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Klinika popálenin
a plastické chirurgie

Preoperative perforator mapping in DIEP flaps using Doppler ultrasonography versus CT angiography for breast reconstrucion

MUDr. Richard Mackovič
Klinika popálenin a plastické chirurgie
FN Brno Bohunice
SCaLPEL

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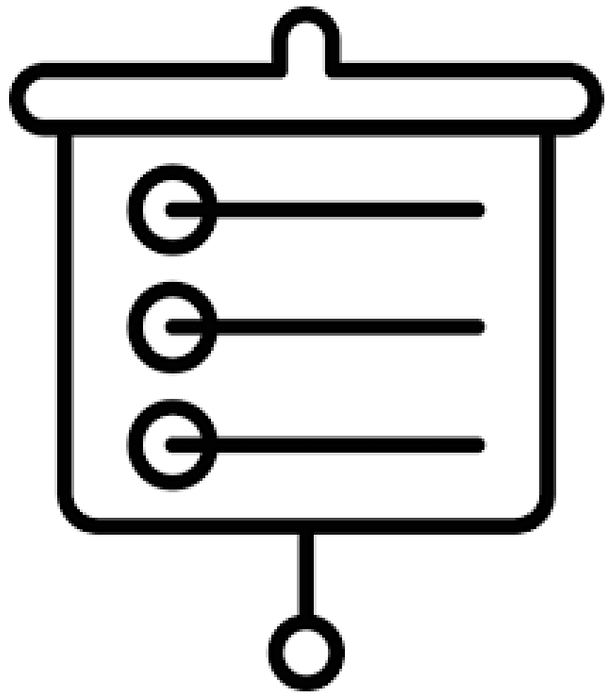
Outline

- Breast cancer incidence
- Vascular anatomy of the abdominal wall
- Classification
- Identification of dominant perforator
- pros and cons of CTA vs. CDU perforator mapping
- Selected publications



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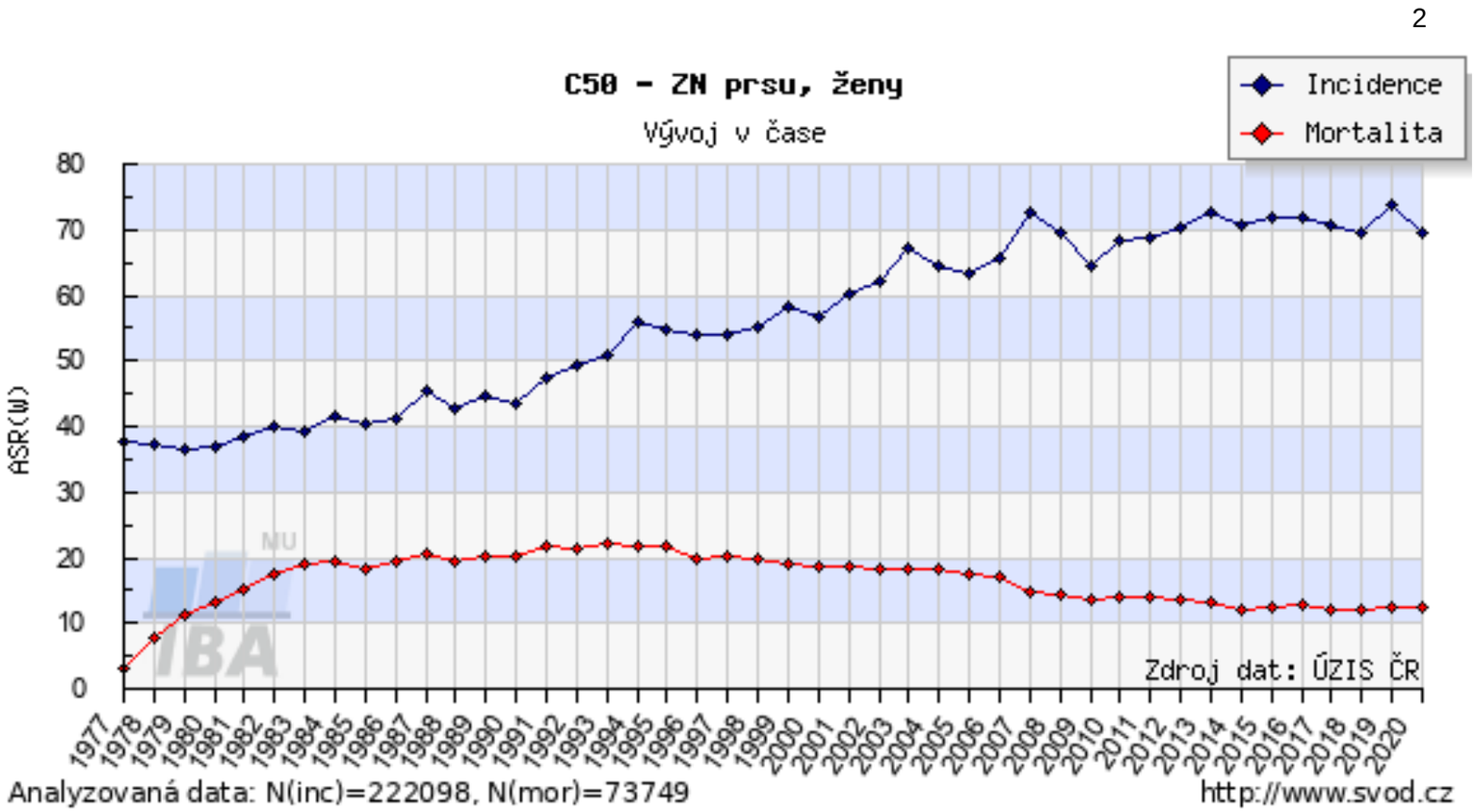
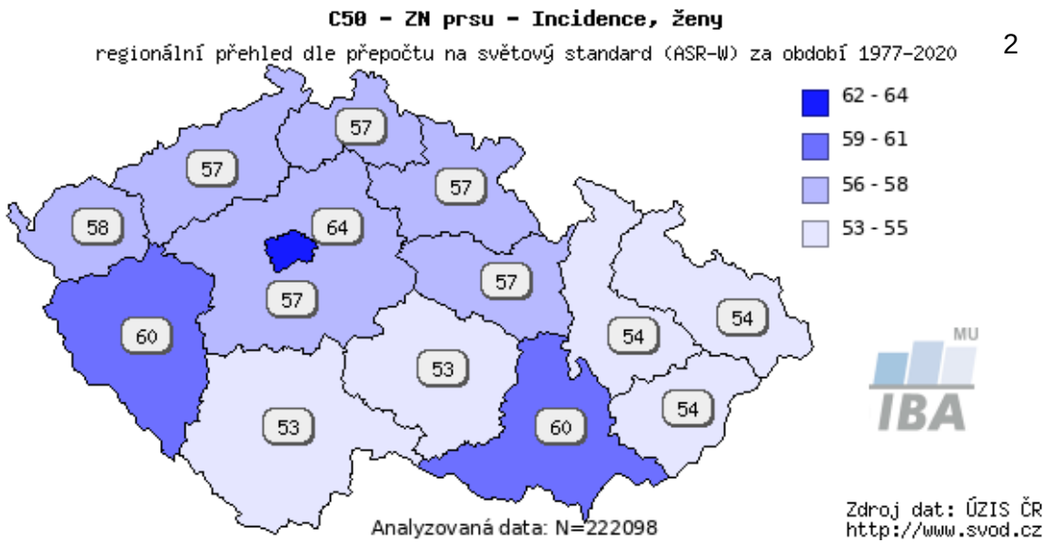
Breast cancer incidence

