

# ANATOMIC VARIATIONS of IVC: 3D IMAGING

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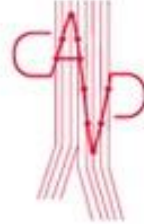
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Chaire UNESCO en  
enseignement et recherche  
en anatomie numérique  
Université Paris Descartes



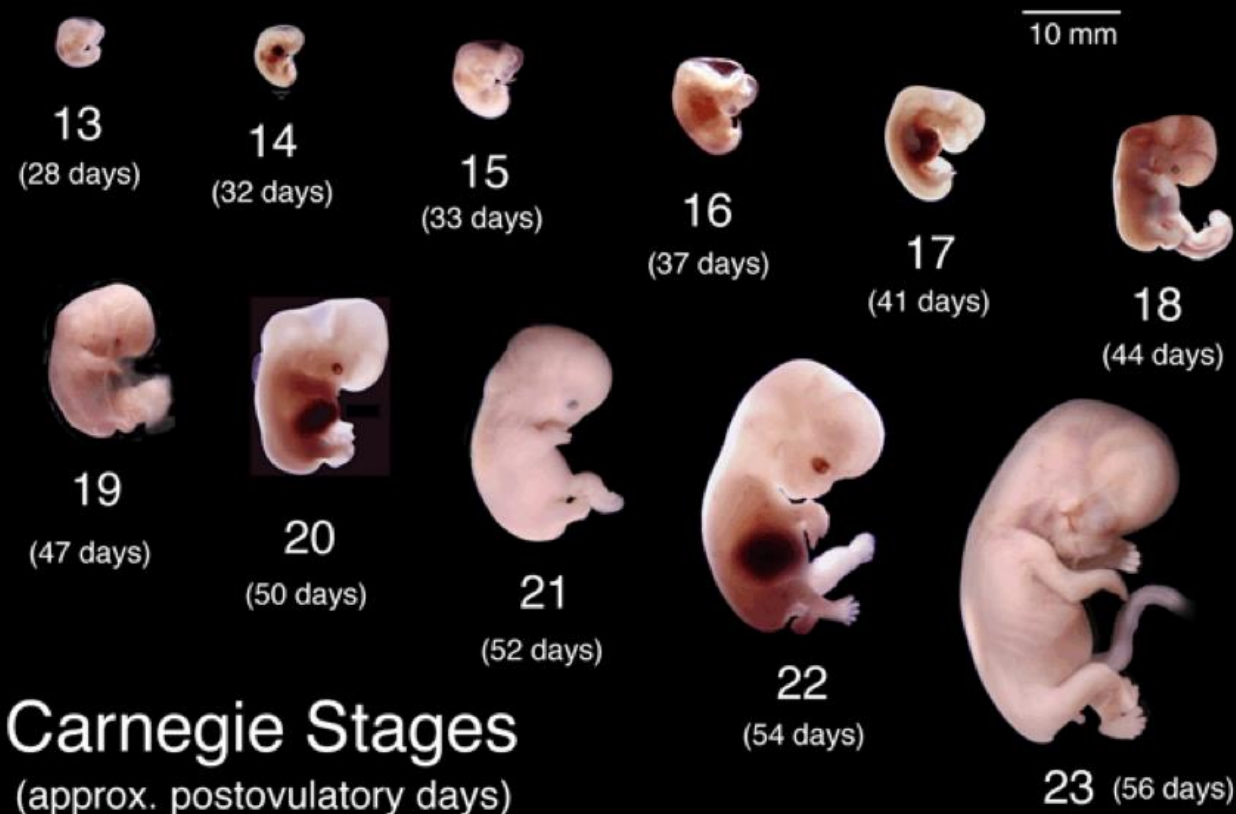
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CONTROVERSIES & UPDATES  
IN VASCULAR SURGERY

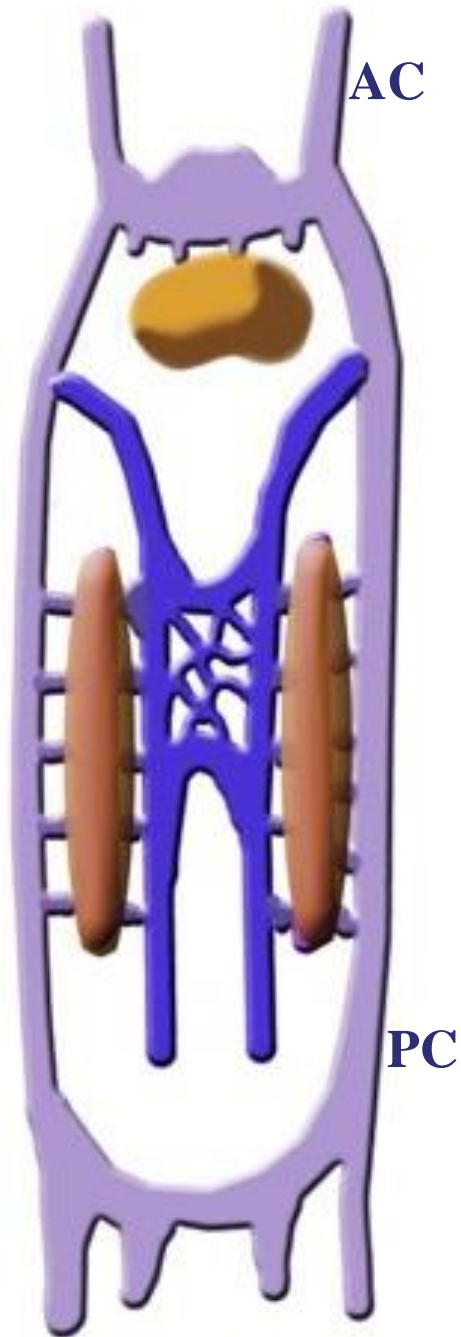
JANUARY 21-23 2016

# IVC anatomical variations are explained by EMBRYOLOGY

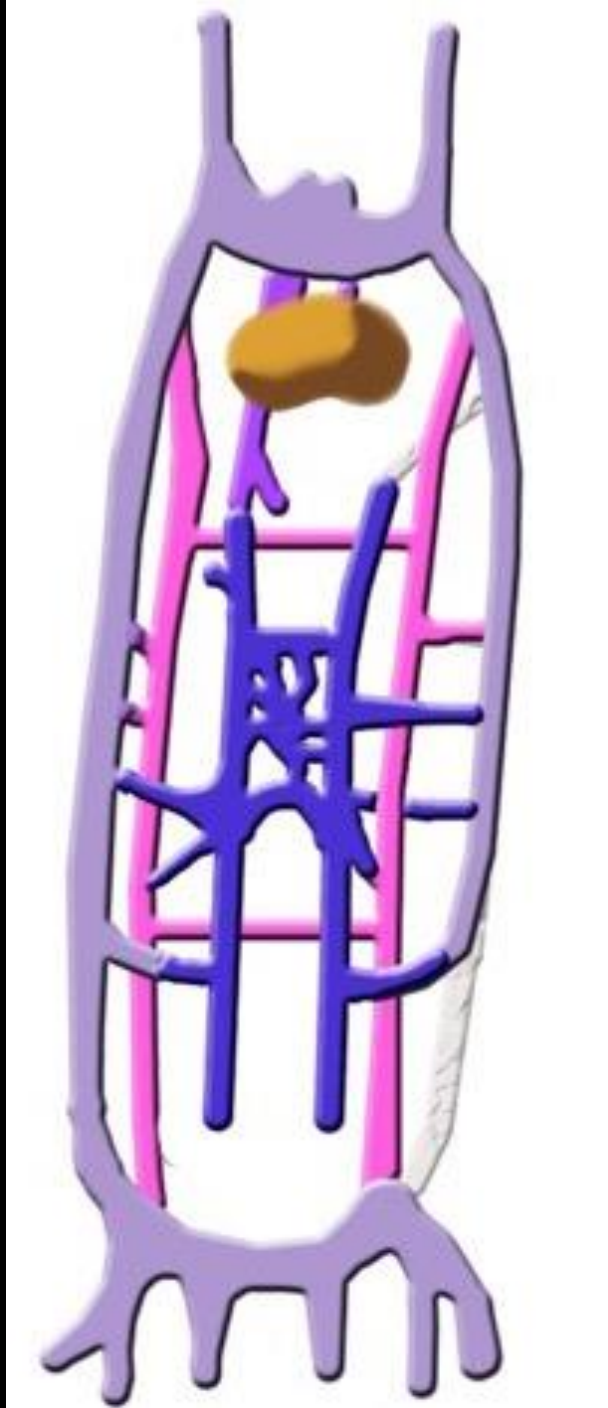


# Reminder of IVC embryogenesis

# Embryo 6th week







- Cardinal veins
- AC anterior
- PC posterior
- Sub-cardinal veins
- Métanephros
- Liver

