

# **Chapter 9**

## **The Donor**

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## 9.1 Introduction

As donor organs are scarce, a detailed donor evaluation and donor management is of the utmost importance. This information will improve the efficacy and efficiency of organ allocation and thereby facilitate maximum utilization of donor organs.

Taking into account that the whole donation procedure (donor detection up to organ procurement) takes a long time, a standard set of minimal donor data was developed in order to facilitate this procedure.

When a donor is reported, this mandatory data should be transferred immediately to the Eurotransplant duty desk. Besides this minimal dataset, additional data can be provided, especially data which might be relevant for additional donor evaluation.

Data must be submitted through DSO.isys (in case of German donor) or through DPA (The Netherlands, Belgium (2007), Austria (2008) and Luxembourg (2009). As of 2008 Croatia and Slovenia have started with their own system, compatible to the ENIS system, to send donor information electronically.

Besides the above mentioned information, guidelines can be found on donor management and organ procurement in this chapter.

### 9.1.1 Definitions with regard to organ donation

#### 9.1.1.1 Donor

A person for whom consent for organ donation was given and who is reported to the Eurotransplant duty desk as organ donor.

#### 9.1.1.2 Utilized deceased donor

A donor of whom at least one organ was transplanted after suffering brain death or cardiac death.

##### 9.1.1.2.1 Brain death donation

A person diagnosed brain dead according to current national regulations and laws on transplantation.

##### 9.1.1.2.2 Non heart beating donation (NHB)

A person whose heart irreversibly stopped beating and who is diagnosed dead according to the respective national laws and regulations and of whom at least one organ is used for transplantation.

Please remember: Not all countries participating in Eurotransplant allow reporting NHB donors or accepting organs from a NHB donor. Accordingly national regulations must be applied.

**Categories of NHBD<sup>1</sup>**

Uncontrolled NHBD

I – Not successful resuscitation outside hospital, dead on arrival at hospital

II – unsuccessful resuscitation inside a hospital

Controlled NHBD

III – awaiting death by cardiopulmonary criteria

IV – death by cardiopulmonary criteria following proven death by brain death criteria

**9.1.1.3 Multi organ donor (MOD)**

A donor of whom at least two organs from different organ groups, e.g. heart and liver, were used for organ transplantation.

**9.1.1.4 Single organ donor (SOD)**

A donor of whom only one organ group, e.g. one lung or both lungs and no other organ, used for organ transplantation.

**9.1.1.5 Kidney only donor**

A donor reported with at least one kidney and no non-renal organ, used for organ transplantation.

**9.1.1.6 Non-kidney donor**

A donor reported with at least one non-renal organ but no kidney, used for organ transplantation.

**9.1.1.7 Living donor**

A living person who donates an organ for transplantation, such as a kidney or a segment of the lung, liver, pancreas, or intestine. Living donors may be blood relatives, emotionally related individuals, or altruistic strangers.

**9.1.1.8 Domino donor**

A recipient of a donor organ, whose explanted organ is used for a consecutive second transplantation. A domino has a primary disease that allows the use of his/her therapeutically explanted organ for a consecutive second transplant.

A domino donor can be considered a living donor if this is in accordance with current national guidelines and/or laws on transplantation.

**9.1.1.9 Non pursued donor**

Consented donor who was reported to the Eurotransplant duty desk as organ donor, of whom no organs were used for transplantation.

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<sup>1</sup> Categories of Non-Heart-Beating Donors. Kootstra G, Daemen J, Oomen A. Transplant Proceedings, Vol 27, No 5, 1995: 2893-2894.



## 9.1.2 Documentation of a donor procedure

Data on the donor can be provided electronically (Schnittstelle, DSO.isys or Donatie Procedure Applicatie, DPA-web service). The data will be automatically entered in the ENIS database.

When the data cannot be provided electronically via the official data exchange programs, the data must be submitted through use of standardized forms by fax or e-mail.

The following standard forms are required:

- 9.1.2.1 Donor Information Form: official documentation concerning organ donor data at time of reporting to Eurotransplant
- 9.1.2.2 Organ Report Form: official documentation concerning donor organs at time of procurement
- 9.1.2.3 Organ Quality Forms: official documentation concerning donor organs at time of transplantation

All forms are available at the members' site at [www.eurotransplant.org](http://www.eurotransplant.org) under 'Forms'. If data is sent by fax or e-mail the most current version of the official forms should be used. The data provided by fax or e-mail will be entered in the central computer by the Eurotransplant duty officers.

All reports must be in English.

### 9.1.2.1 Donor Information Form (DIF): mandatory and optional data

To evaluate the organ for donation and proceed with offering the organ a minimal set of donor information, according to the list, is required. This information needs to be collected and send to the Eurotransplant duty desk. Every donor center and OPO must adhere to these minimal requirements, for each donor reported. These minimal requirements are labeled on the Donor Information Form as mandatory (\*).

Relevant optional data which is available for donor evaluation must be added.

### 9.1.2.2 [www.donordata.eu](http://www.donordata.eu)<sup>1</sup>

All data entered automatically or by the Eurotransplant duty officers can be viewed during the organ offering process by using the web donor reports or via [www.donordata.eu](http://www.donordata.eu).

- A. As of July 1, 2011 exchange of donor information via the web-based application 'donordata.eu' (or similar web-based applications in use within the ET member countries) is mandatory.
- B. In exceptional cases, donor information is allowed to be provided in other ways (e.g. by fax). Exceptional cases will only be considered as such if they are included in the 'donordata.eu exceptional case description'.

A description of exceptional cases will be established prior to implementation of ROPC03.10 (e.g. technical calamities).

For further information concerning this subject please see section **9.2.3**.

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<sup>1</sup> Recommendation ROPC03.10. January 26. 2011

### 9.1.2.3 Organ Report Form

There are three organ reports available at [www.eurotransplant.org](http://www.eurotransplant.org).

- Thoracic organs (heart/lung);
- Liver/pancreas;
- Kidney.

These forms have to be filled out by the transplant coordinator (general donor data) and by the procuring surgeon (organ data) to evaluate organ quality at the time of procurement. At the end of procurement, the transplant coordinator has to verify the completeness of these forms.

Each organ report consists of three copies.

- **One copy should be included with each organ;**
- **One copy should be sent to the Eurotransplant Duty desk;**
- **One copy should be filed at the donor reporting center or organization.**

The data on the organ report sent to the Eurotransplant Duty desk are entered into the central computer database for quality assurance and data analysis.

### 9.1.2.4 Organ quality form

There are four organ reports available at [www.eurotransplant.org](http://www.eurotransplant.org).

- Thoracic organs (heart/lung);
- Liver/pancreas;
- Pancreas islet;
- Kidney.

These forms are used to evaluate the quality of the organ as well as the quality of the procurement at the time of unpacking and, if executed, at implantation.

Findings on anatomic, possible iatrogenic damage (caused by explantation or by packaging), damage by transportation and initial organ function should be indicated.

For each organ procured, either by a local or by a visiting team, an organ quality form should be completed by the transplanting surgeon.

Each organ quality form consists of three copies.

- **One copy of the form is sent to the head of the procurement center;**
- **One copy should be sent to the Eurotransplant Medical Administration;**
- **One copy should be filed at the donor reporting center or organization.**

The data, provided to Eurotransplant, is entered into the central computer database for quality assurance and data analysis.

In case of procurement or procedural problems, that can possibly jeopardize the suitability of an organ for transplantation, the Eurotransplant Duty desk has to be informed immediately. Eurotransplant will then immediately discuss the problems with the physician in charge of the transplant center. He/she has to decide immediately whether or not the organ is still accepted for the selected patient. If this is not the case it has to be decided together with the transplant center and – depending on the individual situation and progress of the donation procedure – the donor center whether to continue the organ allocation as a rescue allocation or as a regular allocation.

In all such cases a copy of the organ quality form, accompanied by a complaint letter, has to be sent to the Eurotransplant Medical Staff and the OPO in charge of this

procedure within one week, indicating the cause of the possible/actual loss of the donor organ(s) for transplantation. These findings will be reported to the head of the involved transplant programs, the OPO and to the Medical Director of Eurotransplant. They will decide if further action is necessary and inform the Organ Procurement Committee if necessary.

For further information concerning this subject please see section **9.2.8**.

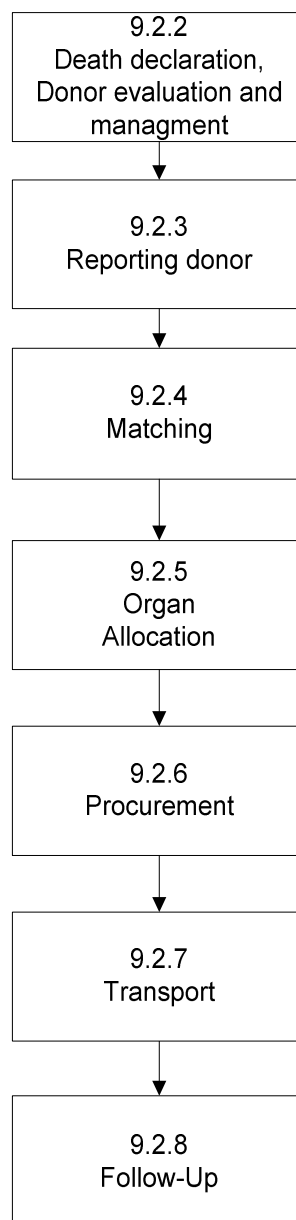
## 9.2 Organizational aspects

### 9.2.1 Introduction

Successful organ recovery and subsequent transplant outcome both depend on a proper donor evaluation, donor management and donor reporting. The following organ procurement flow chart gives a quick overview of the organizational aspects. Details will be discussed in the following sections.

#### 9.2.1.1 Organ procurement flow chart

### Progress of organ procurement



## **9.2.2 Donor evaluation and management**

### *9.2.2.1 Death declaration of the donor*

Prior to the donor evaluation, declaration and documentation of death, according to the national regulations, should be established.

In addition to the death declaration, eligibility for organ donation should be done evaluated and consent for organ donation has to be obtained. In case of an unnatural death, legal authorities have to be contacted.  
There is a special procedure in case of Non heart beating donor (donor evaluation before death declaration).

### *9.2.2.2 Donor evaluation*

Complete donor evaluation and characterization is crucial for an organ offer and accepting an organ offer. This information is often helpful in planning the further donor management.

Donor evaluation includes a detailed medical chart review, assessment of the medical and social history, a full physical examination and necessary laboratory tests.

Organ related physicians of the donor center should be consulted to determine organ viability. The above mentioned physicians may also give support in establishing an optimal donor management plan.

Parallel to the donor evaluation, blood samples for AB0- and HLA- typing should be sent to the affiliated tissue-typing laboratory and virology/bacteriology tests should be performed. The minimum required donor data, according to the Eurotransplant guidelines, should be collected.

### *9.2.2.3 Donor management*

Donor management should start as soon as possible in order to facilitate a successful organ recovery.

As each donor is unique, additional measures, depending on the outcome of the donor evaluation, have to be taken in order to optimize organ recovery.  
As donor management is basically the responsibility of the doctor in charge and most of the donors are on the ICU, a donor management protocol should be available at the ICU ward of each regional donor hospital.