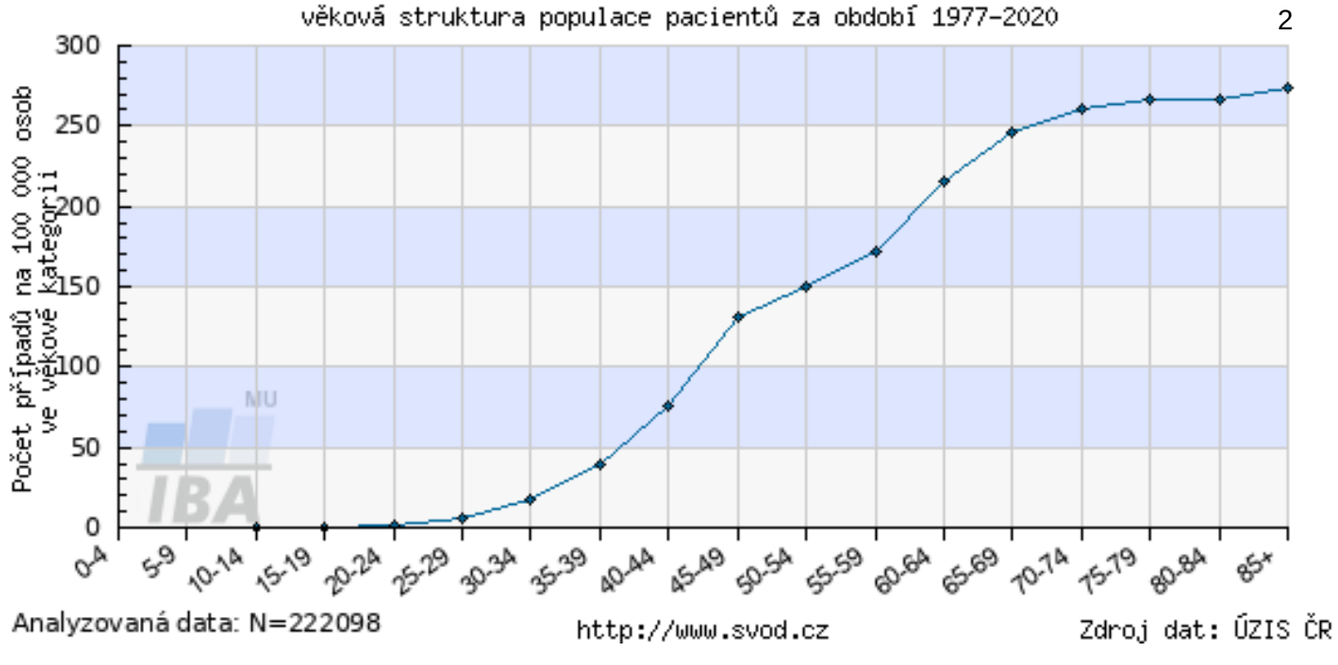
- The most common malignancy diagnosed in women

- The leading cause of cancer death in females worldwide, with an estimated 2.3 million new cancer cases (1 in 4 new cancer cases) and 685,000 cancer deaths (1 in 6 deaths) in 2020 worldwide[1]

- 7200 new cases per year in Czech republic







Types of breast reconstructions

- **Autologous:**
  TRAM,DIEP, SGAP, MLDF,UGF, fat grafting etc.
  - ***20% of all reconstructions***
  - **Natural appearance**
  - **Better outcomes in patients requiring radiation**
  - **Breast-Q- better outcomes than alloplastic reconstruction in sexual, psychosocial and physical well-being**
  - **Low donor site morbidity in DIEP flap reconstruction in comparison with TRAM**
  - **Technically difficult**
  - **Risk associated with general anesthesia, longer operating time**

- **Combination of methods**

- **Alloplastic:** *implant based, tissue expander etc.*
  - ***80% of all reconstructions***
  - **Technically easier**
  - **No donor site morbidity**
  - **Foreign material**
  - **Capsular contracture**
  - **Implant migration or damage**
  - **ALCL**

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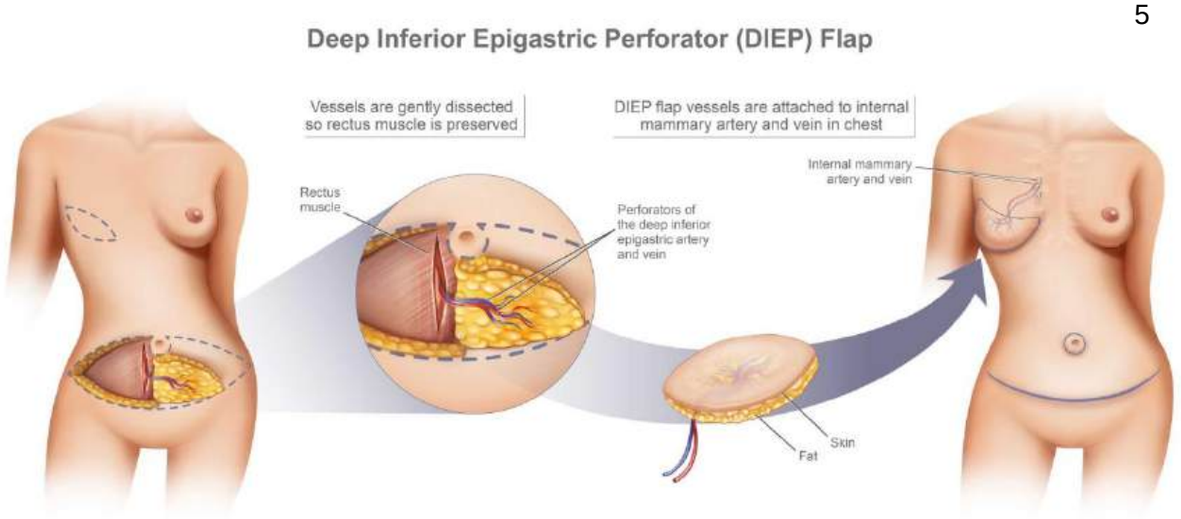