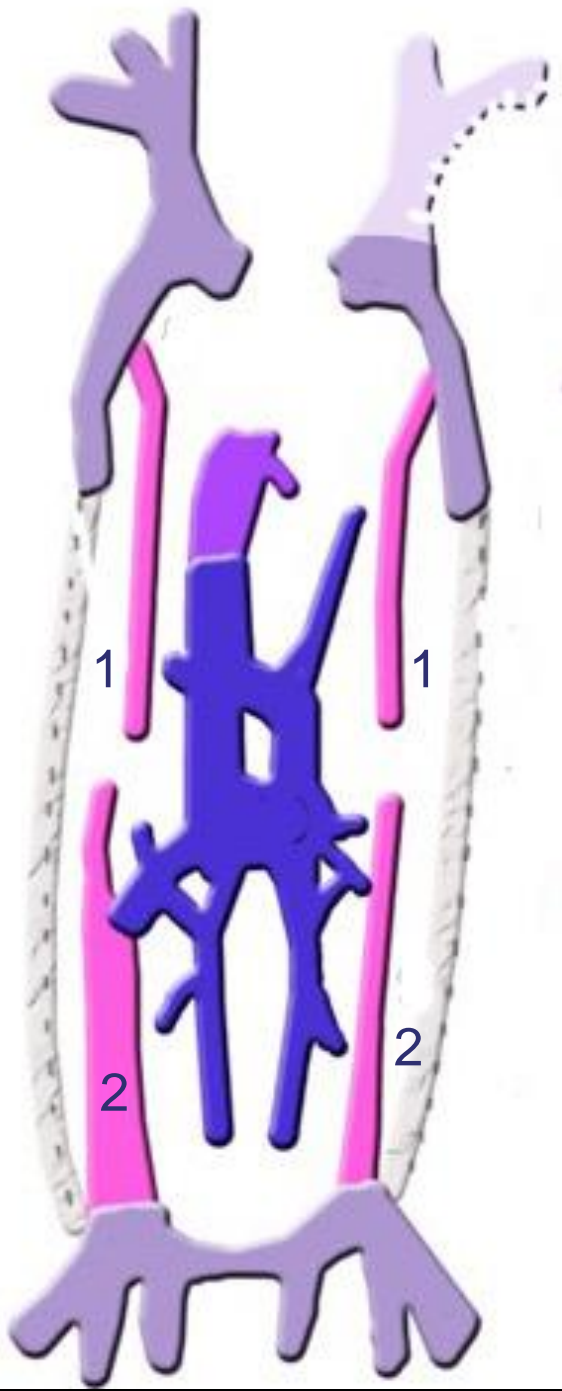


## Embryo 7<sup>th</sup> week

### developpement of sub cardinal veins

-  Vitelline vein > retro-hepatic IVC
  -  Posterior cardinal veins
  -  Sub-cardinal veins
  -  Supra-cardinal veins
- ↑  
↓  
↔
- anastomosis

# Embryo 8<sup>th</sup> week



Post Cardinal veins → regression  
(et antérieure G)



Sub-cardinal veins



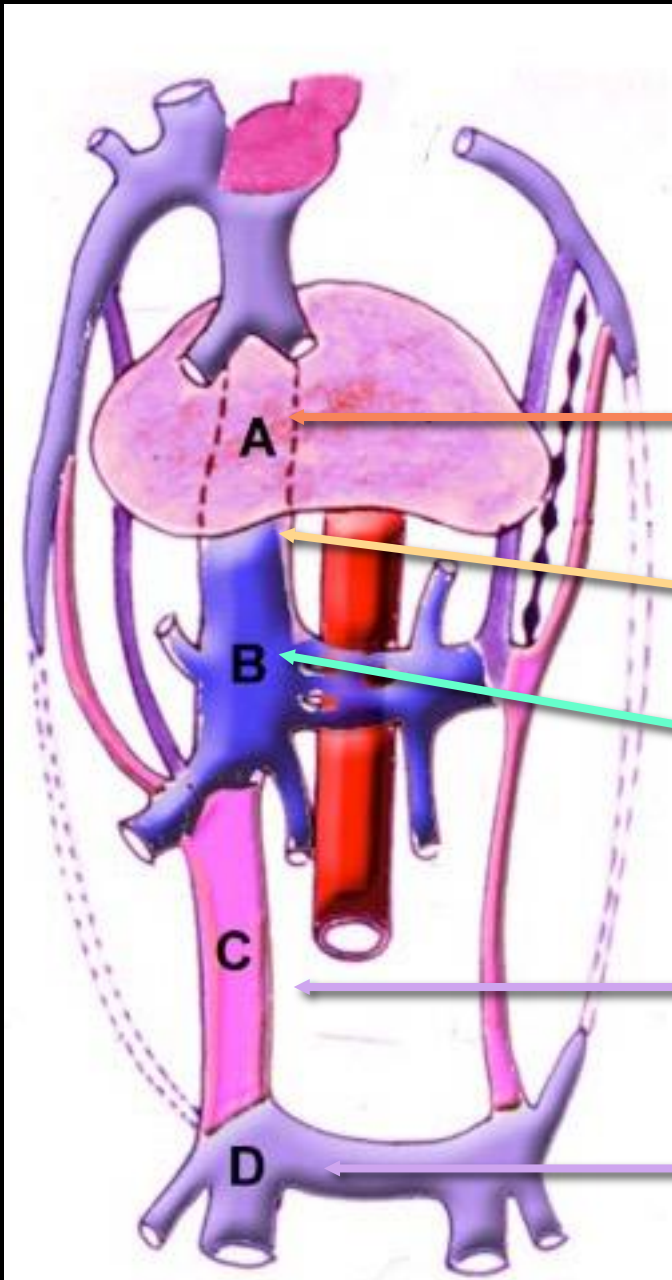
Vitelline vein



Supra-cardinal veins

Giving cranially (1) → azygos  
& caudally (2) → ivc + lumbar veins

# Finally 5 parts of IVC (from embryology)



Supra-HEPATIC Vitelline V.

Retro-HEPATIC Right sub cardinal V.

RENAL Subcardinal anastomosis

INFRA-RENAL Right supracardinal V.

ILIAC Post cardinal V.

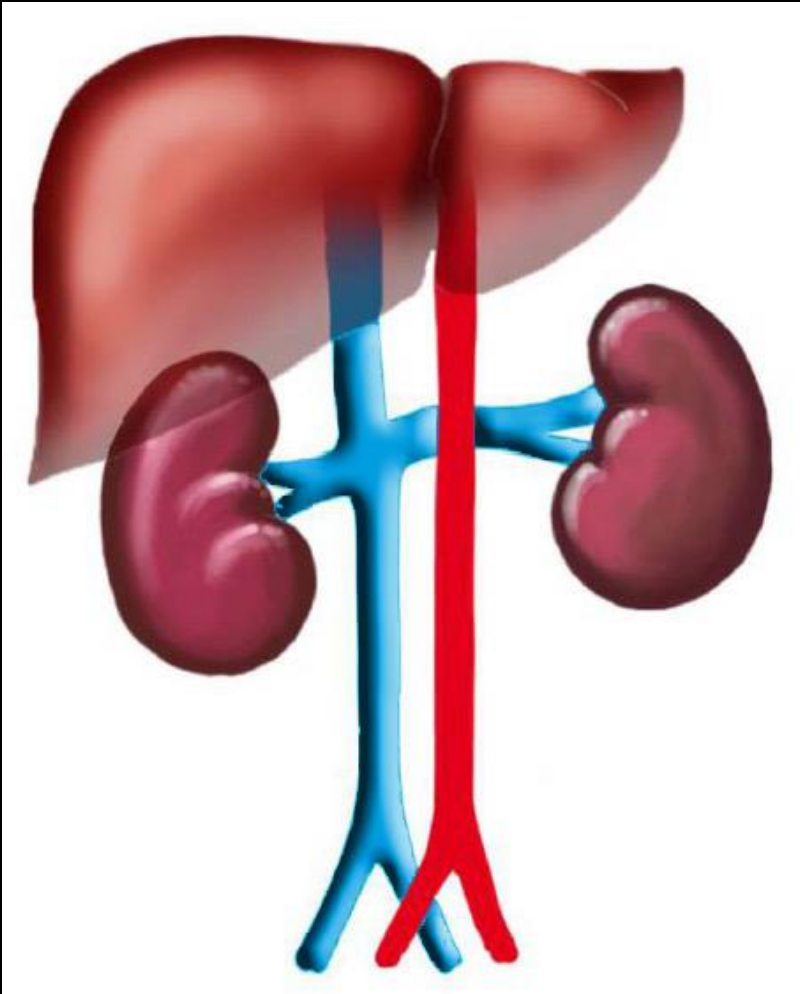
# Main variations of the IVC

- Retro-aortic left renal vein 5-8 %
- Circum aortic left renal vein 2-4 %
- Duplicated vena cava 1- 2 %
- Left vena cava 0.5%
- Retro-caval ureter 0.5%
- Azygos continuation of IVC 0.4%