For further details on Donor Management please see section **9.3**.

## **9.2.3 Report to Eurotransplant**

After the donor evaluation is completed and a donor management plan has been developed, all necessary donor information (please see section 9.2.4.1) should be gathered. The data should be submitted preferably electronically using one of the official data exchange programs or – if this is not possible - sent by fax or e-mail using

the donor information form (DIF).

At the time of reporting the donor to ET the preferred time frame for the organ explantation should be provided. This proposed time frame should take into account possible difficulties during organ allocation or organizational problems from the side of the organ procurement teams. Therefore, a time frame of at least 6 hours between reporting to the Eurotransplant duty desk and the planned start of explantation should be honored. If there is evidence that the clinical condition of the donor does not allow such a time frame - a shorter period for allocation must be agreed upon after consulting the Eurotransplant duty office.

Currently the procurement of the abdominal organs is typically performed by local explantation teams while the thoracic organs are in general procured by an explantation team from the accepting transplant center. In exceptionally cases a local abdominal organ procurement team is not available. If this situation occurs, the transplant coordinator has to notify the Eurotransplant duty officer. The transplant centers can then be informed about this situation by Eurotransplant, if possible already during the offering process. Then arrangements can be made for an explantation with one of their own teams.

#### 9.2.3.1 *Electronic donor reporting*

Currently all Eurotransplant countries are using systems to report a donor electronically.

##### 9.2.3.1.1 Schnittstelle

In Germany the use of a national electronic data exchange program on organ transplantation "Schnittstelle", is mandatory for reporting a donor to the Eurotransplant duty desk, unless this is not possible for a valid reason.

##### 9.2.3.1.2 Donor Procedure Application – web service, (DPA-web service)

In the Netherlands, Belgium, Luxembourg and Austria a national electronic donor reporting system, the Donatie Procedure Applicatie or DPA, is being used. Croatia and Slovenia have their own system compatible to the DPA – web service for sending donor information electronically

## 9.2.4 **Match relevant donor data**

Some of the donor data will influence the composition of the match list and therefore have to be reported, if possible, prior to the matching process. The Eurotransplant matching system compares donor data to recipient data.

The first step in the matching process is the selection of potential recipients based on the **donor blood group**, taking into account the rules set up by the different Organ Advisory Committees. The rules for the specific organs can be found in the respective chapters of this Manual (please see section 9.2.4.1.2).

#### 9.2.4.1 *Minimal donor data for reporting a donor*

For reporting a donor to the Eurotransplant duty desk electronically, by fax or e-mail a set of minimal donor data is mandatory. If these data are not completed, standard allocation of the organs by using the ENIS system is not possible.

#### 9.2.4.2 Minimal data for matching

The list below entails the minimal data that must be reported before Eurotransplant duty desk can start the match or the allocation.

##### Data mandatory for match

Registration date	Hospital name
Center	Contact person
ABO	Contact tel nr.
RH	Death cause
Donor type (HB, NHB)	Death date
Date of birth (DOB)	Admission date
Sex	Intensive care date
Height	Ventilation date
Weight	Cardiac arrest

Virology (HbsAg, HbcAb, HCV, HIV)<sup>1</sup>

HLA (kidney donors)

#### 9.2.4.3 Donor profiles and matching

The next step in creating the match list is filtering based on the center- and recipient-specific 'donor profiles' entered into ENIS. In this 'donor profile' several organ specific items (see below) can be entered and only the recipients with a 'donor profile' that fulfills the donor data will appear on the match.

Note: Every change in the following mentioned donor match criteria will have an influence on the match on a patient level or on the whole match.

##### Match criteria for all organs

- ABO-blood group;
- Age;
- Virology -HBsAg, HBcAb, HCVAb;
- Domino Donor;
- Sepsis;
- Meningitis;
- Malignant tumor;
- IV-drug Abuse.

For definitions of sepsis, meningitis, IV- drug abuse and malignant tumor please see section 9.2.4.2.1

##### Match criteria specific for heart:

- Height in combination with gender;
- Virology - CMV IgG.

##### Match criteria specific for lung:

- Total lung capacity (TLC) (combination of age, gender and height);
- Virology - CMV IgG;
- Non Heart Beating Donor.

<sup>1</sup> Has to be known before transplantation, but preferable at time of reporting the donor

**Match criteria specific for liver:**

If the donor is considered to be a 'marginal donor' only the recipients with 'marginal donor: Yes' in their profile will appear on the liver match.

- Criteria marginal liver donor: one or more of the following points:
  - Donor age > 65 years;
  - ICU stay with ventilation > 7 days;
  - BMI >30;
  - Steatotic liver > 40%;
  - Serum sodium > 165 mmol/l;
  - SGPT > 105 U/l;
  - SGOT > 90 U/l;
  - Serum bilirubine > 3 mg/dl.
- Non Heart Beating Donor

Cut-off point: donor weight, especially < 46 kg vs. ≥ 46 kg

The allocation algorithm for pediatric donors (<46 kg): pediatric patients (<46 kg) are listed above the adult patients (≥ 46 kg) in the same urgency code group.

**Match criteria specific for pancreas:**

- Non Heart Beating

Donor Cut-off point: pancreas match of a donor age > 50 and or BMI ≥ 30 will be an islet match. SU and ACO recipients who need a vascularized pancreas will still come on top of the pancreas islet match

There is a possibility to force a vascularized pancreas match in ENIS but this should be announced when reporting the donor.

**Match criteria specific for kidney:**

- Kidney en bloc (≤ 5 years) (mandatory < 2 years, advisable ≥2 years and ≤ 5 years);
- Human Leukocyte Antigen (HLA) Mismatch;
- Non Heart Beating Donor.

Cut off point: donor age ≥ 65 years will be matched via ES(D)P match instead of ETKAS match

9.2.4.3.1 Definitions of sepsis, meningitis, IV-drug abuse and malignant tumor

9.2.4.3.1.1 IV-drug abuse

**Yes** = intravenous drug abuse within 3 months before donor registration  
**Unknown** = no certainty of IV drug abuse within 3 months before donor registration  
**No** = certainty of no IV drug abuse within 3 months before donor registration.

9.2.4.3.1.2 Malignancy

**Yes** = every known malignancy in the previous history  
**No evidence** = no known history of malignancy in the previous history  
 When a yes for malignancy is entered a specification on the malignancy should be given in the comment.



## 9.2.4.3.1.3 Sepsis

**Yes** = positive blood culture with clinical signs.

**Unknown** = no certainty on sepsis status

**No** = no signs of sepsis at all

When a 'Yes' for sepsis is entered, a specification on the sepsis should be given in the comment.

## 9.2.4.3.1.4 Meningitis

No definition on meningitis, only the possibility to enter **Yes/No/Unknown**.

When a 'Yes' for meningitis is entered, a specification on the meningitis should be given in the comment.

## 9.2.4.4 Donor data needed for allocation/decision per organ

In order to allow adequate evaluation of the offered donor organs additional organ specific data should be made available prior to offering the organ to the transplant centers.

**Heart**

ECG

**Lung**

Blood gas (any);

Chest X-ray (recommended).

**Liver**

Sodium (Na<sup>2+</sup>);

SGOT or SGPT;

Bilirubin;

Gamma GT.

**Pancreas**

Amylase or lipase

**Kidney**

Creatinin or Urea;

Diuresis last hour.

## 9.2.4.5 Non-heart beating donor (NHBD)

In the Netherlands, Belgium, Luxembourg, Austria and Slovenia non-heart beating donations (NHBD) are legally and ethically allowed. NHB donors from these countries can be reported to Eurotransplant. Organs of NHB donors will only be offered to patients registered at a center in one the countries allowing NHB donation.

Initially only kidneys were reported from NHB donors. Meanwhile also liver, pancreas and lungs are offered and transplanted.

There are some specific rules for the reporting of organs from NHBD-donors:

- Permission for donation must be given;
- In Croatia and Germany donation, allocation, procurement and transplantation of NHBD-organs are not allowed (national law and/or ethically). Therefore NHBD-organs are not offered to recipients or transplant centers in these countries;
- In case of reporting lungs, liver or pancreas in the Netherlands, the donor may

not be allocated earlier than 4 hours before the moment of cessation of treatment measures, i.e. the planned ventilator switch-off;

- In case of reporting a kidney, in the Netherlands matching for allocation is not allowed before the cardiac arrest is declared;
- In Belgium and Austria, matching may take place at the moment the donor is reported and the HLA is known.

For further allocation rules please see the organ specific chapters of the Eurotransplant Manual.

#### 9.2.4.6 *Specific diseases of the donor*

##### 9.2.4.6.1 Rabies<sup>1</sup>

The following guidelines are to be followed and taken into account regarding transmission of the rabies virus through organ transplantation:

Transmission of rabies through organ transplantation is a very rare event.

Currently, no rapid blood or tissue tests are available which could reliably rule out the presence of rabies infection in brain dead organ donors.

Rabies vaccination for potential organ recipients is not recommended.

##### 9.2.4.6.2 Epstein Barr Virus<sup>2</sup>

Regarding Epstein Barr Virus testing the following is recommended:

- A. The Epstein Barr test results might have influence on the treatment of a post transplant recipient.
- B. Testing for Epstein Barr Virus in potential donors is mandatory; the test result is allowed to become available only after allocation.
- C. The test result should be forwarded to the transplant centers via Eurotransplant.

##### 9.2.4.6.3 LUES and toxoplasmosis<sup>3</sup>

Regarding LUES and toxoplasmosis testing the following is recommended:

- A. The LUES and toxoplasmosis test results might have influence on the treatment of a post transplant recipient.
- B. Testing for LUES and toxoplasmosis in potential donors is mandatory; the test result is allowed to become available within 72 hours after reporting the donor (not necessary to be known for allocation).
- C. The test results should be forwarded to the recipient centers involved via Eurotransplant.

##### 9.2.4.6.4 Vague or dubious virology results

In case of a vague or dubious virology results.

For example:

1. the lab technician cannot say whether the result is positive or negative
2. in case a donor received several blood transfusions without the possibility to perform the test on a pre-transfusion blood sample,

The organs of these donors should be matched and allocated assuming a positive virus result.

Whenever possible a second test should be performed. If this test result is negative and the organ has not been allocated yet, a new match using the negative test result should be made. Then the organ should be allocated according to the new match result.

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<sup>1</sup> Recommendation ROPC01.06. May 30. 2006

<sup>2</sup> Recommendation ROPC01.08. May 19. 2008

<sup>3</sup> Recommendation ROPC02.08. January 22. 2009

## 9.2.5 Organ allocation

Directly after the donor is reported the allocation of the available organs is initiated by the Eurotransplant duty officers. This is done in accordance to the rules developed by the organ advisory committees.

Organs will be offered in the following order:

Heart + lung → Heart → Lung → Liver → Intestine → Pancreas → Kidney

For each organ, except for the kidney, a primary offer as well as reserve offer is made. For the kidneys in general only a primary offer is made. All necessary information is forwarded to the recipient center.

Critical information regarding the donor, received at a later time, will be directly forwarded to the transplant centers.