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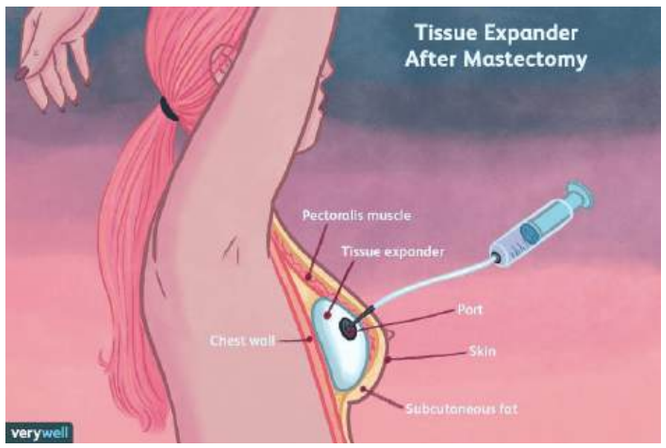

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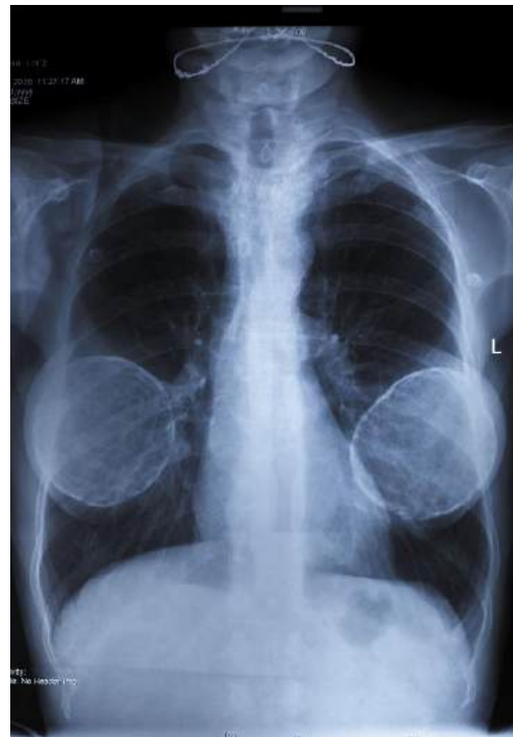
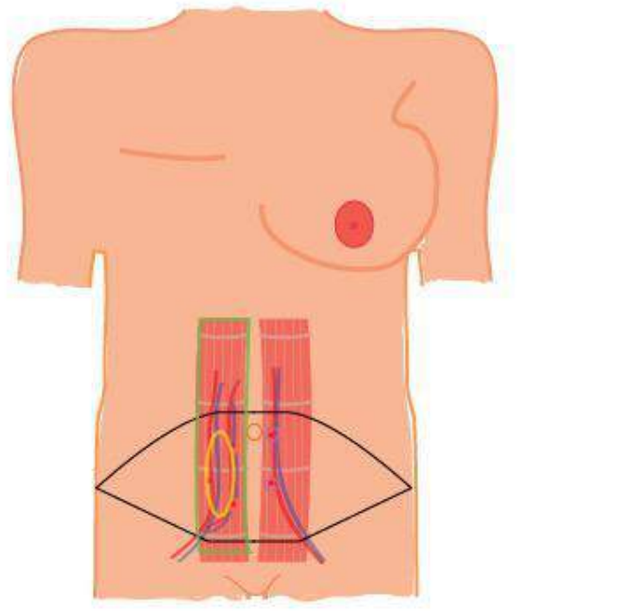
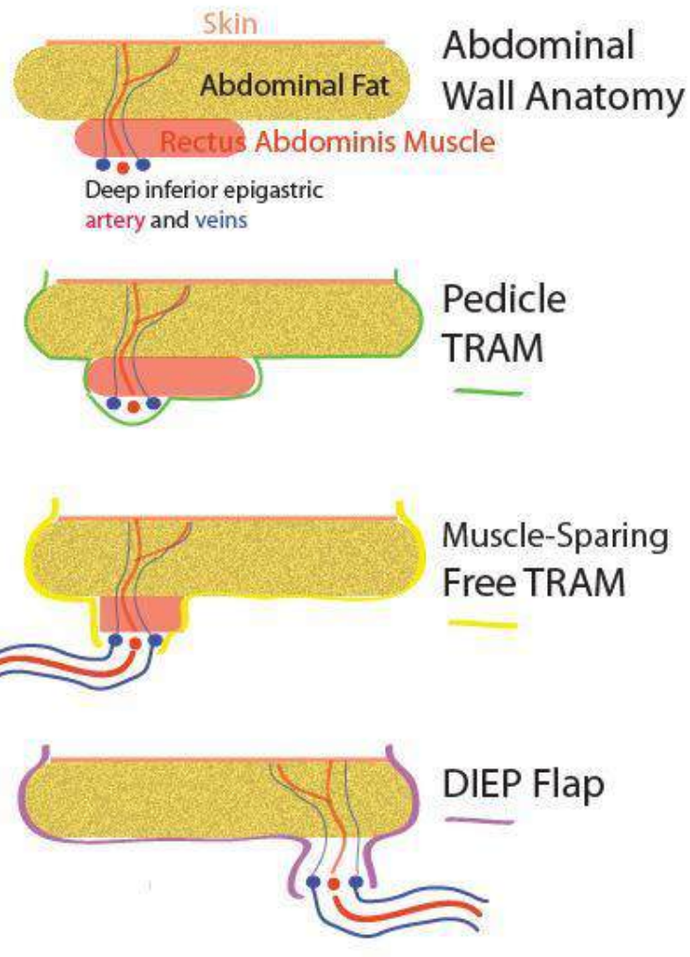