# Isolated RETRO-AORTIC LRV

## Variation in the sub-cardinal anastomosis

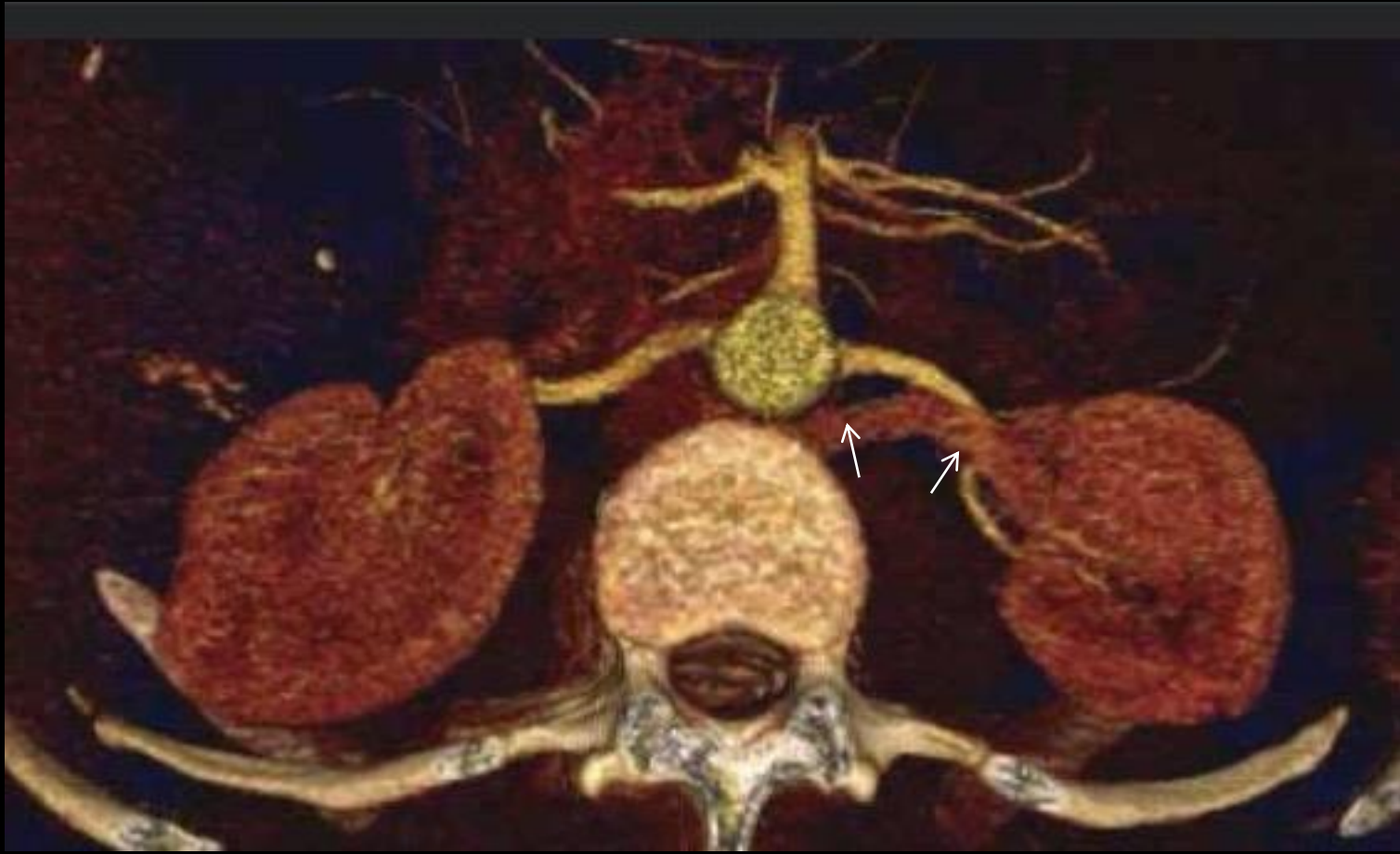


Prevalence = 5 to 8 %

### CLINICAL INTEREST:

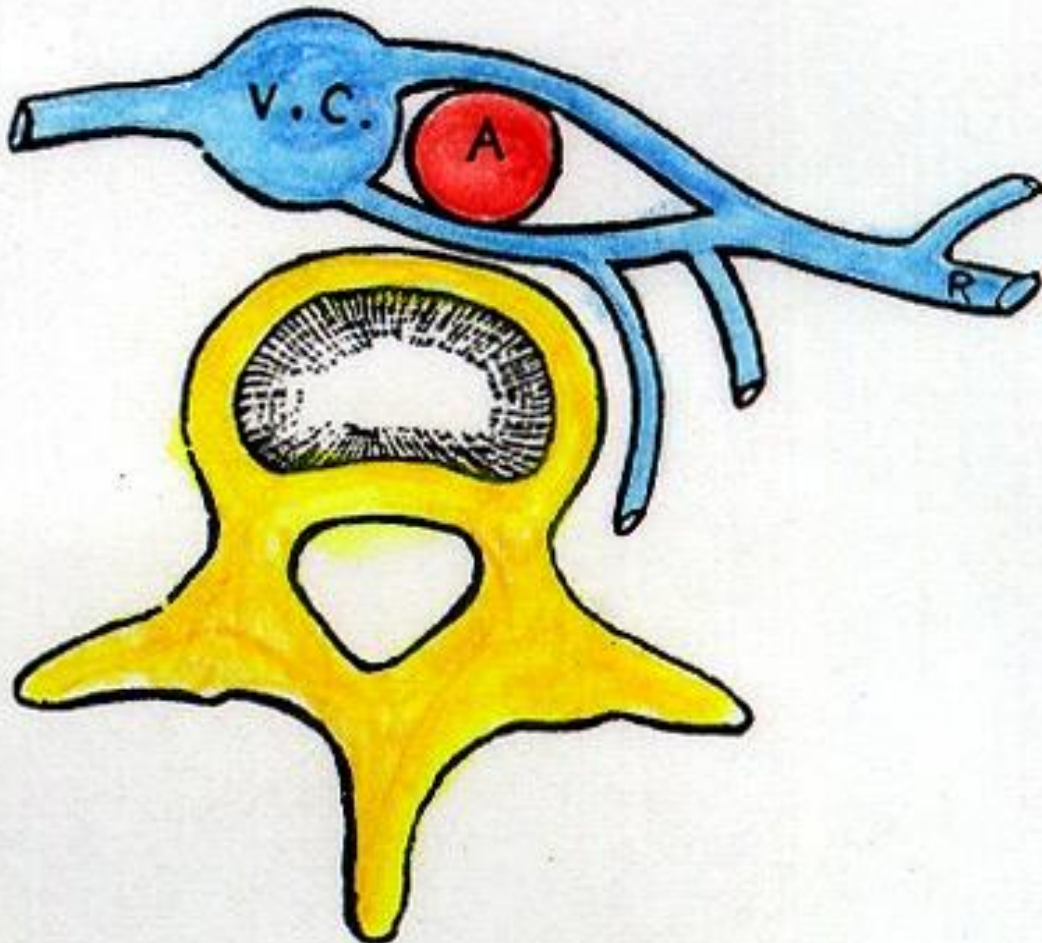
Diff. Diagnosis: Node  
Nephrectomy  
Aortic surgery