The most recent information, on the donor, can be found in the ENIS system and can be viewed in the donor report via the internet ([www.donordata.eu](http://www.donordata.eu)). To view the donor data, an account for the website, and the ET donor number is necessary.

More information about the allocation procedure is found in chapter 3 Allocation of the Eurotransplant manual.

## 9.2.6 Donor operating procedure

### 9.2.6.1 Procurement time

After the allocation of all (non-renal) organs, a final time for the procurement should be agreed upon, taking into account the following

- donor family needs;
- donor hospital needs;
- travel time;
- weather conditions both at the donor hospital and recipient center side.

This time frame should be a realistic and all parties involved must aim at strictly adhering to this time frame. Any reason to postpone this plan should be justified immediately.

If necessary, the transplant coordinator at the procurement center (host transplant coordinator) should contact the nearby (civil or military) airport to arrange for the landing and additional departure, of the airplane(s) transporting the procurement team(s). In addition, transport from the airport to the donor hospital should be arranged according to the agreements made by the host and visiting transplant coordinator.

In order to have everything running smoothly the host transplant coordinator should be informed about the following details:

- expected time of arrival;
- airport of arrival;
- flight number;
- size of the procurement team;
- a contact number of the procurement team.

As well as the size as the number of the procurement teams should be limited. If possible one team for the thoracic organs and one team for the abdominal organs.

Upon arrival the following details should be made available to the procurement teams, especially the procurement surgeon, in the operation room at the time of procurement:

- Patient's identification;
- A copy of the completed donor information form;
- ABO-blood group confirmation form;
- Death certification;
- Consent for donation;
- Assessment of risk factors and the general suitability of the donor.

At this time the host transplant coordinator should enter the most recent donor data and the donor organ reports in ENIS.

#### 9.2.6.2 Procurement

After all documents have been studied, a final plan for the procurement strategy can be made.

The most common time for the donor to become unstable is during the transport to the operating room. For this reason, it can be beneficial to involve the anesthesia team during the procurement preparation, and invite them to come to the ICU.

If there are unexpected findings during the surgical examination of the donor, the host transplant coordinator should provide the procurement teams as well as the Eurotransplant office, with all the possible facilities to achieve a diagnosis (e.g. a liver biopsy before the start of organ cooling in case of hepatic steatosis). The final (pathology) findings should be sent to the Eurotransplant office as well as to the recipient center(s).

The procurement teams are responsible for the correct explantation of the organ(s), as well as the collection of cross-match material and other relevant samples.

The host transplant coordinator must take care that all organs procured by the local team are well packed.

For more information please refer to the procurement guidelines 9.4.

#### 9.2.6.3 Donor follow up at procurement center

The procuring surgeons are responsible for filling out the anatomy details and other findings noticed during the operation. This information is noted in the organ report(s). It is up to the host transplant coordinator to verify the completeness of these documents.

After the procurement has been completed, the host coordinator should file the donor information form and send a copy of the donor organ reports to the Eurotransplant office electronically. If the data cannot be provided electronically, the reports can be sent by fax or e-mail.

## 9.2.6.3.1 Right to choose a kidney

Directly after receiving the anatomy Eurotransplant contacts the transplant center that has the right to choose the kidney they prefer (left or right).

The right to choose which kidney is done according to the following order:

1. Kidney in combination with another organ following the sequence under section 9.2.5
2. AM patient via the AM match
3. Rank order on the kidney match

## 9.2.6.4 Definitions of (ischemic) times

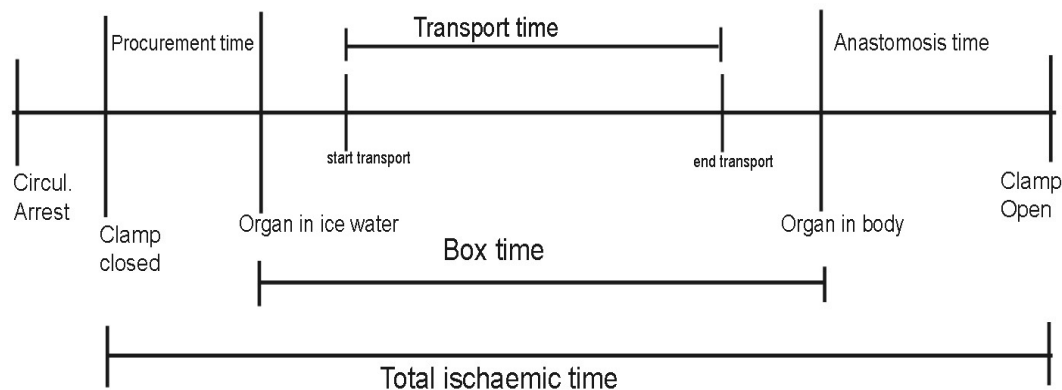


Figure 1

**WIT** : (warm ischemic time) depends on the kind of donor;

- heart beating donor (HBD): the time from clamping till perfusion of the donor (0 to a few minutes);
- non heart beating donor (NHBD): time from cardiac arrest until perfusion of the donor.

The term **CIT** will not be used anymore due to the difficulties in measuring this time period (the time span between when the organ is effectively cooled down and when is it warmed up again, after removal from the transport box).

**Total ischemic time**: time between closing of the arterial clamp in the donor until the moment of opening the arterial clamp in the recipient.

**Procurement time**: time between closing of the arterial clamp in the donor until putting the organ in the transport box.

**Box time**: time between putting the organ in the transport box until it can be placed in the body of the recipient.

**Anastomosis time**: time between putting the organ in the body of the recipient until the moment of opening the arterial clamp.

**Transport time**: time between departures of the organ from the donor hospital until the time of delivery of the organ at the transplantation hospital.

**Transplant time**: start of organ perfusion at the moment of unclamping (clamp open)

#### 9.2.6.5 *Control packing if organ is forwarded*

When an organ is not transplanted in the local transplant center (center where the organ is located) it is the responsibility of the local transplantation coordinator to coordinate who checks the conditions of the packing. This is done in mutual agreement with the local transplant center. Packing conditions of the organ are checked and corrected according to the guidelines, if necessary, before sending the organ to the next transplantation center.

The following should be checked and corrected:

- Sufficient ice for the expected transport time to the next transplant center;
- Sufficient cross match material and/or blood samples;
- The completeness of the forms.

### 9.2.7 **Transport guidelines**

#### 9.2.7.1 *General*

In the transport guidelines you can find the general rules for transport within Eurotransplant.

#### 9.2.7.2 *Quality of transport*

National or local authorities are responsible for the quality of the organ transport.

#### 9.2.7.3 *Transport of non-renal organs*

The host transplant coordinator or DSO are, in agreement with the transplant center, responsible for transport of deceased donor (non renal) organs and tissue typing material. Eurotransplant has no role in the organization of the transporting of non-renal organs.

##### 9.2.7.3.1 Thoracic organs

In almost all cases the thoracic organs are procured by the center that accepted the organs. Arrangement of transport to and from the donor hospital is at the discretion of the thoracic procurement team and shall be communicated with the host transplant coordinator. The host transplant coordinator will help with the coordination of the local transport (e.g. to and from airport).

Please be aware that proper identification is needed for all members of the procurement team in the event the team has to travel cross border.

This holds true for travel to all countries within Eurotransplant; not only for countries that are not yet an EU member. The reason why proper identification is required is because the identification can be asked at all times by various types of officials that are legally required to check the identity of international passengers (e.g. pilot, customs, military, etc.). Incidents have occurred within Eurotransplant that resulted in transport delay of the procurement team. To prevent such incidents every person of the procurement team must be able to identify oneself with a valid identification document (e.g. passport). Through this measure Eurotransplant.

Separate transport for the thoracic procurement team after organ explantation is an essential precondition due to restrictions of cardiac/pulmonary ischemic time restrictions.

#### 9.2.7.4 *Transport of renal organs*

The mode of transport (e.g car, plane etc.) of renal organs depends on the distance between donor and transplant center. Eurotransplant has a consultative role in finding a suitable flight for transport of renal organs. In case the transplant center demands transport by car for a distance of more than 600 km, the transplant center is obliged to give a written agreement of the transport costs via a cost acceptance form (F1.11).

The transport of renal organs to the airport of departure is organized by the host transplant coordinator. The transplant center is responsible for arranging the transport of the kidney from the airport of arrival.

##### 9.2.7.4.1 Deviant national regulations

###### 9.2.7.4.1.1 Germany

Arrangement of transport to or from an airport in Germany (donor and/or transplant center is in Germany) is the responsibility of the DSO and not the responsibility of the donor or transplant center.

The written agreement regarding the expenses (F1.11) is not required in Germany when the DSO has given his/her consent on the transport by telephone.

#### 9.2.7.5 *Arrangement of transfers*

In cases where is no direct flight possible, Eurotransplant is responsible for arranging the transfer.

### 9.2.8 **Donor follow-up information from transplant center**

At the transplant center the transplant coordinator is required to fill out the quality forms. These forms are used as feedback information for the donor center. The transplant surgeon can use these forms to give an evaluation on the quality of the organ (procurement) at the time of unpacking and, if executed, at implantation. Findings on anatomy, possible iatrogenic damage, damage by packing or transport, perfusion problems and initial organ function should be indicated.

In case of procurement or procedural problems, that could possibly jeopardize the suitability of an organ for transplantation, the Eurotransplant Duty desk has to be informed immediately. Eurotransplant will then immediately discuss the problems with the physician in charge of the transplant center. He/she has to decide immediately whether or not the organ is still accepted for the selected patient. If this is not the case it has to be decided together with the transplant center and – depending on the individual situation and progress of the donation procedure – the donor center whether to continue the organ allocation as a rescue allocation.

In all such cases a copy of the organ quality form, accompanied by a complaint letter, has to be sent to the Eurotransplant Medical Staff and the OPO in charge of this procedure within one week, indicating the cause of the possible/actual loss of the donor organ(s) for transplantation. These findings will be reported to the head of the involved transplant programs, the OPO and to the Medical Director of Eurotransplant. They will decide if further action is necessary and inform the Organ Procurement Committee if necessary.

If necessary, a letter of complaint can be sent to the visiting procurement team as well as to the Eurotransplant Department.

The host transplant coordinator can, at his discretion, send a letter to the donor hospital and the donor relatives informing them about the outcome of the procedure.

9.2.8.1 *Policy regarding discarding an organ<sup>1</sup>*

- A. If a procured organ cannot be transplanted, it is mandatory to contact ET directly and only with approval of ET this organ can be discarded;
- B. Discarding an organ intended for organ transplantation is only possible in four ways:
  - 1. Use for donation of cells or tissues in case of consent.
  - 2. Use for research upon consent and in the donor country only; otherwise the organ will have to be cremated, disposed in another way or returned to the donor country. A confirmation report is required.
  - 3. Send the organ for cremation or another way of disposal; a confirmation report is required;
  - 4. Leave the organ with the donor.
- C. The confirmation report of cremation, other way of disposal or research should be forwarded to Eurotransplant. Eurotransplant is responsible for the documentation of these reports of discarded organs.