DIEP flap

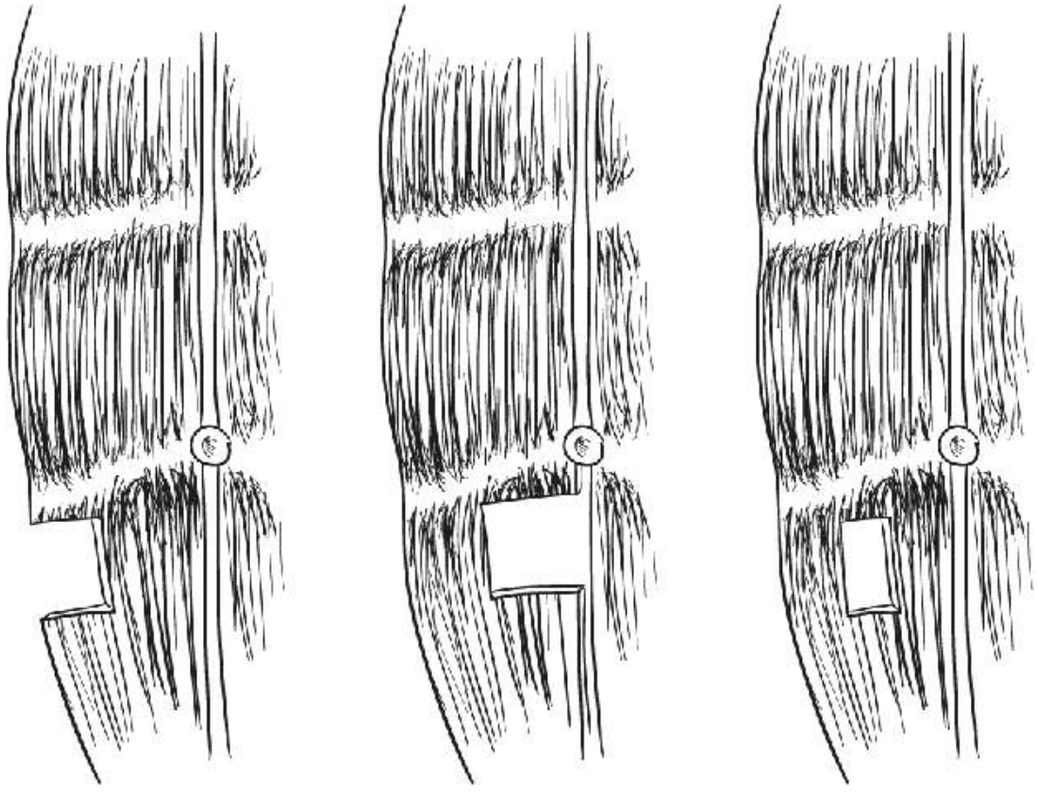


Pedicle TRAM incisions
Muscle-sparing Free TRAM incisions
DIEP Flap incisions

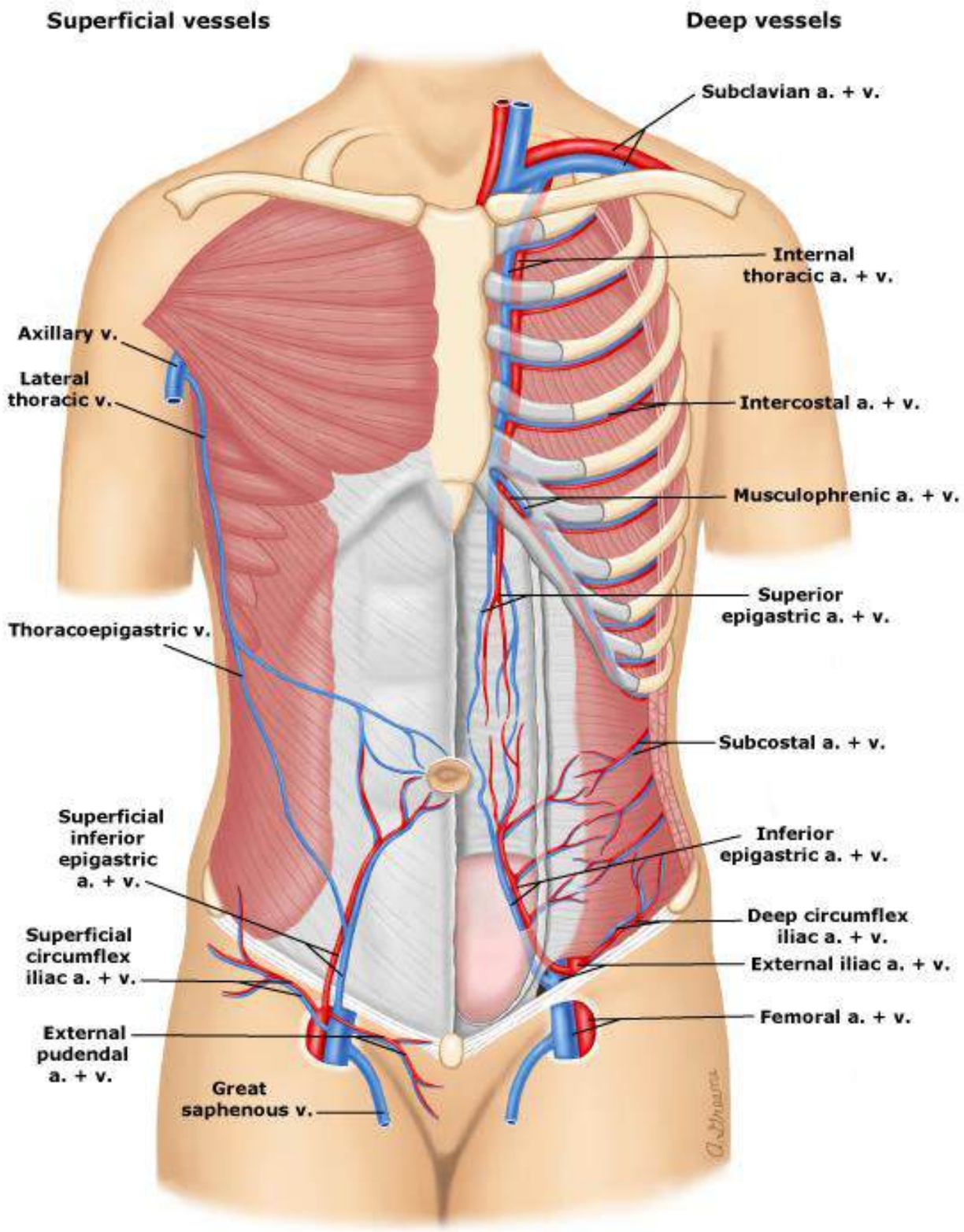
Mychalyn (2011)



