will do two different burns on each lesion and we have done upwards of 5, 6,7 lesions on some occasions but also depends upon how big your liver is and sort of what kind of liver reserve we think you have, but it is really, if its upwards of 5 or 6 lesions in the liver, depending upon the patients that we have that day, we will do up to, I mean that is definitely attainable wouldn't you say Joe.

DR. JOSEPH F. BUELL

Yes, I definitely agree with you Steve, I think that the other important thing is those patients that normally were not RFA candidates say intrahepatic cholangiocarcinomas, non-colorectal metastases, renal cell cancers, lung cancers, gastric cancers, there is small series to indicate that is survival benefit for ablation or surgical excision and we have had several patients with cholangiocarcinomas up to 30 cm. These patients normally survive 3 months. Some of these people survive 2 years with multiple radiofrequency ablations. If we decrease the morbidity and we decrease the mortality for these patients, we can provide survival benefits. So I think it is important for individuals to have advocates and physicians to act as advocates so that we can provide quality life to individuals with cancer.

DR. STEVEN M. RUDICH

Yes, that is well said. The other thing that we need to also mention is that there are some downsides to doing RFA. It is not totally perfect. Again, we are looking at a 2-dimensional screen using two small chopsticks, we have gained a great deal of experience using ultrasound on this and in think ultrasound is probably the biggest tool that has helped us to target lesions and target them successfully. Somebody also did ask a question Joe and lets address some of the sealants that we used. As you know we have multiple applications that we use. We have TSeal, we have Flo-Seal, we have New-Net surgical and people want to know sort of are there any complications or problems post-operatively in using these biological sealants?

DR. JOSEPH F. BUELL

Well you know Steve, I think the one benefit which we have seen and we have gone ahead and done multiple RFA's on patients and then proceeded onto transplantation, when we apply TSeal to these patients during laparoscopy, they have decreased adhesions so actually we find TSeal to be a benefit. As we mentioned during the surgical procedure, the use of TSeal has decreased our bile duct leak rate so I think it has been very beneficial to us. The second part of that question was how aggressive a bleeding can be use with Flo-Seal? I think that for us, in open and laparoscopic surgery we use it very liberally. Those patients that have venous bleeding or small arterial bleeding, we find it to be very beneficial. Obviously if you have arterial bleeding that is squirting or spurting, that is probably not the situation that you want to be dealing with Flo-Seal, or if you have a sizable lesion of a vessel, if you can see it, you probably should not be using Flo-Seal on it.

DR. STEVEN M. RUDICH

But that is where again Argon beam comes in as well as your ability to doing base to caporal suturing. You have to be able to do that. If you can't do that, then I don't think you can safely do these types of operations. But we have had no problems using these sealants, we use them liberally in our liver transplant practice as well as our hepatobiliary practice. Also, another question came in and Joe why don't you address this one. Can we use RFA on any other organs in the body?

DR. JOSEPH F. BUELL

Absolutely. I think that there is some new trials that are going to be coming out that indicate that radiofrequency ablation can be used in breast cancer and it is efficacious. There has been some suggestion that pancreatic lesions that might be resectable can also be radiofrequency ablated. Those lesions that are found in the kidney particularly have been treated with cryoablation which is the alternative to radiofrequency ablation which is a cold or freezing technique. Some of the new trials have demonstrated that the radiofrequency ablation has an equivalent efficacy. So I think in the next 5 or so years we will see radiofrequency ablation being used more commonly. In those instances where we use the cryoablation of freezing, it increases the risk of fracture or breaking of the liver, the kidney or other solid organs. Thus, heating does not allow the fracture of an organ and I believe it is more safer. I don't know Steve, what do you think?

DR. STEVEN M. RUDICH

Yes, I have to agree with you on that. I think when I was a Resident years ago, Washington University 10 years ago we did cryoablation and I think it was very clear that there is relatively few groups, certainly not at the cutting edge like we are here that are really experimenting extensively with cryoablation. I think that we have been pleased since we have been here, the past year to year and a half extensively using RFA, particularly in our cirrhotic populations. We have another question coming in and Joe why don't we talk about this a little bit. Someone asked about the economics. Is there, and I know it is very hard to come up with, in a big Institution like ours, the Health Alliance is Cincinnati, multiple hospitals, its oftentimes difficult to get economic data. Do we have any data from anyone elsewhere or any other groups showing any kind of cost benefit performing laparoscopic liver resection surgery, laparoscopic RFA and I think in the overall, of treating liver disease, not only in the hospital but also treating liver disease, is there any data out there about this?