# 3D modelling by MSCT



# Peri-aortic ring of the LRV

Abnormal regression of the left supra cardinal vein

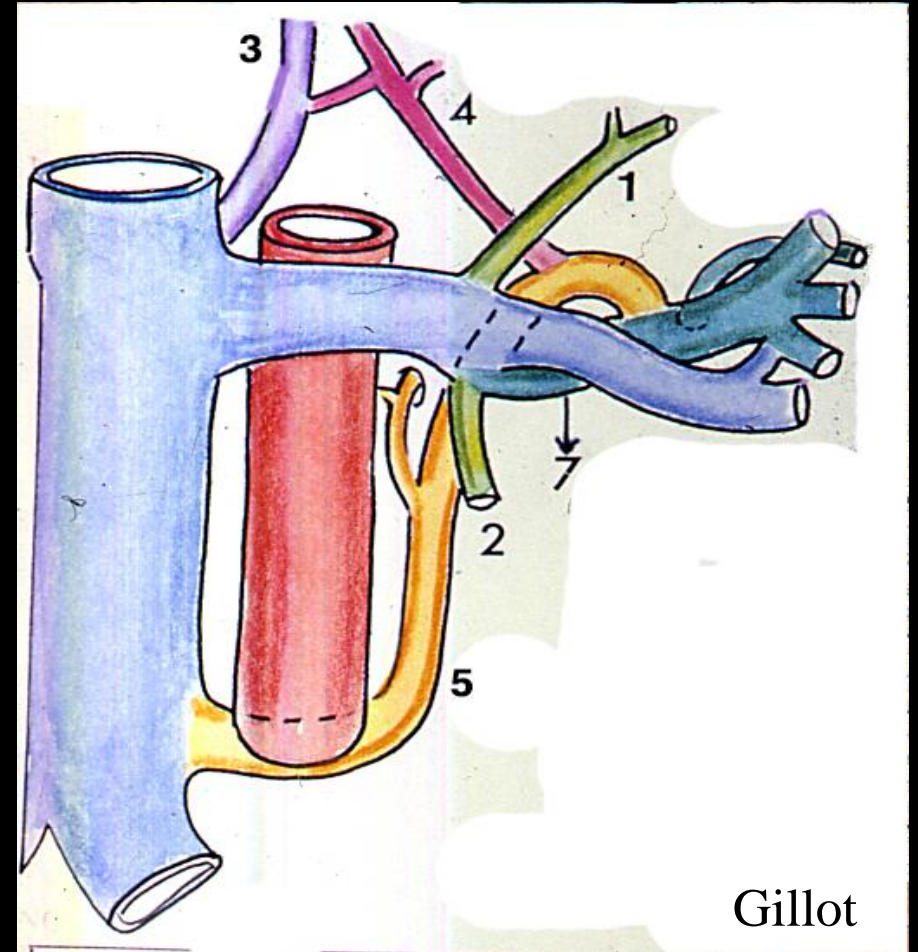
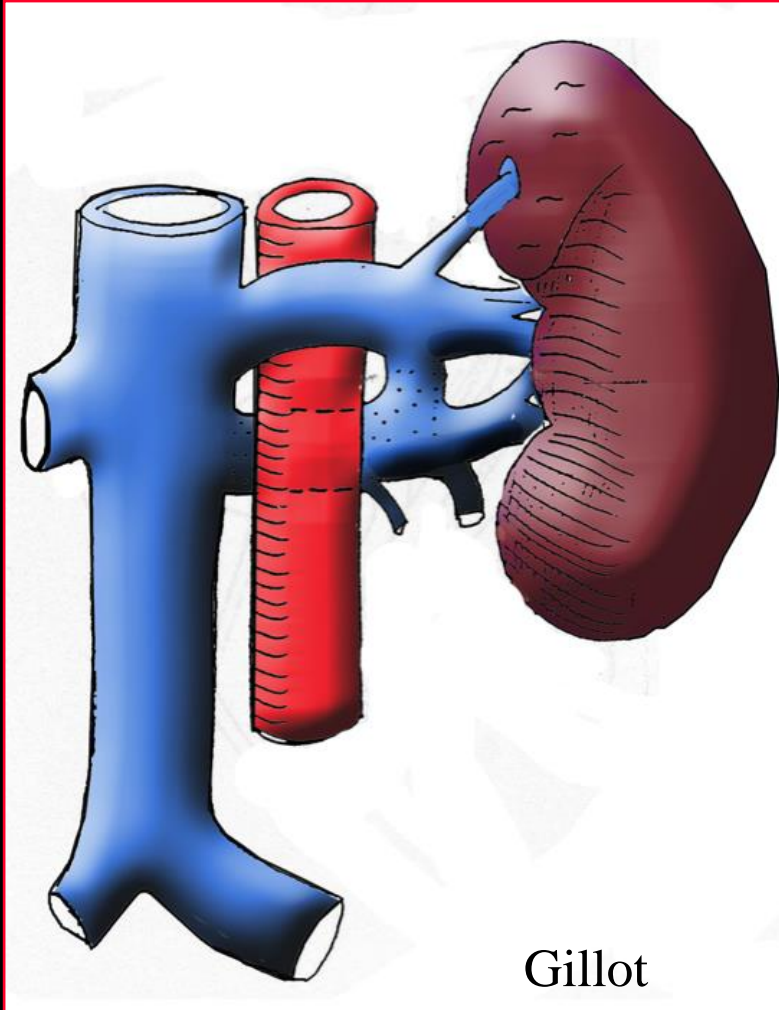