MS-TRAM flap

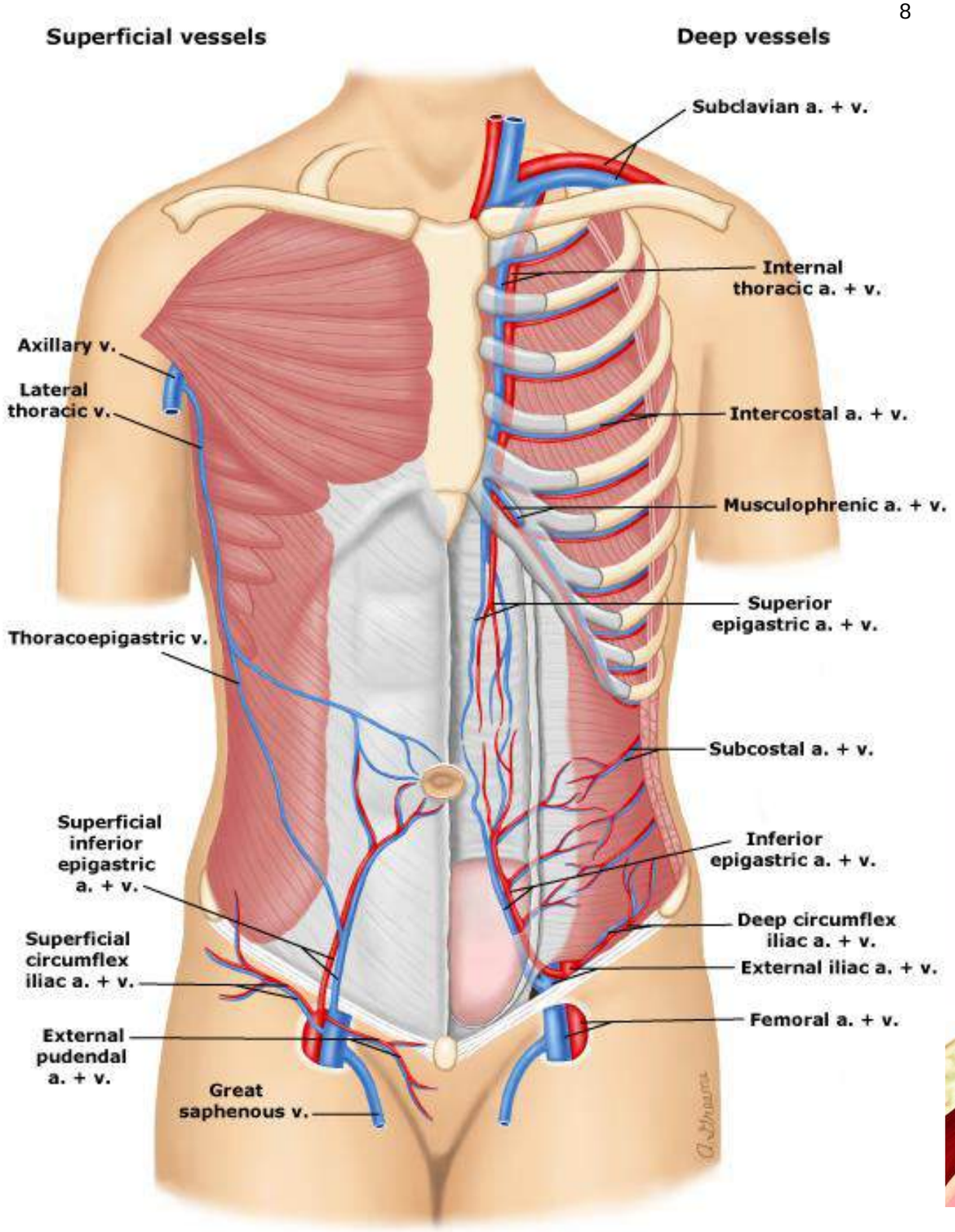


Vascular anatomy of anterior abdominal wall



- **Superficial system**
  - SIEA et SIEV
  - Branch of a. femoralis communis
  - Lack of the system in 15% patients
  - Vessel diamater around 1.5mm
  - SIEV drained into v.femoralis, or v.saph. magna

Vascular anatomy of anterior abdominal wall



- **Deep system**

- DIEA + 2x DIEV+ v.concomitantes
- Branch of a. iliaca externa
- Vessel diameter cca 3-4 mm
- Average length of the vessels is 10cm
- Position of the perforators is 2 cm cranial, up to 6 cm caudal and 1 to 6 cm lateral from umbilicus
- 5-6 perforators per DIEA with diameter at least 1,5 mm
- DIEV drains into v. iliaca externa