DR. JOSEPH F. BUELL

Well, actually, it will be on your desk, but we are actually looking at this right now and we did the similar study with laparoscopic donor nephrectomy. The premise is where we are in the operating room we are using a lot of fancy tools, very expensive but the premise is the patient goes home earlier. So when you look at costs/risk benefit ratio, it costs the same as an open procedure or sometimes less. Now you will notice that we did use a lot of stapler loads through the liver when we transected it and that was the left lateral segment. Often if we are performing a right hepatic lobectomy or left hepatic lobectomy, we may fire 25 loads. This will increase obviously the intraoperative cost. However, it balances out with the Hospital stay. That is merely for the patient to get outside the door. But, if you look at socioeconomic, these patients get to go back to work, they do not put a strain on the system and I think that is the true benefit. For a patients who really have peace of mind that they can have this done minimally invasive and be back to their normal life without having a significant intrusion. I think that is priceless.

DR. STEVEN M. RUDICH

I have to agree with you. We had our hepatobiliary clinic today and we saw multiple patients that had RFA's and it is truly just amazing that most of these people are back to work within a very

short period of time and it is very much interesting for me to see the difference between the patients that have had the open surgery with the standard Mercedes Benz incision versus those that have had the hand-assist port and that have had laparoscopic resections, it really is...

DR. JOSEPH F. BUELL

Obviously I had to reminisce about the old days, but 10 years ago when I was a medical student, 25% of these patients died when they came out of the operating room. And for us, our mortality is less than 2% and these are in extremely high-risk patients. So I think there is a lot to be learned from these procedures and I think you know we have to push the forefront here.

DR. STEVEN M. RUDICH

Yes, I think one of the things that needs to be done for our viewpoint is doing some quality of life surveys, and looking at the quality of life and health adjusting quality of life patients that have had laparoscopic RFA's, laparoscopic liver resections versus open procedures and I think that is going to be very eye-opening. We are just about finishing up with Dr. Thomas. Could we take a look at what the incisions look like and what if finally looks like. Dr. Thomas as well as our Fellow, Dr. Tivar is closing up the incision. I think you will see if you take a look at the on-view shot, we close up the hand-assist port in the standard fashion, 2 layers of fascia with absorbable suture. The wounds are closed using all absorbable sutures, Vicryls, we put steristrips on top of the wounds and then we place some sterile gauze and some Tegaderms. The drain will typically come out very shortly before the patient goes home. This patient I would anticipate would either go home tomorrow or perhaps the day after tomorrow.

DR. JOSEPH F. BUELL

Yes, I think it is important too, we do cosmetic closures on all of our patients. They all have subcutaneous closures. There are no sutures, no staples, nothing to remove and I think that it has been very beneficial, but I do stress to those people out there that if you are endeavoring to proceed with laparoscopic liver resection, it is done cautiously with expertise. You know you want a laparoscopic Surgeon in unison with a Surgeon that commonly does liver surgery. Dr. Rudich and I do liver transplants, we do a lot of laparoscopy, we do a lot of open liver surgery. I think that this has just been an ideal environment and Dr. Thomas who joined us this year. It gives us the clinical expertise on all of these fronts to proceed with doing resections. It has really provided comfort level to proceed with larger and larger resections and I think that it has given us the ability to treat cancers, to treat benign disease and to treat symptomatic diseases. Even people that have active bleeding, we have proceeded with laparoscopic resections. I think that is just a benefit of the experience that we have had here particularly in hepatobiliary surgery and liver transplantation.

DR. STEVEN M. RUDICH

Absolutely, and it has been part of a multidisciplinary program that we have with our Anesthesiologists, our Radiologists, our Pathologists, the surgical oncology guys, and it takes a team effort to do the radiology to interpret this. We have conferences regularly and I think it has added to our ability to treat liver disease in its entirety and not just being able to offer aspects here, aspects there. We can do open, we do a lot of advanced laparoscopically, we then bring

people to liver transplantation. We then bring them to hepatology to treat them afterwards for their recurrent hepatic C and I think it has started to make ours a major liver center in this part of the Country.

DR. JOSEPH F. BUELL

We have really been blessed with our Anesthesiology Colleagues who have done a wonderful job and have adapted to these procedures because there is really no data, there is no prospective randomized trials, this is the forefront of medicine and we are learning how to treat these patients and I think they have done a wonderful job at keeping our patients well, providing appropriate anesthesia, giving us isohemodilution, keeping their kidneys going in hypertensive situations and our Anesthesiologists have been wonderful. They have adapted to intraoperative ultrasounds and they have provided us with some significant quality care.

DR. STEVEN M. RUDICH

One question that came in and this should be addressed as we spoke about how difficult it is or how important positioning is, can we comment on the position of the hand port. Let's talk about both a left-sided lesion as well as right-sided lesion. Where do you place the port, how long do we do it, how much do we measure and do we do muscle splitting, do we do muscle saving? Why don't you describe this and for those surgeons out there that are not familiar with hand-assisted laparoscopy.