9.2.8.2 *Potential risk factors<sup>2</sup>*

- A. It is the responsibility of the procurement and the transplant centers to immediately report to Eurotransplant all known transmittable diseases (e.g. infection, malignancy etc.) that might originate from the donor or the donation procedure.
- B. Eurotransplant must inform all involved recipient and donor parties (e.g. transplant centers, coordinators, tissue typing centers etc.) as soon as the information from the donor center is available.
- C. In a later phase Eurotransplant will inform the competent authorities about the events.

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<sup>1</sup> Recommendation ROPC04.08. May 18.2009, rephrased May 30.2011

<sup>2</sup> Recommendation ROPC02.10. September 22. 2010



## 9.3 Donor management

Organ preservation for the purpose of transplantation starts with donor management.

Cessation of brain stem function causes deregulation of the vital functions including hemodynamic instability, endocrine abnormalities, hypothermia, pulmonary dysfunction, electrolyte imbalance and coagulopathy.

Optimal donor management should aim at maintaining or restoring adequate perfusion and oxygenation of the organs and tissues.

### 9.3.1 General guidelines

Donor management should be the responsibility of the doctor in charge of the ICU and/or emergency room, unless otherwise stated in the protocol of the local donor hospital.

### 9.3.2 Mechanical ventilation

Protective lung ventilation with a low FiO<sub>2</sub> is advisable especially in case of lung donation. Target peak pressure < 35 mm Hg, tidal volume 6-8 ml/kgBw, Peep between 5-10 mmHg.

Monitoring of the arterial blood gasses is required in order to optimize the oxygenation.

- Keep PaO<sub>2</sub> > 80-100 mmHg (> 13.3 kPa) and PaCO<sub>2</sub> between 35 - 45 mmHg (4.6 - 6.0 kPa) O<sub>2</sub> Saturation preferable should be > 95%.  
In general this means continuing on treating the patient the same way as before brain death. This way good organ quality can be maintained.
- Keep the airway clean with intermittent nasopharyngeal suction.
- Avoid aspiration: Nasogastric tube with intermittent suction.

### 9.3.3 Hemodynamic management

For adequate hemodynamic management, 2 or 3 IV lines (including 1 central line) should be in place.

#### 9.3.3.1 Monitoring

- Keep systolic blood pressure: ≥ 90 mmHg, MAP 70-90 mmHg;
- The central venous pressure should be between 6-10 mmHG (5-10 cm H<sub>2</sub>O). Upon indication, put a Swan-Ganz catheter in place;
- Optimally keep the Pulmonary Capillary Wedge Pressure 10 - 15 mmHg or Picco system. Target: ITBVI 750-1000 ml/m<sup>2</sup>.

### 9.3.4 Correction of hypovolemia/hypotension

Infusion to achieve a CVP of 6-10mmHg (5-10 cm H<sub>2</sub>O).

Depending on electrolyte disturbances crystalloid, Glucose 5%, NaCl 0,9%, Glucose 2.5% with NaCl 0.45% or Ringer's lactate (christalloide: colloidale fluids = 2:1) can be used at the discretion of the ICU team.

- After each 1.5 liter of crystalloids, Gelofusin<sup>7</sup> or other colloids should be administered;
- If Hb < 9.6 g/dl (= 6 mmol/l) or Ht < 20 % packed cells, CMV negative, should be given;
- If the donor remains hypotension despite adequate rehydration or if blood pressure falls < 80 mm Hg, catecholamine should be given. Preferably use dopamine ( $\leq 10 \mu\text{g}/\text{kg BW}/\text{min}$ ) or Norepinephrin <  $0,2\mu\text{g}/\text{Kg}/\text{BW}/\text{min}$ .

**Beware:** a higher doses of catecholamines can reduce renal and hepatic perfusion (Dopamine: renal dose is 3-6  $\mu\text{g}/\text{kg BW}/\text{min}$ ). Whenever possible, catecholamines should be avoided.

### 9.3.5 Diuresis

Maintain diuresis at 1-2 ml/kg/BW/hr.

Prevent or correct electrolyte abnormalities; check electrolyte levels (especially Na<sup>+</sup>, K<sup>+</sup>, Ca<sup>++</sup>) every 4 hours.

If diuresis does not increase despite adequate hydration, furosemide (20 - 40 mg IV; children 1 mg/kg BW) should be given.

#### 9.3.5.1 Diabetes Insipidus

Diabetes insipidus is caused by a deficit in the production of anti-diuretic hormone. Diuresis >5 ml/kg/BW/hr, urine specific gravity < 1005 or 300 mosmol/kg  
May cause pronounced electrolyte changes: monitoring every 2 to 4 hours.

**Correction:**

- Infusion on a 1 to 1 basis using glucose 5%;
- Desmopressine (DDAVP) 2-4  $\mu\text{g}$  i. v. in bolus. (children: 0.4  $\mu\text{g}$  i.v.) in case diuresis > 5 - 7 ml/kg BW/hr.

### 9.3.6 Hyperglycemia

Hyperglycemia is caused by reduced insulin levels and/or fluid access using glucose containing fluids. Monitoring of serum glucose every 4 hours is advisable.

**Correction:** Continuous infusion of Insulin (rapid acting).

### 9.3.7 Electrolyte abnormalities

Electrolyte disturbances like hyponatremia, hypomagnesaemia, hypocalcaemia, hypokalemia and hypophosphatemia, can all be complications of diabetes insipidus. They may also responsible for severe hemodynamic instability (so called unstable donors).

Reminder			
Hyponatremia:	< 134 mmol/l Na <sup>+</sup>	Hyponatremia:	>150 mmol/l Na <sup>+</sup>
Hypokalemia:	< 3.0 mmol/l K <sup>+</sup>	Hyperkalemia:	> 5.6 mmol/l K <sup>+</sup>
Hypocalcemia:	< 2.0 mmol/l Ca <sup>2+</sup>	Hypercalcemia:	> 2.8 mmol/l Ca <sup>2+</sup>
Hypophosphatemia:	< 0.5 mmol/l PO <sub>4</sub> <sup>2+</sup>	Hyperphosphatemia:	> 1.6 mmol/l PO <sub>4</sub> <sup>2+</sup>

Hypomagnesemia: < 0.7 mmol/l Mg <sup>2+</sup>	Hypermagnesemia: > 1.0 mmol/l Mg <sup>2+</sup>
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#### 9.3.7.1 Hyponatremia

Restoration of osmolality with NaCl 0.9 % or molar NaCl  
 Central venous pressure monitoring is needed to acquire/maintain normovolemia  
 Monitoring of serum sodium every 4 hours

#### 9.3.7.2 Hypophosphatemia

Can cause rhabdomyolysis  
**Correction:** K<sub>2</sub>PO<sub>4</sub> or glucose phosphate administration.

#### 9.3.7.3 Hypocalcemia

Can cause hemodynamic instability  
**Correction:** IV calcium - gluconate administration.

#### 9.3.7.4 Hypokalemia

Can cause cardiac abnormalities  
 Monitoring of serum potassium levels every 4 hours.  
**Correction:** Replacement of urine output using Ringers Lactate containing KCl > 20 mmol/l or adapted KCl administration using continuous infusion

### 9.3.8 Hypothermia (< 35°C)

The loss of central temperature regulation can cause hypothermia. Hypothermia may contribute to bradycardia, myocardial depression and induces coagulopathy.  
**Correction:** Restore body temperature to 35 - 37°C via warming mattress, blankets and warming up infusion fluids to 37°C

### 9.3.9 Coagulopathy

Brain death may be responsible for severe coagulation disturbances manifested by non - correctable thrombopenia and disturbance of all coagulation factors (Goodnight syndrome); these disturbances are not a contra-indication for liver transplantation  
**Correction:** In case of evident bleeding give fresh frozen plasma (Hematocrit > 20%).

### 9.3.10 Infection

Strict aseptic conditions are required to prevent infection.  
 Check urine, sputum and blood cultures. Take special care to rule out sepsis.

Prophylactic antibiotherapy may be warranted, preferably:

- Amoxicilline 15 mg/kg BW 4dd or
- Cefazoline 15 mg/kg BW 4dd

Avoid nephrotoxic and hepatotoxic drugs

In case of assumed sepsis (CRP > 150mg/dl, PCT > 2,5 ng/ml), collect 2 blood cultures and give broad antibiotic treatment

### **9.3.11 Drugs to be avoided**

Vasopressor drugs like adrenaline and phenylephrine may compromise organ perfusion and render these organs unsuitable for transplantation.

Nephrotoxic and hepatotoxic drugs.

### **9.3.12 Additional diagnostics**

Abdominal ultrasound should be performed on every multi-organ donor; it is mandatory in case there is suspicion on liver and/or kidney pathology and in any case of  $\gamma$ GT elevation.

Liver ultrasound screening is a reliable, easy and a cheap method used to indicate severe steatotic livers. The steatosis of the liver should be evaluated during the procurement to judge whether the liver is suitable for transplantation.

Cardiac ultrasound should be performed at whenever heart procurement for the purpose of solid organ transplantation is planned.

For a potential lung donor standard arterial blood gas analysis (i.e.  $FiO_2$  100% + pEEP 5cm H<sub>2</sub>O, 5mmHg) every 4 hours is mandatory.

## **9.4 Thoracic and abdominal organ procurement guidelines**

### **9.4.1 Introduction**

The following pages contains descriptions of the current techniques for preservation and explantation of thoracic and abdominal organ for transplantation according to published techniques in the international literature.

The thoracic procurement guidelines, written by Dr. Florian Wagner, are based on existing similar guidelines published by the British Healthcare NHS Trust and UNOS California, USA.

The abdominal procurement guidelines, written by A.G. Baranski, based on the literature found in the references (see section 9.4.11)

These guidelines were written to reflect and combine existing policies within the Eurotransplant Region. Furthermore they were written to establish and provide general rules for thoracic and abdominal organ procurement.

New proposals for changing the guidelines (thoracic or abdominal) should be send to the secretary of the OPC. These proposals will then be discussed in the next OPC meeting. If agreed upon they will be incorporated in the Eurotransplant Manual.

### **9.4.2 Procurement team**

#### *9.4.2.1 Thoracic*

The Heart and Lung Transplantation Donor procurement team generally consists of:

- Cardiac and/or thoracic surgeon who is/are suitably trained and certified in performing cardiothoracic donor operations;
- If possible a trainee donor surgeon;
- Donor perfusionist/technician.

All additional staff is usually supplied by the donor hospital, which normally consists of an anaesthesiologist, instrumentist and circulating nurse as well as the abdominal procurement team.

#### *9.4.2.2 Abdominal*

- 1 procurement surgeon;
- 1 assistant;
- 1 procurement nurse or coordinator (for back table and flush procedures).

### 9.4.3 Equipment

#### 9.4.3.1 Thoracic

The procurement teams should bring their own equipment to avoid extra cost for the donor hospital, including the following:

- Organ storage bags and ice;
- Cool box containing all necessary perfusion fluids, blood bottles and specimen pots (for spleen and lymph nodes);
- Antibiotics, steroids and other relevant drugs;
- Optional:invasive monitoring equipment (e.g. left atrial pressure line, Swan Ganz Catheter etc.);
- Bronchoscope.

#### 9.4.3.2 Abdominal

##### 9.4.3.2.1 Preservation fluids

###### 9.4.3.2.1.1 UW Solution (ViaSpam®)

At least 4 liters of UW solution (2,5 l. = minimal volume, in fact 50 – 100ml/kg/donor body weight) through the abdominal aorta and 1 liter UW solution for each abdominal organ (back table flush and transport).