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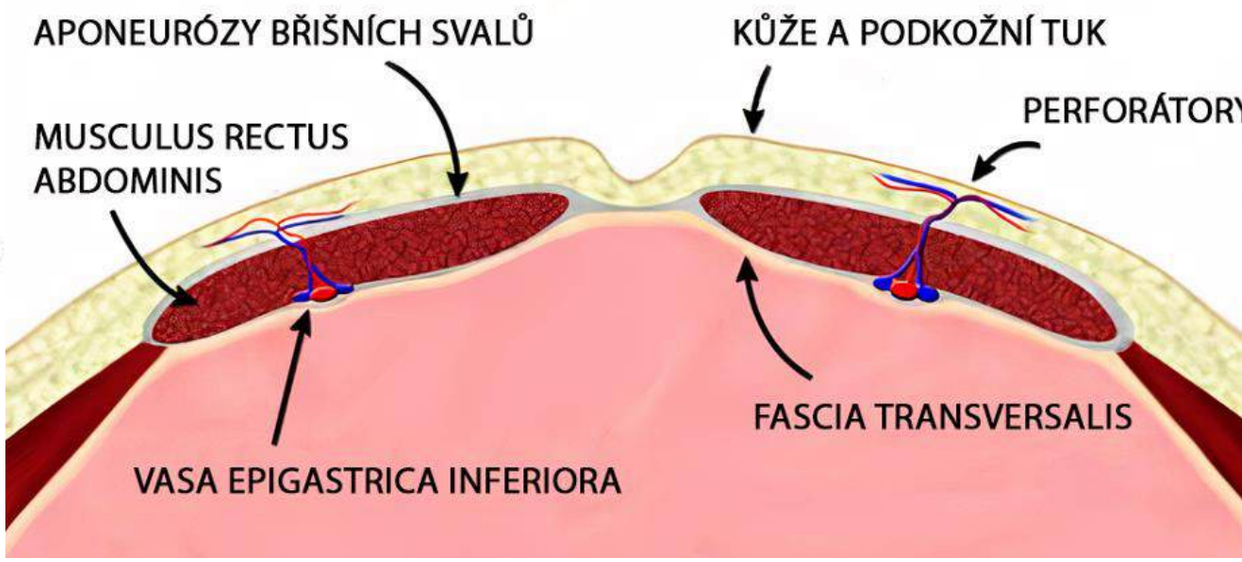
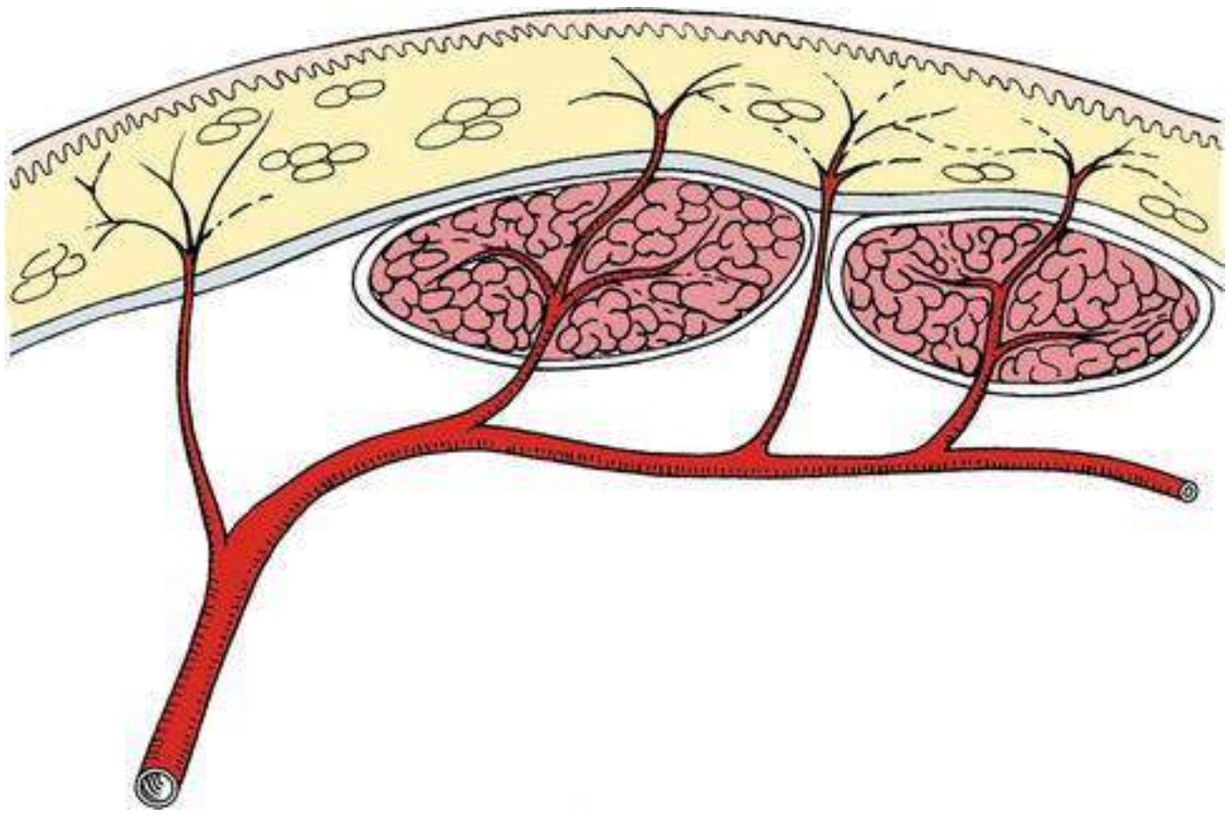
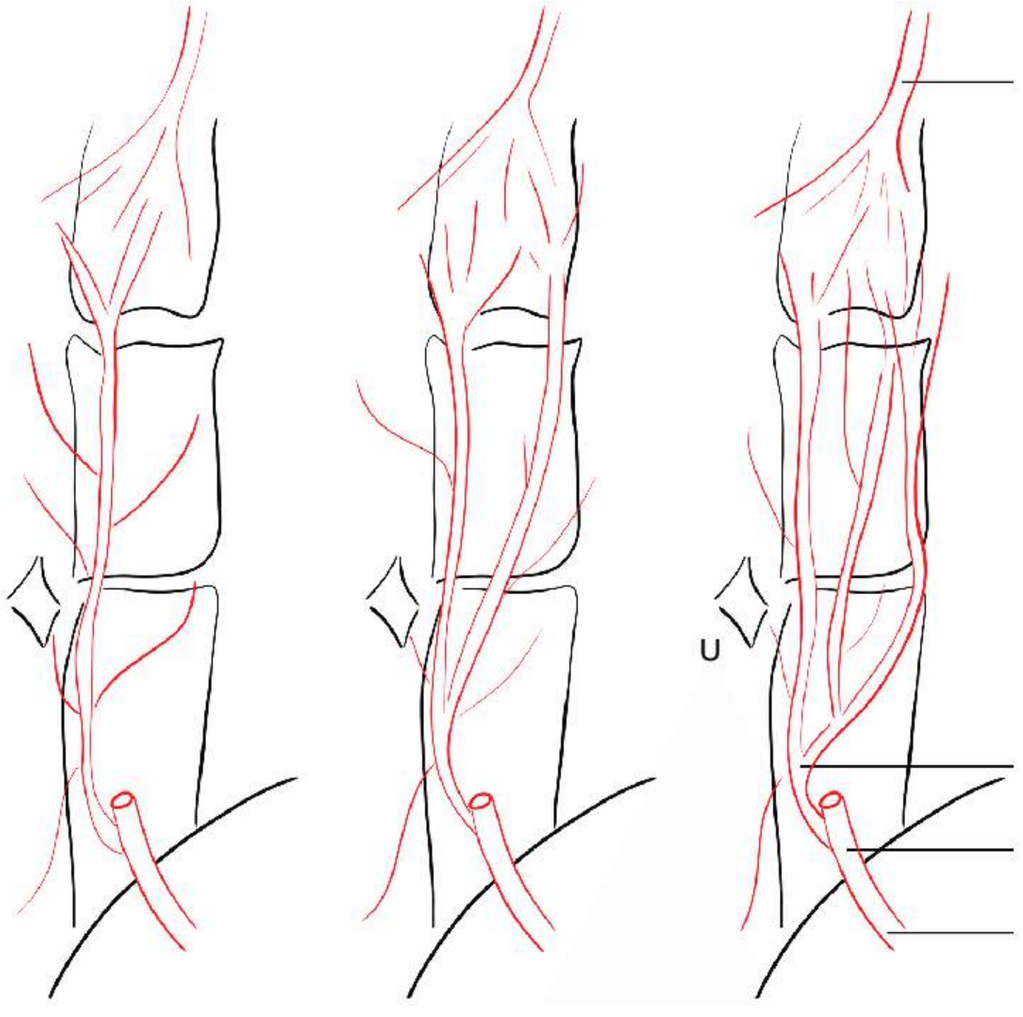