Prevalence = 2 to 4 %

## CLINICAL INTEREST:

Diff. Diagnosis: Node  
Nephrectomy  
Venous catheters

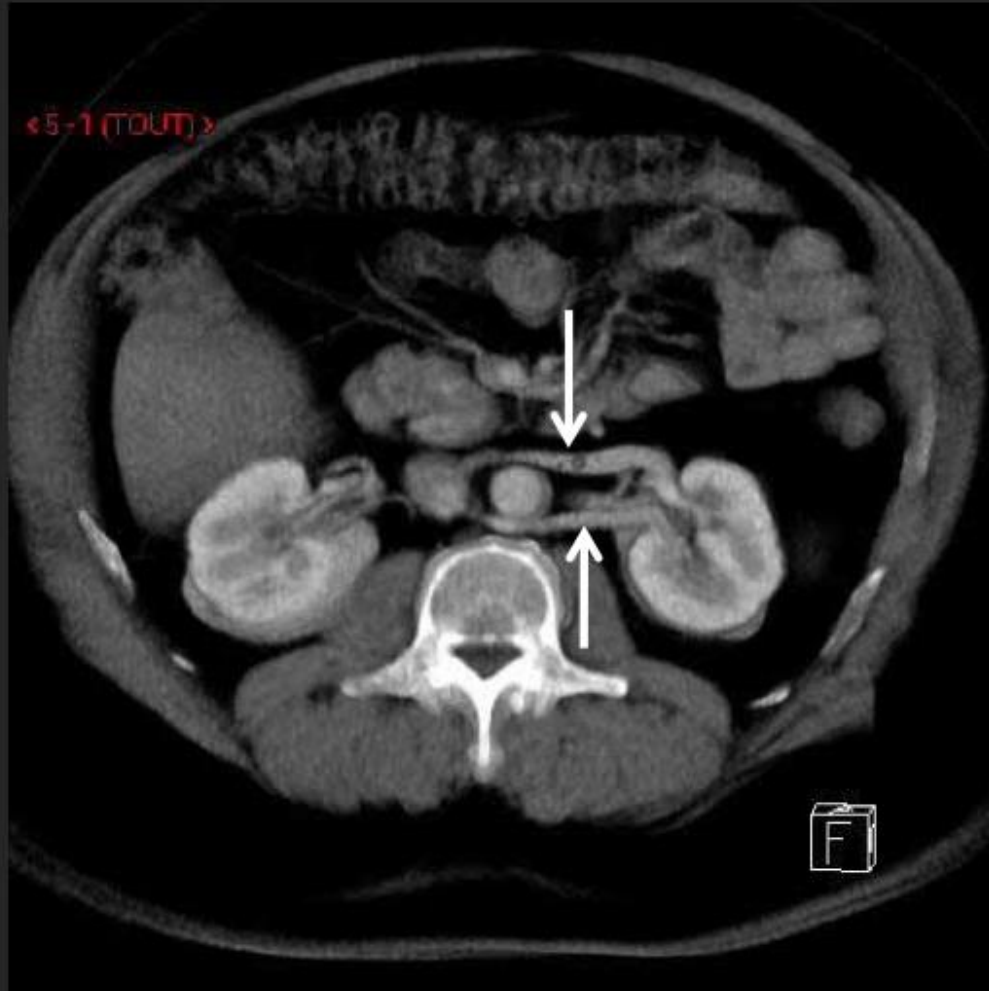
# Peri-aortic ring of the LRV



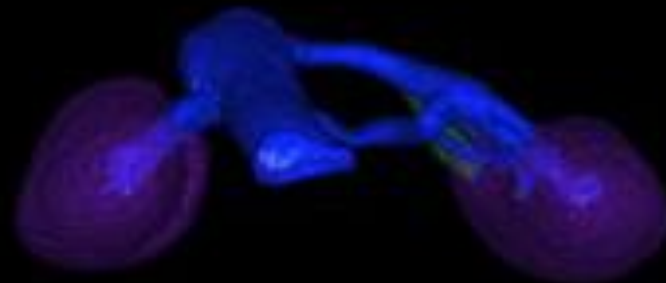
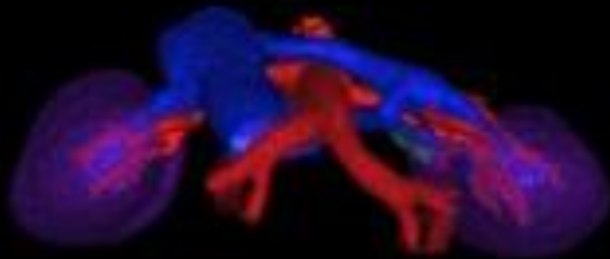
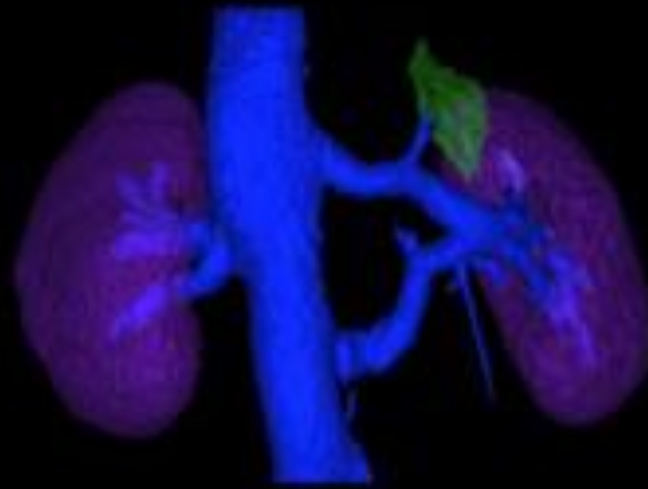
To be distinguishd from a RENO-CAVAL arch



# 3D VRT modelling by MSCT

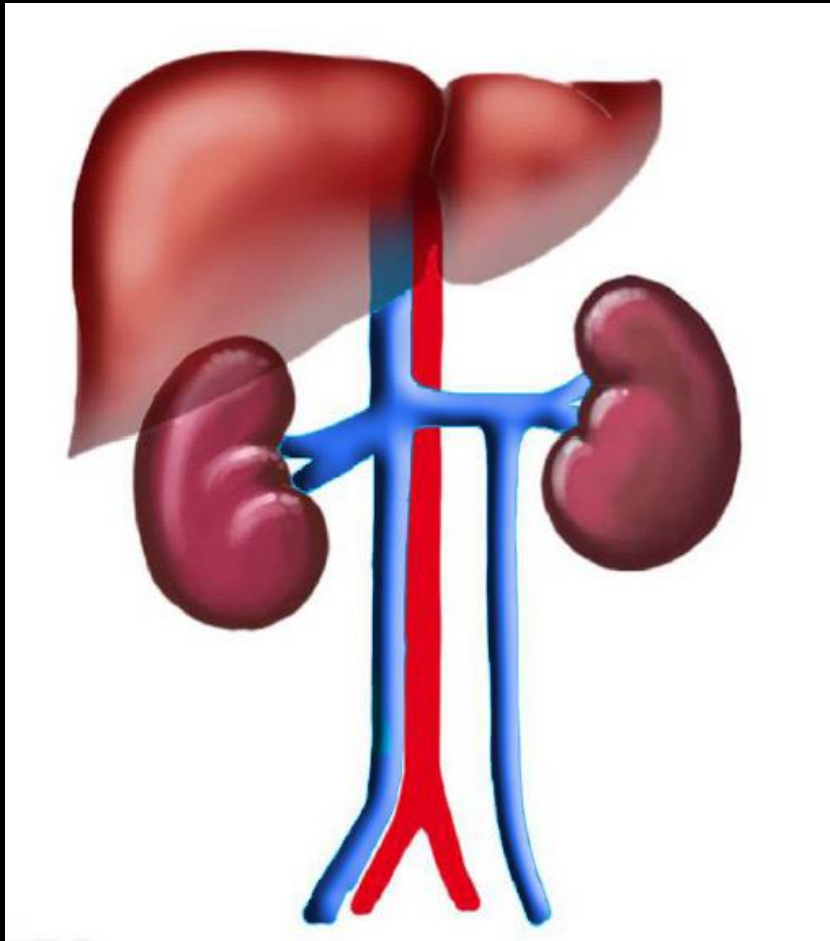


# 3D VRT modelling by MSCT



# DUPLICATION of the IVC

No regression of the left sub cardinal vein

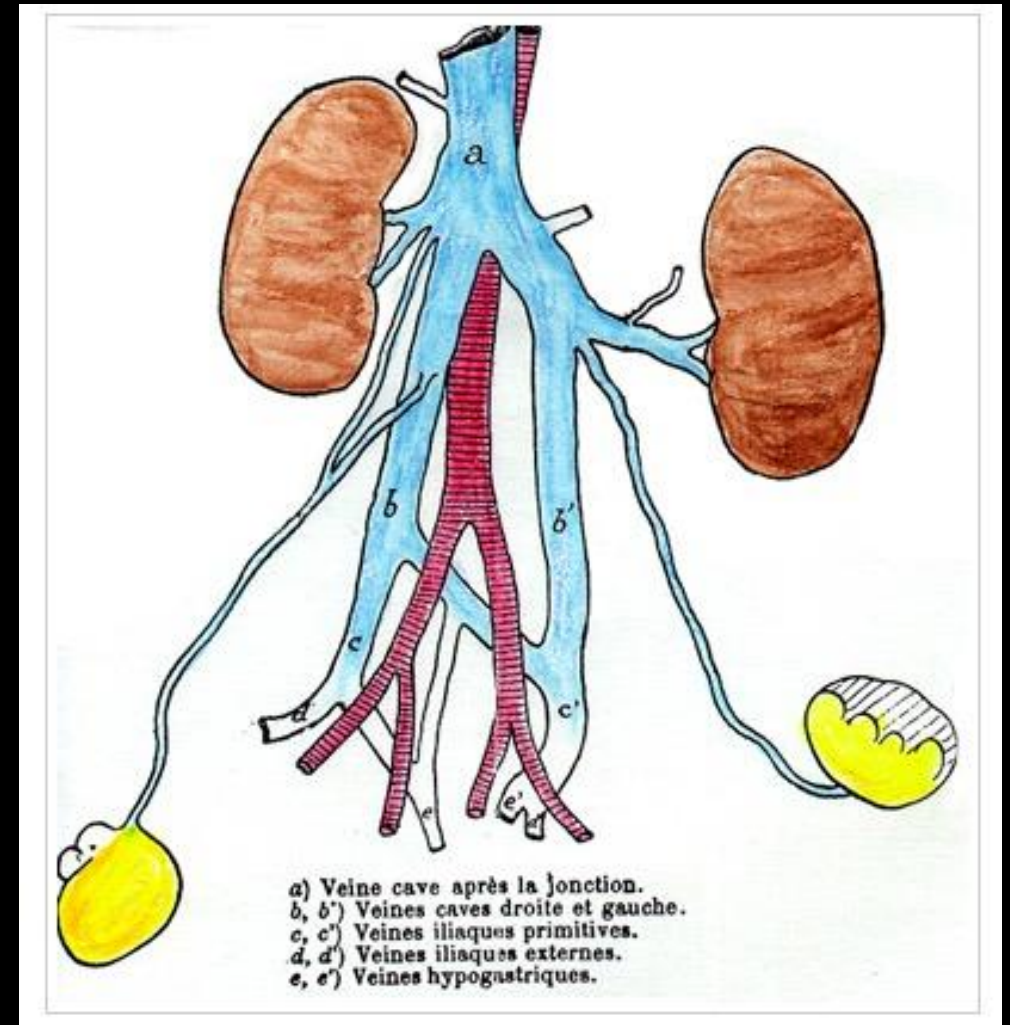
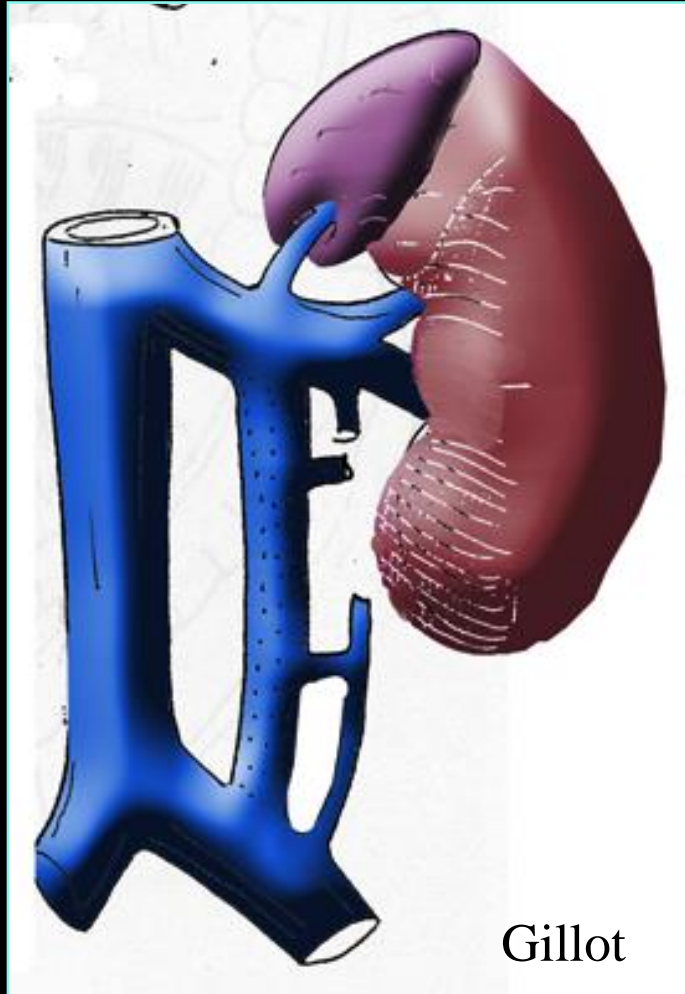