The conventional additives per liter solution are:

- 1.000.000 U Penicillin;
- 40 U Insulin;
- 16 mg Dexamethason;
- Temperature 4 °C.

Any other medication may be added to the preservation solution only in accordance to an official protocol. This protocol has to have been submitted to and accepted by the Eurotransplant Organ Procurement Committee.

**Please note:**

Preservation solution stored in PVC bags may contain undissolved particles. PALL SQ-40 blood filters will effectively reduce the amount of particles delivered. This is mandatory for UW solution.

###### 9.4.3.2.1.2 HTK solution

- 10 to 20 liters of HTK solution (150 – 300 ml/kg/donor weight) through the abdominal aorta;
- Temperature 4 °C;
- For one multivisceral harvest: 12 liters of cold saline solution.

##### 9.4.3.2.2 Preservation by non-heart beating donation

In the case of liver, pancreas (whole organ or islets) and kidney procurement from non- heart beating donor for transplantation the standard preservation fluid is HTK or UW solution (ViaSpam®). To the first and the second bag (container) of both preservation solutions before organ perfusion 25 000 U of Heparin has to be added (total 50 000 U).

#### 9.4.3.3 *Other equipment*

For each abdominal organ:

- 3 sterile bags;
- 1 ice box;
- 1 small box for a piece of spleen;
- 1 tube for clotted blood (at least 4 ml);
- 1 tube for EDTA blood (at least 4 ml);
- 1 tube for heparin blood (at least 4 ml);
- For tissue typing: 1 tube for EDTA blood (10ml each).

#### 9.4.3.4 *Equipment for tool-kit*

For each abdominal organ (for the kidney if requested) 1 small sterile box (3 bags, container) for “tool-kit” reconstruction vessels (veins and the arteries) is needed. For liver and pancreas, veins and arteries may be added to the organ bags.

### 9.4.4 **Transport surgical team**

Arrangement of transport to and from the donor hospital is at the discretion of the thoracic explantation team and shall be communicated with the donor transplant coordinator. The donor transplant coordinator will help with local transport (e.g. to and from airport).

Please be aware that proper identification is needed for all members of the procurement team in the event the team has to travel cross border.

This holds true for travel to all countries within Eurotransplant; not only for countries that are not yet an EU member. The reason why proper identification is required is because the identification can be asked at all times by various types of officials that are legally required to check the identity of international passengers (e.g. pilot, customs, military, etc.). Incidents have occurred within Eurotransplant that resulted in transport delay of the procurement team. To prevent such incidents every person of the procurement team must be able to identify oneself with a valid identification document (e.g. passport). Through this measure Eurotransplant.

Separate transport for the thoracic procurement team after organ explantation is a necessary precondition due to restrictions of cardiac/pulmonary ischemic tolerance restrictions.

### 9.4.5 **Communication**

#### 9.4.5.1 *Arrival in the donor hospital*

It is essential to present your team and communicate with all people involved in the retrieval process. The emphasis is on collaboration within a the multidisciplinary team and professionalism must be maintained at all times.

The host transplant coordinator will be present throughout the whole retrieval process to ensure that:

1. The family’s wishes are honored;
2. The retrieval process runs smoothly;
3. The relevant donor charts and documents, including certificate of brain death, blood group, serological results and organ donation consent (in countries where required legally) are accurately filled out.

Upon arrival the following details should be made available to the procurement teams, especially the procurement surgeon, in the operation room at the time of procurement:

- Patient's identification;
- ABO-blood group confirmation form;
- Death certification;
- Consent for donation;
- Assessment of risk factors with the general suitability of the donor;
- A copy of the completed donor information form

For thoracic team the chest X-Ray and ECG should be reviewed.

#### 9.4.5.2 *In the operating room*

In the operating room the surgeon should introduce him- or herself and their team. Furthermore the surgeon needs to communicate with the other procurement team(s) scrub nurses, anesthesiologist and transplant coordinators concerning which organs are to be removed and following point need to be agreed upon:

- Donor heparinization;
- Vessels cannulation;
- Use of unusual medicines.

After inspection and before explantation of the thoracic organs, the explantation surgeon should contact the consultant cardiothoracic surgeon at the recipient transplant center and discuss the findings. A decision will then be made regarding the suitability of the organs. Pertinent information should include the past medical history, pharmacology, haemodynamic data, macroscopic appearance and performance of the heart, pulmonary gas exchange, and bronchoscopic appearance of the lungs. This comprehensive review will be the basis for any decision regarding acceptance or denial of the organs.

The recipient transplant coordinator will be contacted to confirm time and the suitability of the organs so that necessary arrangements at the recipient hospital can proceed. At this time, the explanting surgeon should be able to advise an approximate time for cross clamp application and the time that the organs will be ready to leave the donor hospital.

Before returning to the operating table, donor information should be completed on the specific forms, one for each Recipient Center, and possibly one for the local procurement agency.

#### 9.4.5.3 *Leaving the donor hospital*

As the heart and lungs are the organs most susceptible to ischemic injury it is customary for the heart and/or lung team to leave prior to the closure of the donor. The cardiac and/or thoracic surgeon should express final thanks to members of the donor hospital and the other procurement teams who will continue with the final stages of the donor procedures.

Before departure, the cardiac and/or thoracic surgeon should ensure that all necessary paper work is completed as required by the donor transplant coordinator and write a short concise note in the donor's medical notes.

As soon as possible after starting the return journey, the recipient transplant coordinator should be informed of the estimated time of arrival at recipient hospital.



#### 9.4.6 Donor preparation

Before the start of the procurement procedure the following should be checked:

- Stability and haemodynamic data;
- Blood gases/Fio<sub>2</sub>;
- Central venous line;
- Nasogastric tube;
- Lung compliance;
- Amount of tracheal suction, aspect and bacterial exam (direct and/or culture);
- Blood results;
- Inotropic and vasopressive support and any extra requirements;
- Blood loss and colloid replacement;
- Administration of prophylactic antibiotics (e.g. Cefazoline 2 g), methyl prednisolone;
- Sampling of required blood specimen;
- Urine catheter (check the urine before, during and after the procurement procedure).

Place the donor in the supine position. Scrub and sterile drape the operating field from the neck (above the sternal notch) to the pubis.

#### 9.4.7 Start of the procurement procedure

1. Perform median thoraco-abdominal incision from the lower part of the neck to the pubic region.
2. Perform median laparotomy (pay attention to possible sites for tumor or infection)
3. Install abdominal retractor.
4. Cut and ligate ligament Teres of the liver.
5. Cut liver falciform ligament close to the abdominal wall and the diaphragm, up to hepatic veins. Perform the first fast general inspection of the abdominal cavity and the first general abdominal organ inspection.
6. Before sternotomy protect the liver with large wet gauze
7. Perform median sternotomy.
8. Use the sterile wax and/or electrocautery to obtain adequate hemostasis.
9. Cut anterior side of the diaphragm.
10. Use the thorax and the abdominal retractors to achieve optimal exposure and stable operating field.

## 9.4.8 Inspection

### 9.4.8.1 General

Recommendation performing pathology research in case of tumor:<sup>1</sup>  
In case a tumor is found, it is strongly recommended to perform a pathology research to have a clear diagnosis on this tumor.

### 9.4.8.2 Thoracic organ inspection

#### 9.4.8.2.1 Heart

The pericardium may only be opened by the cardiac surgeon. He/she inspects / examines the heart for:

- Size;
- Contractility;
- Anomaly;
- Coronary Arteries for damage or evidence of coronary artery disease;
- Left and right atrial pressures should be invasively measured.

#### 9.4.8.2.2 Lungs

In case the lungs are to be harvested both pleura may only be opened by the retrieving surgeon. The lungs should be examined for:

- Appearance and size;
- Palpation;
- Consolidations, atelectasis and trauma;
- Extensive swelling, air trapping, large lacerations and large bulla;
- Sampling for pulmonary venous gases.

If lungs are to be removed a bronchoscopy may be performed by the surgeon prior to a sternotomy to allow an assessment of the state of the lungs (edema, trauma, secretions, etc). A sputum sample is obtained, and bronchial lavage is performed at this stage for visual inspection and for culture. A recent blood gas analysis should be present before the bronchoscopic manipulation.

### 9.4.8.3 Abdominal organ inspection

Inspect all abdominal organs for:

- Tumor (malignancy);
- Infection;
- Injury;

#### 9.4.8.3.1 Liver inspection

Examine the liver parenchyma for:

- Quality (steatosis, fibrosis, cirrhosis, edema);
- Injury (tear, haematoma);
- Tumor (benign, malignant);
- Infection (cholecystitis, cholangitis);

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<sup>1</sup> Recommendation ROPC03.08. May 18. 2009

Examine liver arterial blood supply:

- Hepato-gastric and
- Hepato-duodenal ligament

**Warning and remember:**

- 42% has the normal arterial blood supply, the common and proper hepatic artery and no additional arterial branches;
- 30% has the left aberrant hepatic artery coming from the left gastric artery and the normal liver arterial blood supply;
- 20% has the right aberrant hepatic artery coming from the superior mesenteric artery (SMA) and the normal liver arterial blood supply;
- 8% has both right and left aberrant hepatic arteries and the normal liver arterial blood supply;
- 3% of the population has a common aberrant hepatic artery coming from the SMA and no coeliac trunk and no common hepatic artery,

9.4.8.3.2 Intestine Inspection

Examine the liver parenchyma for:

- General state of organ (edema, congestion, hematoma,);
- Motility;
- Adhesions, peritonitis;
- Angiodysplasias, petechial bleeding, signs of contusion.

9.4.8.3.3 Pancreas inspection

Surgical routes during pancreas inspection are going through the:

1. Hepatogastric ligament (can also be left intact);
2. Gastrocolic ligament;
3. Detaching greater omentum from the transverse colon;
4. Kocher maneuver (only head).

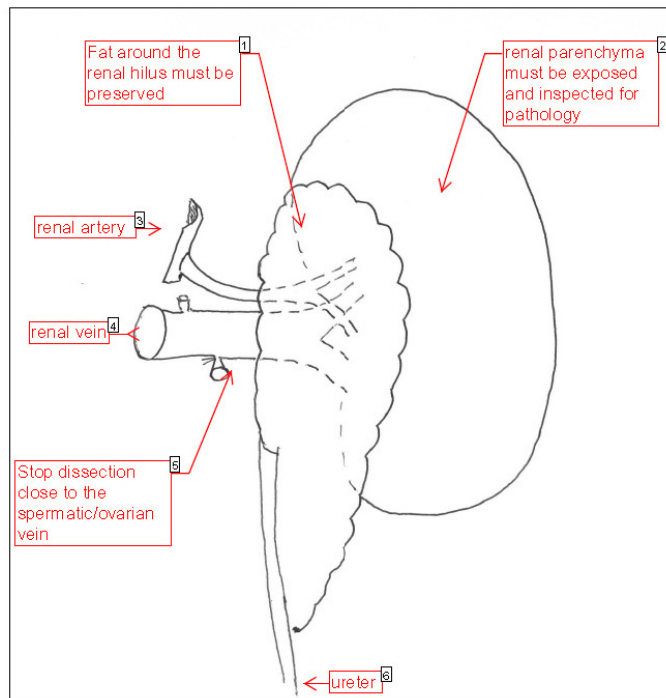
**Remember** during pancreas inspection use the “no touch technique”.