DR. JOSEPH F. BUELL

Well you know I think first Steve, it has really worked out well to place the port always on the right-hand side. It is more important where to place the operative surgeon to be honest with you. If you are doing a left-sided operation, you place your hand closer to the midline and a little bit superior. This allows you to place your right hand underneath the left lateral segment and lift it up. I use a lot of finger dissection to take down the triangular ligaments. If you are doing a right-sided lesion, you want to come in with your left hand, again on that patients right-hand side. This allows you to sweep your hand posteriorly and lift all of the triangular ligaments and expose your vena cava, and I think that gives the optimal and obviously as in our laparoscopy donor experience, anytime we can perform muscle splitting, I think that is optimal for patients to recover.

DR. STEVEN M. RUDICH

Someone also asked the question, what are the indications for opening? And also when we do open up, how does the hand-assist port get underway? How does that get incorporated into any possible Mercedes Benz type incision?

DR. JOSEPH F. BUELL

You know in the majority, we have been very lucky Steve to be honest with you. We have not had to convert in 41 patients in almost 50 odd resections. I think that we had been very diligent in placing the hand-assist device so if we needed to convert, we could use a low Chevron incision. So we can incorporate that hand-assist device so I don't think it is a major problem, I

think it is something that we can utilize. As far as the indications for conversion, I think that those would be uncontrolled blood loss, or if the patient has in fact an embolism. We have had one experience during liver transplantation where we had embolism and we recognized it. We have good anesthesiologists, we use TEE-probes, we can identify it and that gives us a situation where we know we need to convert. We have had some bleeding in significant cirrhotic patients with significant size lesions. We have removed tumors, hepatoma approximately 7cm. We were able to remove that with a blood loss of about 650cc but in a situation where you are slowly bleeding, slow loosing but you have control, I think that is relative common sense that it has to prevail more than anything else.

DR. STEVEN M. RUDICH

I agree Joe, and I think that the hand-assist port is really key. It is key for obtaining mechanical compression of liver, key for putting in a laparotomy pad, obtaining topical, putting New-Net Surgicel and I think again the experience with less advanced laparoscopy using the hand port is very important for this and of course in most transplant programs, our program is totally a laparoscopic donor nephrectomy program and in think that is where we initially got our experience using the hand-assist port and learning how to use it.

DR. JOSEPH F. BUELL

Well you know the other thing too that that I think has been beneficial is the mixture of surgical oncology transplantation. You know we have developed the isolated hepatic profusion trial as well. We were able to use heated chemotherapy to treat tumors that are too diffuse for laparoscopic resection or laparoscopic RFA. So pretty much all patients, unless they have diffuse metastatic disease outside their liver, are some for a candidate for intervention here so I think it is a great mix.

DR. STEVEN M. RUDICH

I think at some point it would be nice if we could convince our Chairmen and maybe show an isolated hepatic profusion, I think a lot of people would be very interested in this.

DR. JOSEPH F. BUELL

It seems as if one our local reporters has said hello to us, Channel 12. They are watching us do work and why aren't we wearing gloves? You know we are hard working guys. We appreciate the kindness and the support and I hope you guys are working real hard too because we are.

DR. STEVEN M. RUDICH

I think it is important to note that, at least with the RFA and I really think that if people wanted to start of doing laparoscopic surgery, Joe wouldn't you say doing an laparoscopic RFA is really the way to go in terms of getting use to using intraoperative ultrasound and again it is important for people to know that people that have cirrhosis and end-stage disease, they are the ideal candidates for this and simply because someone is a childs "C" with a MELD of 20-25, it does not mean that they should not be a candidate for laparoscopy RFA.

DR. JOSEPH F. BUELL

The question initiated too was are the surgeons wearing gloves? And actually they are. Let's take a close-up of Mark. Mark can you wave. These are latex-free gloves and they are very thin and they are actually much more dexterous than the normal gloves that we use to wear. We use to wear these cumbersome gray and blue gloves and they were sort of like wearing a rubber tire but these are wonderful gloves where you can feel and they are latex-free and if someone has a latex allergy, we do wonderful for them.

DR. STEVEN M. RUDICH

I would say Liz from Channel 12, in the old days, surgeons did not wear gloves sometimes but they are wearing gloves and we have new things that we scrub our hands with. But again, we would just like to acknowledge our Chairmen and the leaders that help run the University of Cincinnati for allowing us the privilege of being able to show this and we certainly hope that our Surgeons and Physicians, as well as public out there that are watching this know that there are many techniques that we have available to assist in liver disease.

DR. JOSEPH F. BUELL

I would really like to thank all of the Corporate sponsors for giving us the backing and really giving us the technology to do this because one or two years ago, this was not doable without the devices, the sealants, the products that we use commonly and I think that it is a combination of support, academics, and just gumption to the right thing for people, so we are here for you.

DR. STEVEN M. RUDICH

Thank you very much, we appreciate the privilege of being able to show you this and we hope to see you back again soon for Dr. Joseph Buell, Dr. Mark Thomas, Dr. Tivar, this is Dr. Steve Rudich and we very much appreciated being able to show you some of your work.