Prevalence = 1 to 2 %

## CLINICAL INTEREST:

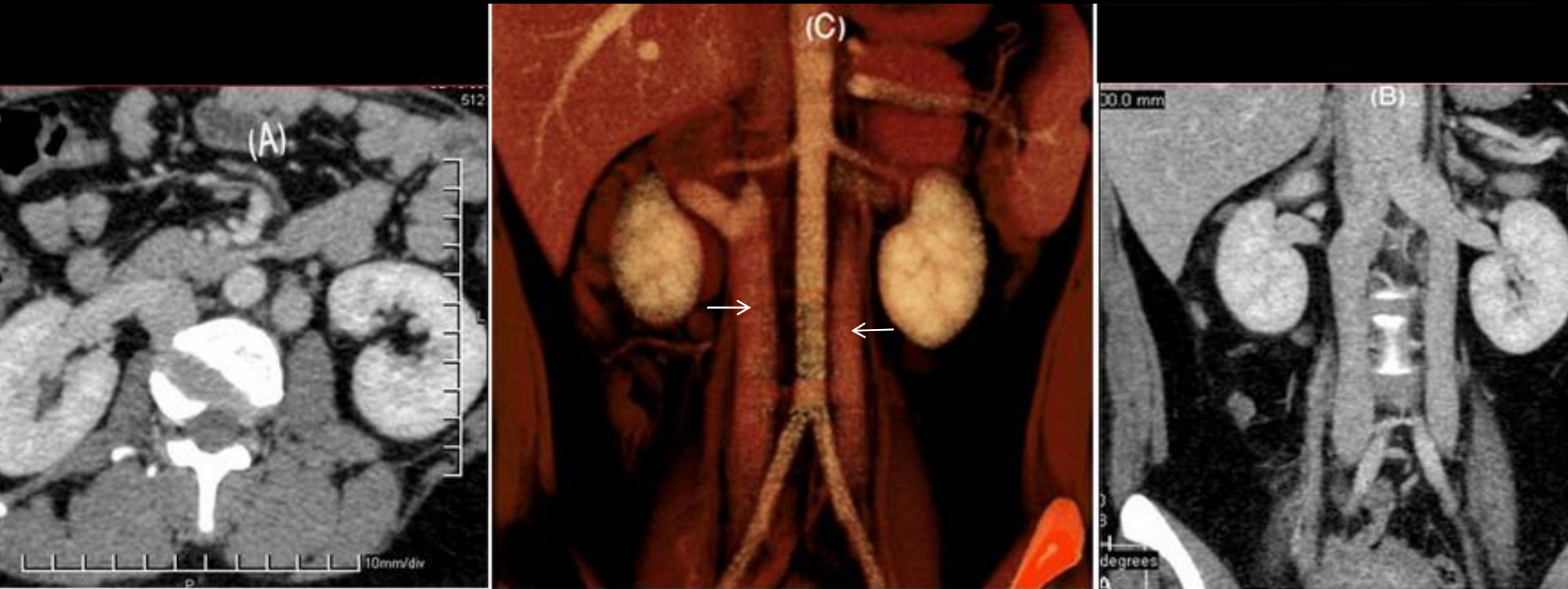
Diff. Diagnosis: Node  
Caval filters  
Aortic surgery  
Laparoscopy

# Duplicated IVCs



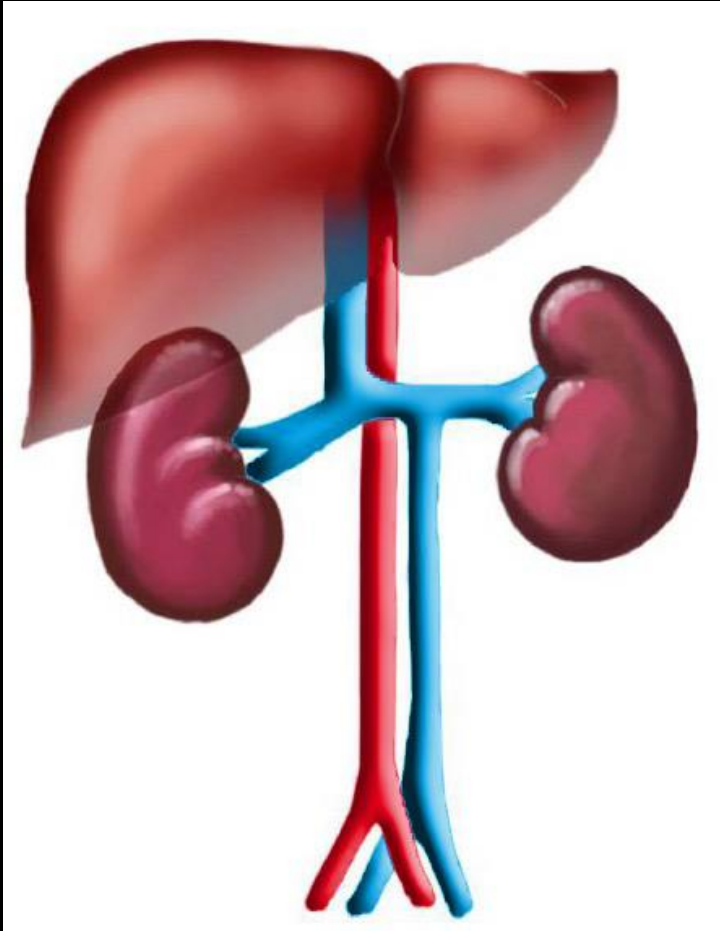


# 3D modelling of a duplicated IVC



# LEFT SIDED IVC

no regression of the left sub cardinal vein  
+ regression of the right sub cardinal vein