**Look for:** interlobular edema, tumor, fibrosis, injury, hematoma and infection.

9.4.8.3.4 Kidney inspection

The procuring surgeon has the responsibility to perform a thorough inspection of the kidneys by removing all the perirenal adipose tissue. **See Drawing.**

Examine the kidney for: anatomy, state of perfusion, tumor, injury and infection.



#### 9.4.8.4 Abnormalities found by inspection

In case relevant abnormalities are found during the organ inspection, the following tests can be performed, if necessary:

- An open or needle biopsy;
- Ultrasonography;
- Bacteriological examination;
- Pathology analysis.

### 9.4.9 Thoracic procurement

#### 9.4.9.1 Introduction

**Splanchnic** dissection usually takes from minutes to hours, during which time it is not uncommon to have frequent and large hemodynamic fluctuations due to compression of the inferior vena cava (IVC) and manipulation of the adrenal glands. Considerable blood and heat loss may occur. Maximal anesthesiological monitoring and management during this phase is required. Advice should be sought from the liver surgeon regarding the predicted length of time for the **splanchnic** dissection.

Maximal coordination and cooperation is required at this time. The goal is to minimize warm ischemic time and to effectively but rapidly and safely remove all organs.

The cardiac and/or thoracic surgeon(s) return to the operating table following the abdominal dissection but before any abdominal cannulation. Once the dissection is complete, Heparin 3mg (300 Units)/kg should be administered. Ensure that the prophylactic antibiotics have been given and blood samples, that are required, have been obtained.

#### 9.4.9.2 *Heart and lung perfusion*

- Set up cardioplegia (e.g. Bretschneider) and pulmoplegia perfusion;
- Position aortic needle vent and connect to the cardioplegia line after de-airing;
- Position pulmonary artery catheter and connect to pulmonary perfusion solution (e.g. Perfadex) after de-airing;
- Dissect around the superior vena cava (SVC) and inferior vena cava (IVC);
- Separate Aorta and pulmonary artery to facilitate cross clamping and latter excision;
- Ask the Anesthesiologist to remove all central lines (Swan Ganz) and to inflate the lungs manually to open up potential atelectases; thereafter try to continue ventilation with maximal FiO<sub>2</sub> 0.5;
- Ligate both Vv. Cava to stop cardiac inflow;
- Cross-clamp the ascending aorta – ensure that the abdominal team are aware so that splanchnic perfusion can commence. This represents the start of the ischemic period;
- Incise IVC and left atrium (left atrial appendage {LAA} if lungs are harvested) to allow cardiac decompression while the cardioplegia and pulmonary perfusion are running;
- Commence cardioplegia solution (recommended dose varies between solutions!) until asystole occurs and continue infusion until recommended volume is reached;
- Pulmonary perfusion is started at the same time until effluent out of the LAA is clear and / or recommended volume is reached.

#### 9.4.9.3 *Heart dissection*

1. At this stage the liver team usually starts the liver perfusion causing flooding into the pericardial cavity, which should be dealt with by the presence of strong suction. Alternately the IVC is occluded intrapericardially, the liver effluent should be removed by venting from the intra-abdominal part of the vena cava (preferable in children).
2. During perfusion observe that there is adequate pressure being exerted to the cardioplegia bag (exact pressure depends on solution used; usually 80-100mmhg for an adult heart)

#### **Warning:**

If pressure is low, be aware of aortic valve incompetence, check for left ventricle (LV) distension and check the aortic valve after dividing the aorta. It is mandatory to avoid LV distension during cardioplegia!

The electrical activity of the heart should be observed. In the presence of continuing electrical activity you may need to worry about the adequacy and delivery of the cardioplegia solution or even indicate the presence of unknown coronary artery disease. In some cases additional amounts may be necessary.

With a history of hypertension, there may be the presence of left ventricular hypertrophy (LVH), therefore additional cardioplegic solution may be necessary to obtain adequate perfusion and preservation of the heart.

3. After giving the cardioplegia remove the cardiac cannula from the ascending aorta
4. Divide the SVC at the level of the azygos vein and IVC leaving an adequate cuff/vessel length towards heart and liver

5. The left pulmonary veins are divided from the left atrium leaving a sufficient muscular cuff around both pulmonary veins ostia on both sides
6. The left atrium is released from the posterior mediastinum by separating it from the posterior pericardium until complete exposure of the pulmonary arteries
7. Divide the pulmonary artery at the bifurcation level
8. Divide the ascending aorta as high as possible; in cases of complex recipient anatomy (e.g. pediatric patients with congenital cardiac malformations) it is advisable to harvest the whole or part of the aortic arch by dividing all brachio-cephalic vessels
9. Further specific details may vary for pediatric heart removal.

#### 9.4.9.4 Lung dissection

Lungs are generally dissected after the heart has been explanted as described above.

A retrograde flush can be administered after heart extraction with an additional liter of pulmoplegia solution via the 4 pulmonary veins with the lungs gently ventilated in order to remove small clots and debris from the pulmonary artery. Alternatively, the retrograde flush can be performed on the back table after the lungs have been explanted and inflated (9.4.9.4.1).

1. Pleura is opened widely bilaterally, anterior half of pericardium is removed bilaterally to an anterior level of the pulmonary hilum (along Nn. phrenici).
2. Excise posterior layer of pericardium transversely.
3. Start dissecting left lung beginning by dividing left inferior pulmonary ligament, going upwards close to the oesophagus.
4. Transect descending aorta below the origin of left subclavian.
5. Divide all left neck vessels away from trachea.
6. Dissect right lung starting from inferior pulmonary ligament, going upwards to the level of azygos vein, which is ligated and divided.
7. Divide all right neck vessels away from trachea.

At this point ask anesthesiologist to gently inflate lungs manually (FiO<sub>2</sub> 0.5) until all atelectases are opened (typically found on the posterior aspect of both lower lobes). Once atelectases are sufficiently removed ask anesthesiologist to hold inflation at mid ventilatory level.

8. Staple trachea as high as possible after assurance that endotracheal tube has been pulled back sufficiently. Place second staple line and divide trachea between lines.
9. Disinfect tracheal stump before removal.
10. Lungs should be easily removed from the thoracic cavity at this point.
11. For shipment of one of the lungs, separation will be completed on the back table by double stapling of one of the main bronchus.

##### 9.4.9.4.1 Back table preparation and package of the lungs

On a back table the explanted lungs must be checked for any suspicious findings (e.g. exorbitant hemorrhage after heparinization, air leakage, iatrogen trauma). Make sure that every part is complete and has enough material (e.g. atrial cuff). Especially in donors with a longer hospitalization before explantation and a risk for lung embolization it is advisable to flush the pulmonary arteries retrograde with pulmoplegic solution. Retrograde flush can be done by inserting a urine catheter in each pulmonary vein orifice and remove thrombo-embolic material. It is important not

to skeletonize the main stem bronchus; this avoids devascularization and lowers the risk for insufficiency of the bronchus anastomosis. Only in cases when the left and right lung are transplanted in different recipient hospitals the left and right bronchi have to be dissected as near as possible to the carina with an additional stapler line.

#### 9.4.9.5 *Heart-lung bloc dissection*

1. After completion of cardiopulmonary perfusion, complete division of IVC and SVC is performed as described above (9.1.9.3 points 1 - 6).
2. Excise posterior layer of pericardium transversely.
3. Start dissecting left lung beginning by dividing left inferior pulmonary ligament, going upwards close to the oesophagus.
4. Transect descending aorta below the origin of left subclavian.
5. Divide all left neck vessels away from trachea.
6. Dissect right lung starting from inferior pulmonary ligament, going upwards to the level of azygos vein, which is ligated or divided.
7. Divide all right neck vessels away from trachea.
8. Divide aorta as high as possible.
9. Ligate and divide anonymous vein.
10. Double staple trachea as high as possible after inflation maneuver as described above and divide trachea between staple lines.
11. The heart-lung bloc can then be lifted out of the thorax.

### 9.4.10 **Abdominal procurement**

#### 9.4.10.1 *General*

##### 9.4.10.1.1 Procurement Techniques

In principle there are three different techniques to retrieve abdominal organs.

- A. Rapid technique "Dissection in the cold" (mandatory for instable donors). This technique allows the removal of the liver and pancreas en bloc, enabling a shorter warm ischaemic time in the donor body.
- B. Warm dissection technique. Dissection of organs takes place prior to cannulation and perfusion. There is evidence that dissection prior to perfusion causes vasospasm and increased oxygen consumption of the abdominal organs (i.e. liver). In order to compensate for this, the time needed by the thoracic retrieval team will allow reversing these changes. Once thoracic organs are not being allocated a recovery period of 30-60 min should be implemented for compensation in case warm dissection technique is applied. This technique has been show to be more time consuming. Additionally it is associated with a higher rate of parenchymal and vascular injuries as well as with inferior graft function of liver and pancreas. Complete exposure of retroperitoneum following mobilization of right hemicolon and Kocher's maneuver.
- C. Kidney only retrieval (see section 9.4.10.9).

9.4.10.2 *Dissection of the avascular surfaces – organ mobilization*

1. Pull the ascending and transverse colon to the left side and cut the posterior peritoneum starting from the distal part of the right external iliac artery up to the ligament of Treitz, (please be aware of the right ureter).
2. Perform a Kocher manoeuvre by cutting the peritoneum at the right side of the duodenum. If wanted (not necessary) cut also the avascular inferior border of the foramen omentale (Winslow) - the pancreatic head from the right side has been mobilized up to the aorta.
3. During this preparation the V cava inf. is identified and freed at the ventral aspect up to the left renal vein.
4. Mobilize the left renal vein. Free the posterior surface of the left renal vein from the abdominal aorta (undermine with caution by using scissors).
5. If wanted (not necessary) cut and ligate the inferior mesenteric vein. In this way you can get good access to the celiac plexus, left renal and adrenal vein.
6. Replace the mobilized ascending colon and the small bowel to the upper abdomen.

It is not necessary to ligate and cut the left adrenal vein.

7. Free the anterior wall of the abdominal aorta and the inferior vena cava up to the upper border of the left renal vein.
8. Put two long ligatures (nr 2) around the abdominal aorta and the inferior vena cava close to their bifurcations leaving about 2 cm between the sutures. If necessary ligate and cut the inferior mesenteric artery, it will give you more space and make it easier to cannulize the abdominal aorta.
9. Place colon and small bowel back into the abdominal cavity in the physiologic position. Avoid colon and the small bowel mesentery torsion – especially important during organ perfusion.
10. Mobilize the left lobe of the liver and control the abdominal aorta by cutting the left triangular ligament.
11. Reflect the left liver lobe gently to the right. Look for the left aberrant hepatic artery. (see section 9.4.8.3.1 and 9.4.10.7)

In case the aberrant left hepatic artery is absent, cut with electrocautery the lesser omentum (hepatogastric ligament) from the diaphragm up to the hepatoduodenal ligament. When you check for a left accessory artery you can also try to identify a pulsation in the hilum and eventually a right accessory artery.