Moon and Taylor classification

- Perforator- every branch of a vessel, which pierces through an anatomical tissue envelope and supplies the tissue
- Type II. optimal because of the shortest intramuscular course of the perforators
- Type III.- longest intramuscular course





Type I- 15% **Type II.-59%** **Type III.-26%**

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Identification of the dominant perforator

- Adequate perfusion
- 1 perforator per flap is optimal for most of the flaps
- Diameter of the vessels ranging from 1.5mm-2mm
- 2 perforators - smaller of the two should have at least 85% of the diamater of the bigger one
- position of the perforator

Hagen–Poiseuille Equation

Q	Flow rate
P	Pressure
r	Radius
η	Fluid viscosity
l	Length of tubing

- Simplified form of Poiseuille's Law:

$$\Delta P = \frac{V}{r^4}$$

$$Q = \frac{\pi \Pr^4}{8\eta l}$$

The Navarra criteria for selecting the ideal perforator	
1.	Large caliber DIEA and vascular pedicle
2.	Large caliber perforator both artery and veins
3.	Central location within the flap
4.	Short intramuscular course
5.	Broad subcutaneous branching into the flap
6.	Avoids tendinous intersections
7.	Perforating veins communicate with the superficial venous network

Perfusion zones

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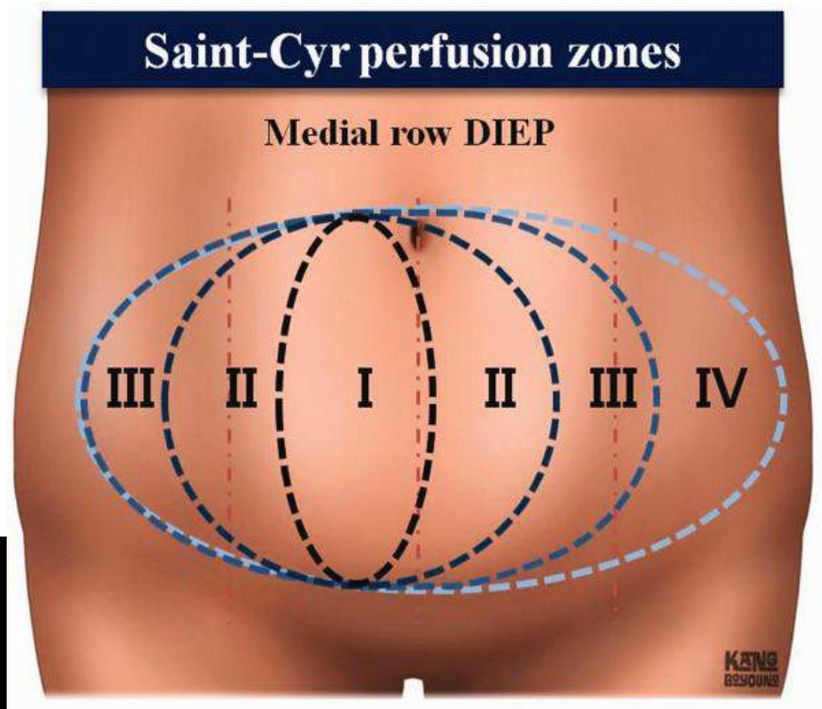
- **Perforasome**



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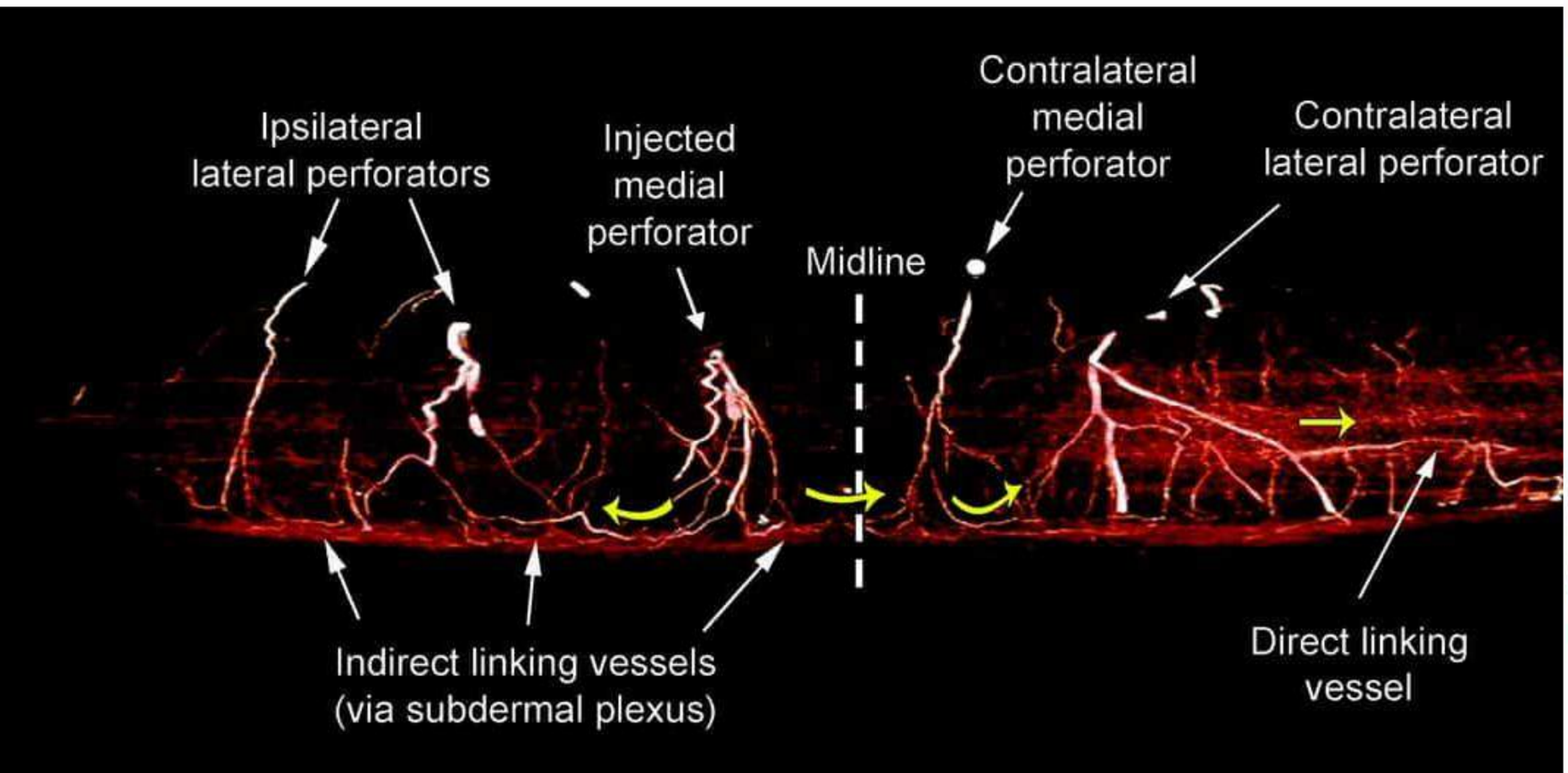