Prevalence = 0.5 %

## CLINICAL INTEREST:

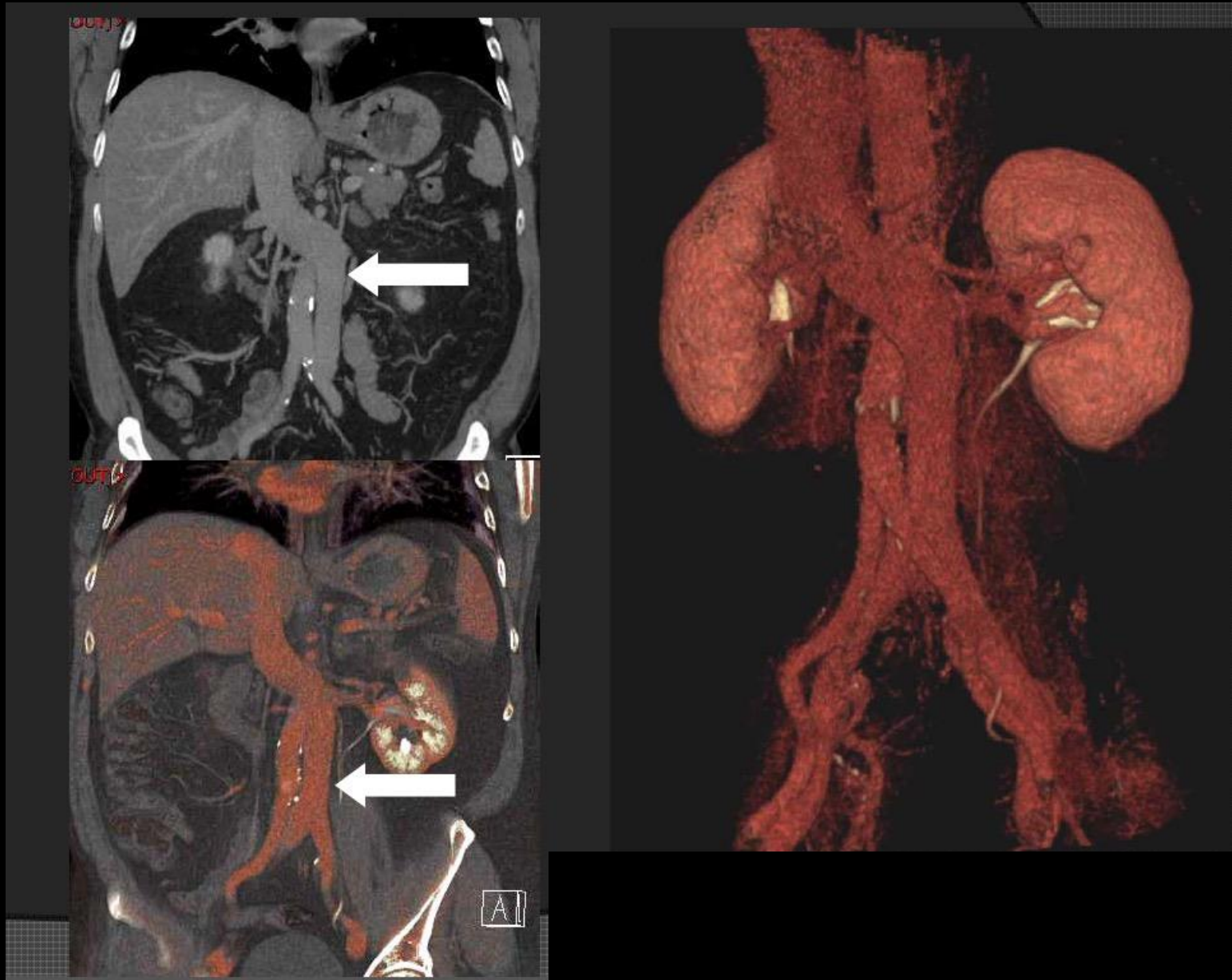
Dg# Adénopathie  
Filtres caves  
Chirurgie aortique  
Laparoscopie

# Left sided IVC: Investigation by angio-CT



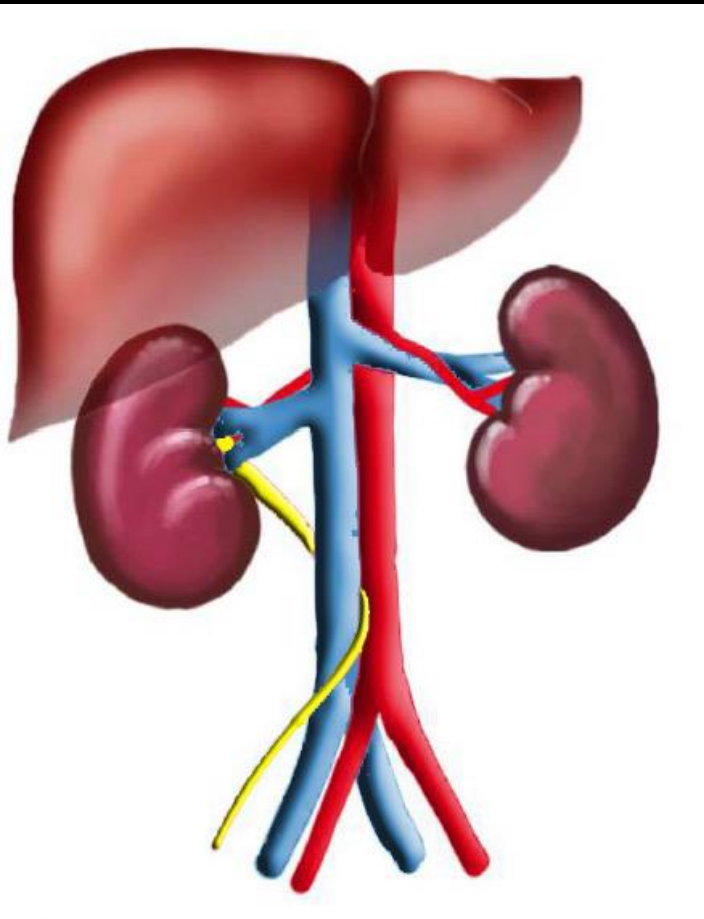


# Investigation by angio-CT



# RIGHT RETRO-CAVAL URETER

infrarenal IVC develops from the right post. cardinal vein  
instead of the right supracardinal vein