1. Free the abdominal part of the esophagus and pull it to the left side of the abdomen.
2. To visualize the abdominal aorta under the diaphragm divide the crura muscles of diaphragm from the aorta hiatus up to the celiac trunk.
3. Free and encircle the abdominal aorta under the diaphragm with a long thick ligature (Vicryl nr 2 or a Teflon band /tape). Around the aorta there is some fibrous tissue and after cutting this tissue its much easier to get around the aorta
4. Ligate the cystic duct.



### 9.4.10.3 Abdominal perfusion

#### 9.4.10.3.1 Preparation for abdominal perfusion

Now you are ready for perfusion, all other steps can be performed after perfusion. Allow the other teams to prepare the thoracic organs (see section 9.4.9).

Protect all abdominal organs with 3- 4 wet big gauzes. Liver surface is in the most of the thoracic organ procurement operations the best place for collecting surgical instruments.

Donor heparinization (heparin does not start to work before 3-5 minutes):

- Give 25 000 - 35 000 U Heparin i.v. (adult) **OR**
- 300-500 U Heparin/kg /donor body weight/ i.v. (adults and children)

Fill the rapid perfusion system with cold preservation solution without air and close it with a clamp.

Prepare the inferior vena cava decompression system by connecting sterile thorax drain (22-24F) with a long silicon tube and close it temporary with a clamp. This system is not always necessary; you can also obtain decompression by cutting the vena cava above the diaphragm close to the right atrium.

#### 9.4.10.3.2 Start abdominal organ perfusion

1. Reflect the colon and the small bowel to the upper part of the abdomen/thorax.
2. Ligate the aorta and the inferior vena cava close to their bifurcations.
3. First cannulate the abdominal aorta
4. Second the inferior vena cava
5. Fix every cannula with thick ligature around vessels - avoid blood leakage.
6. Ligate with thick ligature or close with the clamp abdominal the aorta under the diaphragm.

**Warning 1:** with clamp closing, there is more risk for left liver lobe parenchyma injury

#### 9.4.10.3.3 Cannulation and retrieval preparation

After clamping the vessel, the insertion of the perfusion cannula into the right common iliac artery or into the abdominal aorta (below the inferior mesenteric artery) should be done, first. Here, it is essential to exclude the presence of aberrant lower pole renal arteries. A large-lumen perfusion catheter (22-24 F), which is already connected to a perfusion system and flushed with perfusion solution, is to be placed correctly. Fix the cannula with a ligature around vessels to avoid blood leakage.

**Warning 1:** In 1-3% of individuals lower pole renal arteries arise from the CIA. Especially in this case the right common iliac artery should be cannulated below the lower pole artery. Additionally another tie has to be put around the left CIA, for later closure, in order to avoid perfusion solution loss going into the left lower extremity. Ties should only be knotted and the CIA or aortic cannula inserted 3 minutes after administration of heparin (25,000 Units or 300mg/kg bodyweight).

**Warning 2:** In case of severe arteriosclerosis of the abdominal aorta or CIA the perfusion cannula is to be positioned into the distal aorta. If the distal abdominal aorta is not useable in case of severe arteriosclerosis or aneurysms the thoracic aorta should be used for perfusion access in order to avoid thrombo-embolisms or false cannulation.

1. Remove both clamps from the silicon tubes and start cold perfusion of the abdominal organs.
2. At the same time start continuous (external) topic cooling of the abdominal. Use for that cold, sterile Ringer's lactate or 0.9% NaCl solution and sterile ice or ice-slush. Replace one of the cold solutions regularly.
3. Check the quality of the abdominal organ perfusion, mesentery of the small bowel must be free of blood.

If necessary replace or reposition aorta's cannula.

First the thoracic organs are procured in the following order: heart and then lungs separately or heart and lungs together.

In case no small bowel or pancreas is being retrieved additional portal vein perfusion can be performed (CAVE: low pressure in order to avoid sinusoidal damage).

All retrieved organs are to be perfused on the back table (liver arterial perfusion using pressure in order to prevent ITBL).

#### 9.4.10.4 *Hepatoduodenal ligament dissection*

1. Gently lift up head of the pancreas together with hepato-duodenal ligament and examine the posterior side of the hepatoduodenal ligament.

**Warning:**

During hepatoduodenal ligament dissection be very careful. Always look for the right aberrant hepatic artery (location: right side of the portal vein, behind the common bile duct) or common aberrant hepatic artery.

2. Identify and free 1- 2 cm of the common bile duct close to the pancreas head
3. Identify and free 1.5 cm of the common hepatic artery (close to the gastro-duodenal artery).
4. Identify and free 1 cm gastro-duodenal (close to the common hepatic artery and pancreas head).
5. Flush under the low-pressure the common bile duct and the intra-hepatic biliary tree. Make use of cold perfusion solution separated before perfusion. Or simply ligate the cystic duct. The gall bladder can than be removed or left attached. Opening up the gall bladder leads to contamination and should be avoided. In Germany the gallbladder is routinely removed by the donor surgeon.

**Optional:**

We recommend cholecystectomy instead of opening the bladder and flushing it.

6. Dissect free the portal vein 2 – 3 cm above the pancreas head.

#### 9.4.10.5 *Dissection during small bowel procurement*

1. Perform resection of the ascending and transverse mesocolon to obtain free access to the superior mesenteric vessels (SMA, SMV).
2. Dissect and separate the SMA and SMV close to the uncinate process of the pancreas.
3. Transect the first jejunal loop at about 5-10 cm from Treitz ligament using the GIA stapler.

The entire intestine is kept in place in order to avoid traction on the superior mesenteric veins.

4. Transect the several small jejunal branches of the jejunal mesenteric artery close to the jejunal wall of the first loop.
5. Free the proximal parts of the mesenteric vessels for about 2 cm so the small pancreatic veins, joining the right part of the SMV, are ligated.
6. Once the SMV is freed, the abdominal organ perfusion can be started.
7. When the perfusion is ended. The liver-pancreas-intestine en-block or apart can be retrieved. In case of an isolated intestinal transplant, it may be necessary to prolong SMA and SMV using free venous and arterial grafts (tool-kit see 9.4.10.11).

**Optional:**

This point should only be done in discussion with the transplant center!  
Inject, through the gastric tube, 50-80 ml povidone iodine water solution (Betadine).  
Replace the gastric tube from the duodenum to the stomach.

**Warning:**

Try to avoid tissue damage: pancreas (capsule, parenchyma) or mesenteric vessels

8. Use the GIA to close and cut the duodenum distal from the pylorus.
9. Connect the rapid perfusion system with the Aorta's cannula.

9.4.10.6 *Small bowel procurement*

The small bowel is harvested as the first from the abdomen, before or after heart and lungs procurement. The reason for this is that the ischemia time for small bowel is limited.

9.4.10.6.1 Simultaneous intestine and pancreas procurement

In the case of simultaneous pancreas procurement, inferior pancreato-duodenal vessels have to be respected. Very early branching of the SMA may be a contra-indication for simultaneous procurement in rare cases and procurement of the intestine should be preferred. However, when complex anatomical situations present, en-bloc procurement with subsequent back table separation should be performed. The latter procedure shortens the donor procedure, however, prolongs cold ischemia time.

Procurement of the intestine is to be performed by the transplanting center

1. Kocher maneuver;
2. Cattell-Braasch maneuver;
3. Exposure of abdominal aorta and ICV up to the SMA;
4. Broad mobilization of the lig. of Treitz and distal duodenum;
5. Transect the inferior mesenteric vein;
6. Encircle the SMA;
7. Encircle the aorta and ICV distally; ligation of IMA;
8. Divide the gastrocolic omentum;
9. Mobilize the left colon;
10. Dissect the complete colon and expose the colic vessels;
11. Complete colectomy after transection terminal ileum/sigmoid;
12. Medial visceral rotation and mobilize the pancreatic tail / spleen;
13. Division of highest jejunal arcades close to jejunal wall;
14. Transect the proximal jejunum;

15. Anterior exposure of superior mesenteric vessels by transverse dissection of the mesenteric root distal to the level of the middle celiac vessels;
16. Transect the post pyloric duodenum;
17. Ligate the left gastric artery, division of short gastric vessels to the spleen.

**Warning:** Antegrade decompression of the intestine as proposed by some centers is discouraged due to mechanical stress

#### 9.4.10.7 Pancreas and liver procurement

It is necessary to deliver the common iliacal artery and vein with the bifurcation of the internal iliacal artery and vein by the pancreas

It is necessary to deliver the second set of common iliacal artery and vein with the bifurcation of the internal iliacal artery and vein by the liver.

1. Divide hepatogastric and gastrocolic ligament close to the stomach wall starting from the pylorus up to the oesophagus. If present safe the left aberrant hepatic artery.
2. Close and divide the duodenum from the jejunum with the Gastrointestinal Stapling Device (GIA).
3. Pull down the transverse colon and the greater omentum to achieve the optimal visualization of the mesenteric vessels and the transverse mesocolon.
4. Divide the mesenteric vessels 3 - 5 cm below the uncinata process of the pancreas by using gastrointestinal or vascular stapling device or ligation (try to make small steps).
5. Cut the transverse mesocolon 2 - 3 cm beneath the lower part of the pancreas from the right to the left side up to the spleen (the uncinata process) and transverse mesocolon up to the spleen.
6. Cut the gastroduodenal artery 0.5 cm above the pancreas head (mark pancreas side of the gastroduodenal artery with the Prolene 5/0 suture).
7. Cut the portal vein 2 - 3 cm above the pancreas head.
8. Free the common hepatic artery, the celiac trunk and first 5 mm of the splenic artery towards aorta.
9. Look for the dorsal pancreatic artery, in absence of the dorsal pancreatic artery from the common hepatic artery or from the celiac trunk:  
Cut the splenic artery 0.3 - 0.5 cm from the celiac trunk, (mark the pancreas side of the splenic artery with the Prolene 5/0 suture).
10. Visualize the superior mesenteric artery and the celiac trunk from the right side of the aorta.
11. Cut the spleen ligaments and free the pancreas from retroperitoneal attachments up to the left side of the aorta. Use the spleen as a "handle".

Communication between the pancreas and liver teams is necessary in order to decide about the final use of pancreas for whole organ transplantation because of the possible anatomical difficulties.

In the presence of an **aberrant right hepatic** artery with a complete extra-pancreatic course, one can decide to dissect this artery close to its origin with 1cm cuff or patch from the SMA.

In case of an **intra-pancreatic right hepatic artery**, its division should only be done after consultation between pancreas and liver teams. If this artery is transected proximal to the pancreatic head, the liver surgeon must have the possibility to implant the right aberrant hepatic artery into the ostium of either gastroduodenal or splenic artery.

In case of the **dorsal pancreatic artery** is arising **from** the **common hepatic artery** **or from the celiac trunk** the procurement surgeon has to communicate with the liver and the pancreas acceptor center(s). In these two cases of anatomical abnormality the common hepatic artery has to be cut 3-5mm from the celiac trunk and the celiac trunk and the SMA has to be given to the pancreas with the aorta patch.

In some cases (small children as donors and acceptors, difficult adult acceptor, **no adequate “tool-kit”** for organ reconstruction) the pancreas procurement as a whole organ should be avoided.

12. Harvest pancreas always with the hilum of the spleen, for the typing laboratory cut only 3-4 cm of the external surface of the spleen.
13. Place the procured pancreas in a sterile container filled with ice and cold sterile 0.9%NaCl or Ringer's lactate or preservation solution.
14. Reflect the colon and the small bowel to the thorax.
15. Cut the patch from inferior vena cava with the left renal vein, reflect and put it on the left kidney (cover the vein with small wet sterile gauze).
16. Localize the ostium of the right renal vein(s) through the left renal vein opening in the inferior vena cava.
17. Cut the VCI 1-1.5 cm above the ostium of the right renal vein.
18. Cut the diaphragm from the left side of the liver.
19. If heart was not procured cut the vena cava inferior 2 - 3 cm above the diaphragm and free it from pericardium. Put the forefinger in the IVC and gently hold up the liver during dissection.
20. Cut the right anterior, lateral and posterior side of the diaphragm.

**Warning:** Stay away from the liver ligaments to avoid liver capsule and parenchyma injury.

21. Procured the liver and place the liver in a sterile container filled with 4°C preservation solution (no ringer or NaCl)

**Warnings:**

The back-table liver perfusion through portal vein has to be done by:

- Suboptimal organ perfusion;
- Difficult aorta or iliac artery cannulation;
- Severe atherosclerosis;
- Other reason.

The liver has to be flushed with minimum 500 ml of cold preservation solution. Inform recipient center of this as well as the quality of the result.

**Remember:** the distance from the liver and the preservation solution container should not exceed more than 80 cm (normal pressure in the portal vein is about 6-12 mmHg)

9.4.10.7.1 Back table split of liver and pancreas following en-bloc kidney removal

1. Cut the right anterior, lateral and posterior side of the diaphragm. The separation of liver and pancreas starts with the division of the common hepatic artery and superior mesenteric artery.
2. Suture marking (towards the pancreas) of the gastroduodenal artery at the upper border of the head of the pancreas with consecutive transsection of the GDA leaving a stump at the common hepatic artery.

3. The bloc is further divided by cutting of the splenic artery close to the celiac trunc. Following placement of an identification stich (6-0 Prolene) at its distal part transection of the splenic artery in the middle of its origin and its first branch for the pancreas.
4. Transsection of the portal vein well above the confluence of the splenic and superior mesenteric vein will leave sufficient of the portal vein for the liver as well as for the pancreas.
5. An aberrant/accessory right hepatic artery might appear dorsally of the portal vein. (if present ligation of right hepatic artery at its origin preserving the SMA for the pancreas)
6. Ligation of the distal ductus choledochus and transsection will end the division of liver and pancreas. At this of time it is advisable to perform an additional rinsing of the bile ducts .

#### 9.4.10.8 Whole pancreas procurement for islet transplantation

The pancreas has to be procured following the same rules together with duodenum (to avoid damage of the pancreatic ducts) and disinfection of the duodenum content. Liver and the pancreas should be separately or removed en-bloc and separated on the back-table in the donor or liver/pancreas recipient hospital.

#### 9.4.10.9 Kidney - Separate kidney procurement

##### **Remember:**

By **donors  $\leq$  5 years** the kidneys should be removed “en bloc” (9.1.20.5.5), including complete abdominal aorta and IVC - from their bifurcations up to SMA and 1 cm above the renal veins (IVC). In the case of child as a donor always discuss your procurement technique with the kidney acceptor center(s).

1. Cut the ligatures placed on the aorta and the VCI.
2. Remove the cannula's and open the anterior wall of the aorta longitudinally. Stay exactly in the middle.
3. Check the ostia of the renal arteries. Look for accessory renal arteries from aorta and from the iliac vessels.
4. Cut the abdominal aorta 1 cm above renal arteries and 0.5cm above aorta's and vena cava inferior bifurcation..
5. Mobilize each kidney and the ureter with as much as possible adjacent tissues.
6. Cut the ureters close to the urinary bladder.
7. The right kidney has to be procured together with inferior vena cava up to the bifurcation (in case of multiple renal veins, difficult recipient, very short right renal vein the inferior vena cava should be used for right renal vein elongation)
8. Reduce the adipose tissue around the kidney and the ureter and examine each kidney.
9. Put each kidney in sterile container with 4 °C preservation solution and sterile ice.

#### 9.4.10.10 Kidney – “en-bloc” kidney procurement on request

1. After mobilization from retroperitoneum, the kidneys are removed starting at the lower end of the abdomen. Localize the ureters and cut the ureters close to urinary bladder. Mark the ureters with small mosquito clamps.
2. Pull up the cannulas inserted in the IVC and abdominal aorta.
3. Cut the aorta and the IVC below the cannulas close to their bifurcations and lift

- them gently up together with the ureters.
4. Cut all tissues passing posterior to the aorta and IVC close to the ligaments and the muscles covering the vertebral bodies. This manoeuvre is continued upwards until the previous transections of aorta and IVC are reached.
  5. Take out the kidneys and place the en-bloc kidneys in a 4 °C preservation solution and sterile ice.

**Warning:** centralized preparation and preparation between the lower pole of the kidney and ureter is to be avoided (cave: blood supply of the ureter). Finally, additional perfusion should be done to assess the perfusion quality and the vascular status of each renal artery. The venous outflow is to be assessed individually.

If necessary separate the kidney bloc on the back-table:

1. Remove the left renal vein from the IVC (with cava patch) to turn the specimen over.
2. Incise the posterior wall of the aorta in between the different lumbar arteries. This allows defining very easily the orifices of (possibly aberrant) renal arteries.

The detailed dissection of the kidney structures should be left to the transplant surgeon.

In case it is unclear whether there are preexisting diseases, a biopsy should be performed and evaluated by the pathologist of the donor or recipient center as soon as possible.

#### 9.4.10.11 *Tool - kit (donor vessels for vascular organ reconstruction)*

Take only a good quality "tool kit" out!

Examine especially the state and the length of the procured veins and arteries and try to find the best quality for the "tool-kit" (brachiocephalic trunk, subclavian, brachial, iliac, femoral artery and vein)

In case the quality of the "tool- kit" is bad inform transplant coordinator and the recipient center.

Vessels have to be covered with preservation solution and packed on the same way as every abdominal organ (3 bags, - the second and the third bag are not filled).

#### 9.4.10.12 *Post procurement care of the body*

1. Before closing the donor body, remove the residual fluid. It is optional to fill up the body with the absorbing materials.
2. Close the thorax and the abdomen with the solid sutures.
3. Close carefully intracutaneous and with the greatest respect for the body, the midline incision with running sutures.
4. Cover the incision with wound dressing.

#### 9.4.10.13 Packaging

All organs as well as a tool kit have to be packed separately in an ice filled transport box according to the following Eurotransplant regulations:

##### 9.4.10.13.1 Thoracic organ

Organs should be placed in a 3 bag technique.

- The first bag is filled with preservation solution or 0.9% saline;
- The first bag is put into the second bag which is filled with broken iced 0.9% saline and cold liquid 0.9% saline;
- The second bag is put into the dry third bag.

Each bag is firmly closed after de-airing

As the heart and lungs are at most susceptible to ischemic injury, it is customary for the heart/lung team to leave prior to the closure of the donor wounds.

The thoracic team members are supposed to collect, package and clear all equipment in a quiet and efficient way in order not to disturb the abdominal team in its continuation of the donor operation.

##### 9.4.10.13.2 Abdominal organ

Each organ is stored in three separate bags:

- The first bag is filled with 4 °C preservation solution;
- The first bag is put into the second bag (or a wax impregnated fiber container) which is filled with cooled saline or Ringer's lactate solution;
- The second bag is put into the third bag. It is recommended to keep the third bag dry.

All bags are de-aired and well tied. The organ is put into a transport box and well covered with non-sterile melting ice.

The abdominal team is supposed to collect, package and clear all equipment in such a way that any residues of the donor operation are efficiently cleared.

#### 9.4.10.14 Uniform packing of organs and blood/tissue samples<sup>1</sup>

According to the guidelines UN3373, Biological Substance, category B the packaging of organs and blood/tissue samples is recommended to consist of the following three components:

1. a leak-proof primary receptacle(s);
2. a leak-proof secondary packaging;
3. an outer packaging of adequate strength for its capacity, mass and intended use, and with at least one surface having minimum dimensions of 100 mm × 100 mm

#### 9.4.10.15 Other requirements

After the organ retrieval, all organs are to be put into an ice filled transport box with one piece of spleen (or good quality lymph nodes\* if no spleen is available) and blood specimen. The spleen and lymph nodes are to be put into tubes containing saline or Ringer's lactate solution which tubes are to be put into a labeled small box.

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<sup>1</sup> Recommendation ROPC01.10. March 3. 2010



*\*para-aortic, small bowel or mesentery located*

Another piece of spleen is used for tissue typing and cross matching. This piece of spleen is stored in the same way as described above.

Blood samples (clotted and EDTA), lymph nodes and/or spleen for each abdominal organ should be properly and identically identified.

As organ procurement is an acknowledged surgical procedure, an operation report (for the donor center) as well as an organ report and organ quality form (for ET and recipient center), filled out and signed by the procurement surgeon in charge, is mandatory. His/her signature serves as the confirmation that the ET organ procurement rules are fulfilled.

A copy of the respective organ report, signed by the surgeon in charge, as well as a quality form per organ should be included in the transport box.

The host transplant coordinator is responsible for informing ET as soon as possible in case an organ is not procured. In case this rule is not followed it will be interpreted as a violation.

#### 9.4.10.16 *Cross-match*

The host transplant coordinator should take care of shipment of tissue typing and cross match material to the affiliated tissue typing laboratory, for the purpose of kidney transplantation or for other organ transplantation if indicated.

#### 9.4.10.17 *Uniform identification organ, spleen, blood samples etcetera*

Identical identification items should be written **on** the transport box as well as on the bags, blood samples, etcetera **inside** the transport box.

The following identification items are mandatory:

1. ET donor number;
2. Blood group;
3. Donor date of birth;
4. Donor center code and address;
5. Date (procurement);
6. Destination center code and address;
7. Organ specification (e.g. 'liver', 'kidney left').

Form 1.9 Human\_ organ \_for \_transport is available via the member site and can be used for identification.

#### 9.4.11 References

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Surgical technique of abdominal organ procurement Course inventor and invited speaker during several proceedings:

- European Society for Organ Transplantation 1-th and 2 -nd European Donor Surgery Master-class Course, in 2005, 2006, Leiden, The Netherlands.
- National Donor Surgery Master-class Course, Dutch Transplant Foundation in 2000, 2001, 2002, 2003, 2004, 2005, Leiden University Medical Center, Leiden, The Netherlands (annual course)
- European Donor Surgery Master-class Course, European Society for Organ Transplantation, 2004, 2005, Leiden University Medical Center, Leiden, The Netherlands (annual course)

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## 9.5 Forms

All forms can be found and downloaded from the section 'Forms' of the member site at [www.Eurotransplant.org](http://www.Eurotransplant.org).