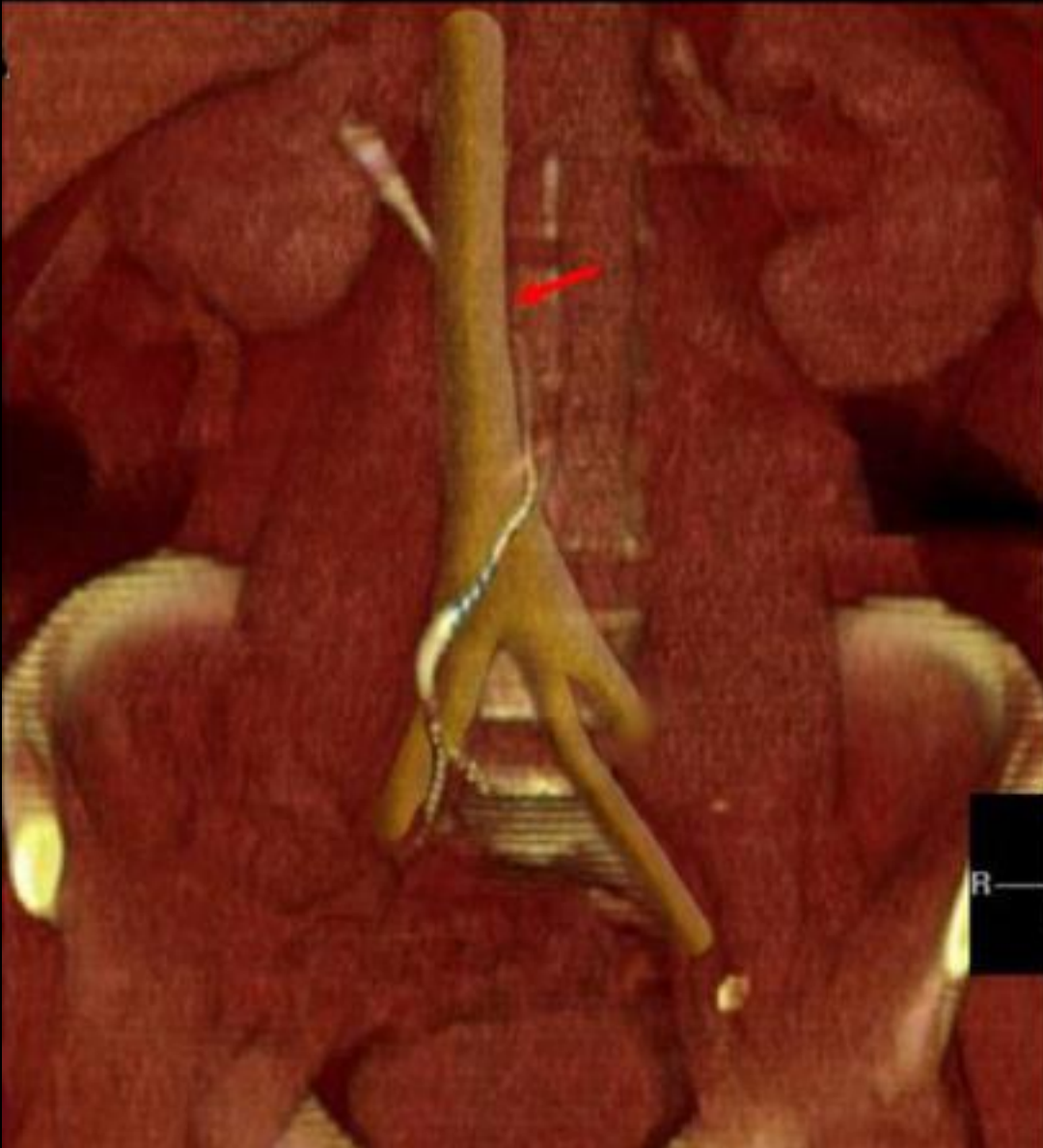


Prevalence = 0.5 %

## CLINICAL INTEREST:

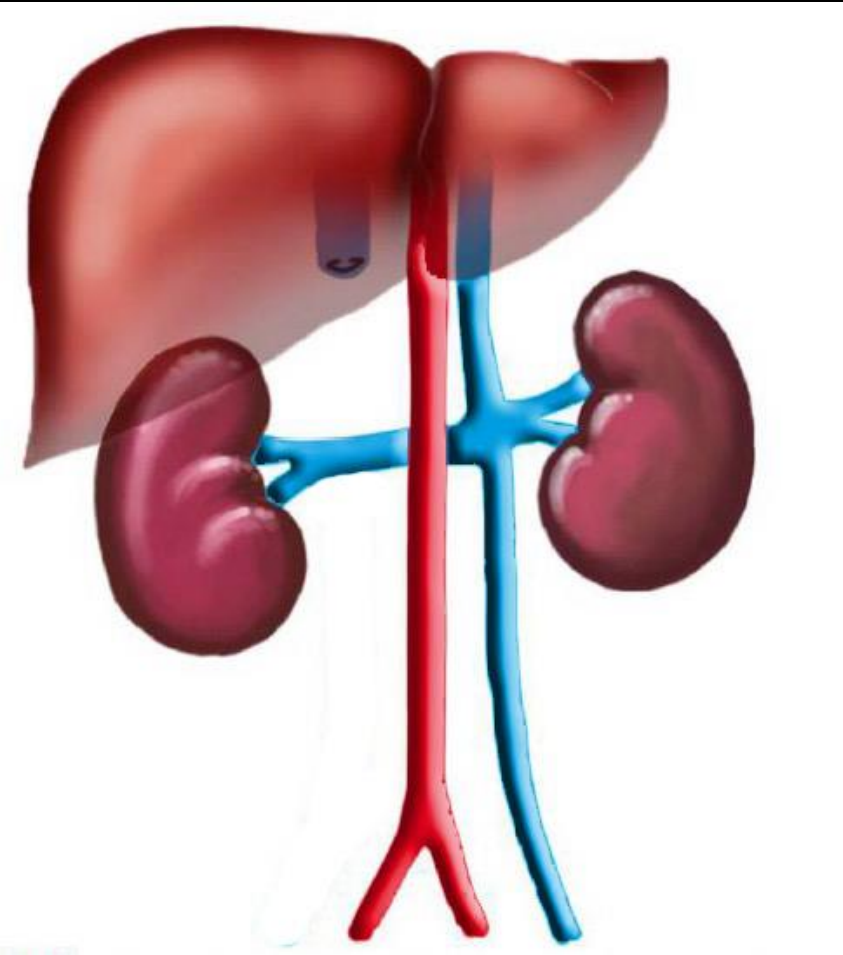
Urinary obstruction  
Vascular surgery

# Investigation by angio-CT



# AZYGOS CONTINUATION of IVC

Regression of the right upper sub cardinal vein



Prevalence = 0.4 %

Often associated with double or left IVC

## CLINICAL INTEREST:

Azygos arch #  
Mediastinal node  
Cardiac KT  
Thoracic surgery



# Investigation by angio-CT

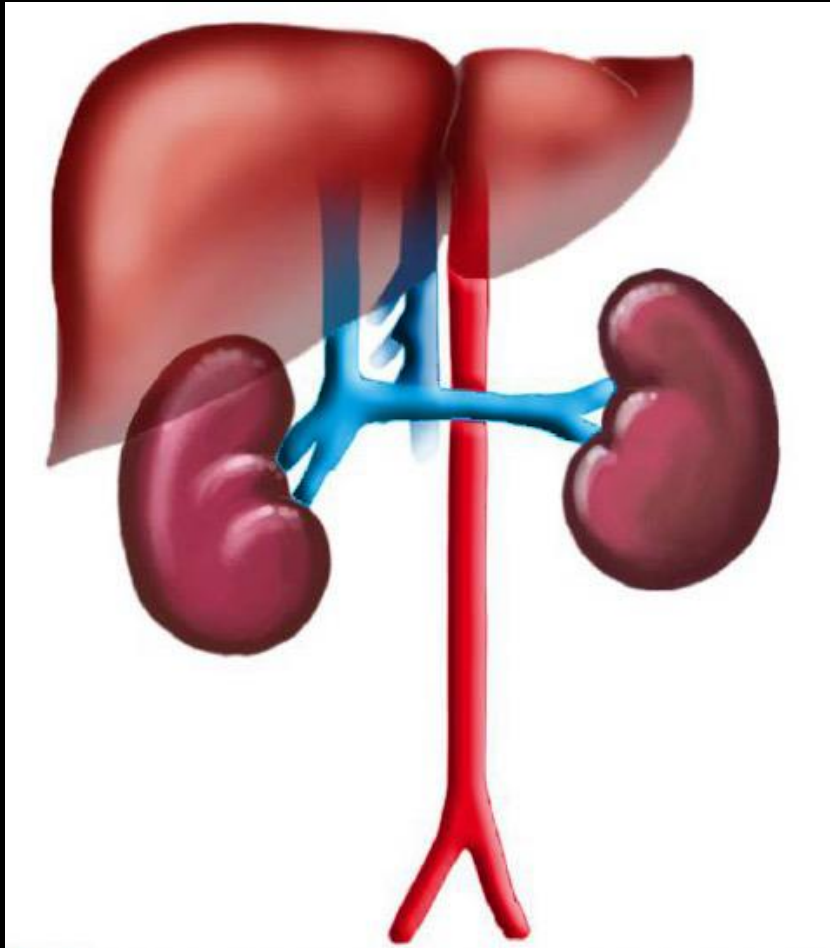
Continuation hémi-Azygos (→) rejoignant la grande Azygos (→)





# CONGENITAL ABSENCE of IVC

Regression of both supra cardinal veins

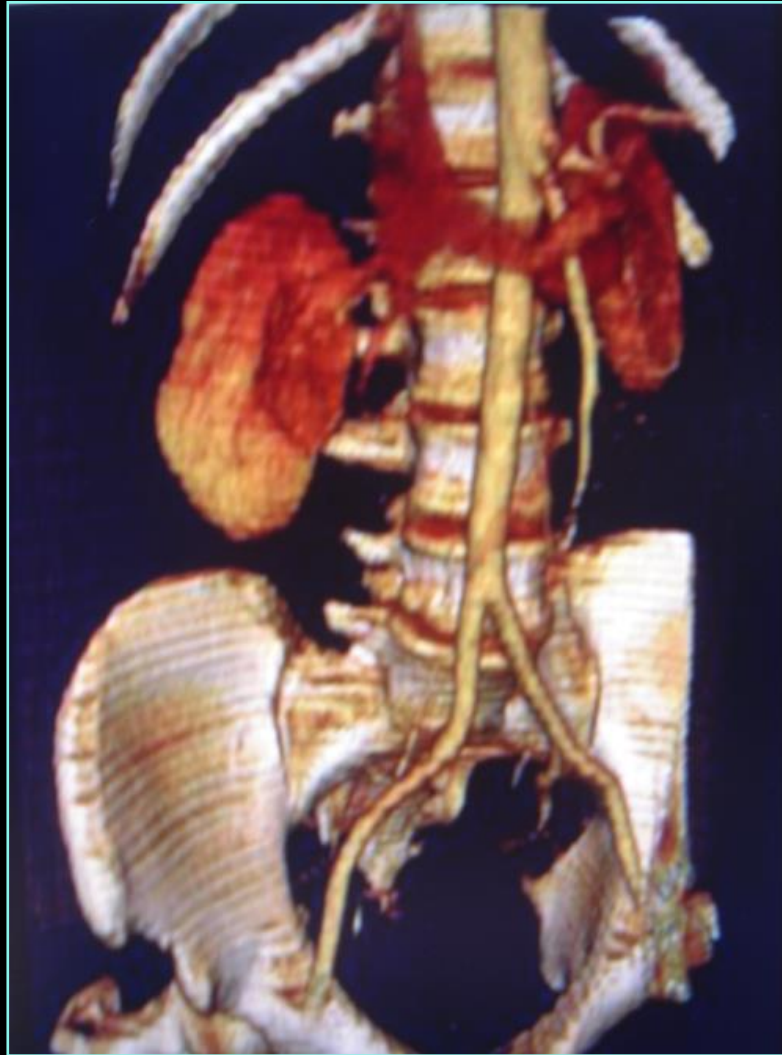


Prevalence = 0.2 %

## CLINICAL INTEREST:

Dg # thrombus VCI  
KT cardiaque

# Investigation by angio-CT



# CONCLUSION

RISK of anatomical variations during aortic surgery  
(567 patients Calligaro et al. AVF 99)

Retro aortic LRV	11	1.9 %
Peri aortic LRV	3	0.5 %
Duplicated IVC	3	0.5 %
Left sided IVC	2	0.35 %
Total	19	3.3 %

4 massive hemorrhage during surgery  
due to the malformation (21%)

Thank you  
for your attention