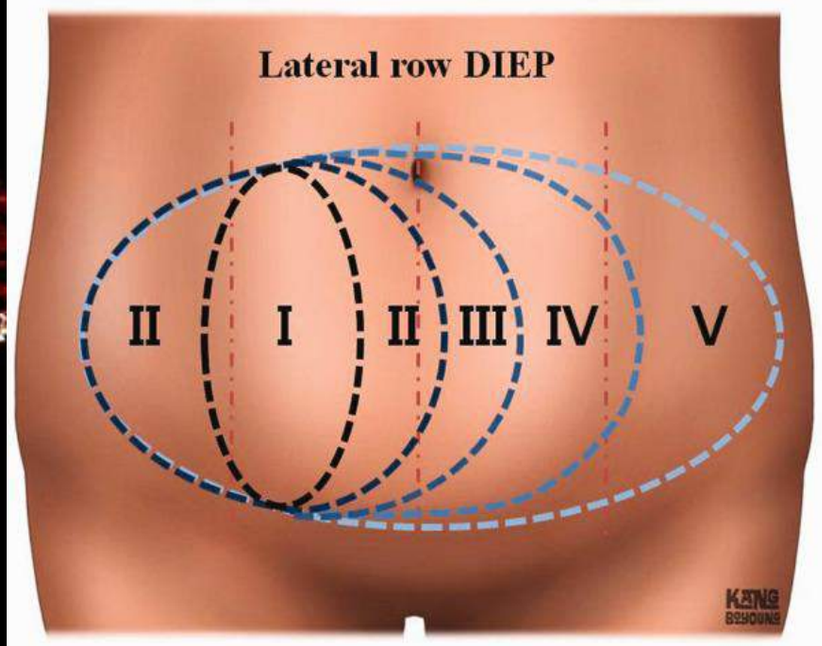

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Mapping of perforators using CTA

- “Gold standard “
- X rays combined with special dye
- Identify a perforator ≥1mm in diameter
- Pros- effectiveness, reproducibility, accuracy, previous abdominal surgeries
- Cons- ionizing radiation, contrast agent, vein visualisation, need a radiologist

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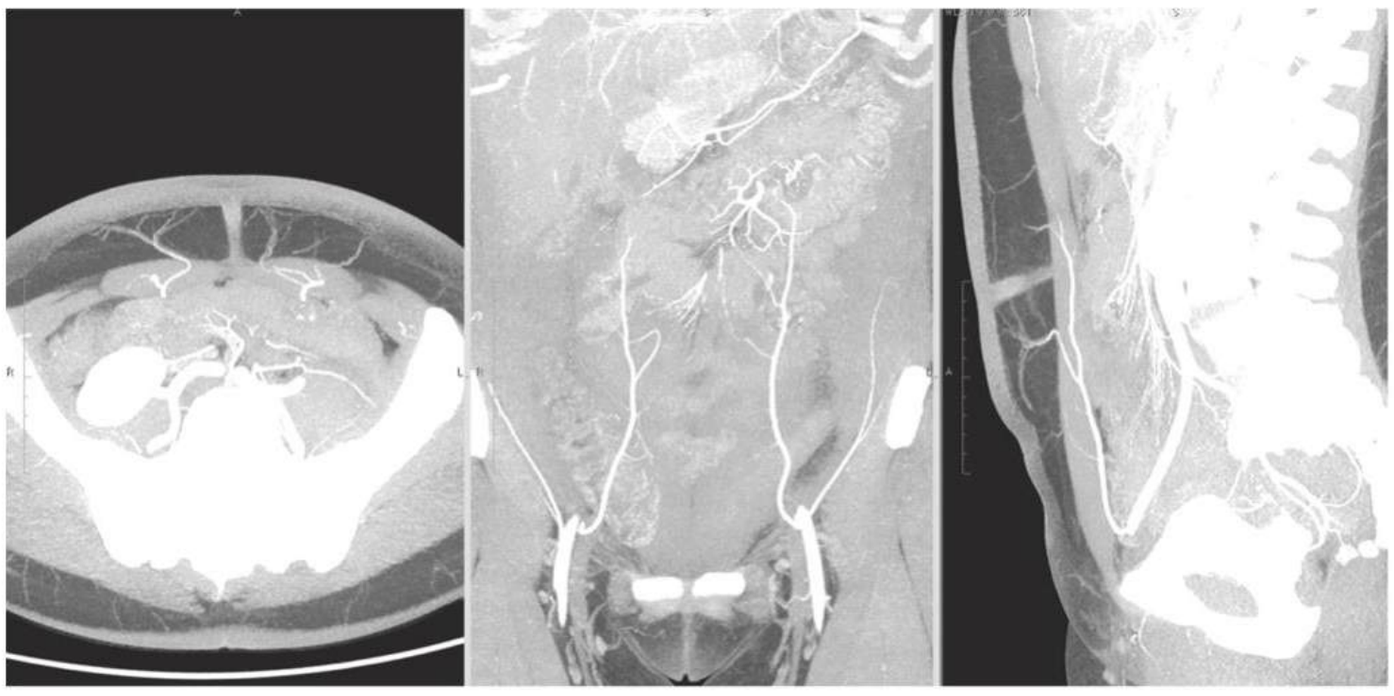

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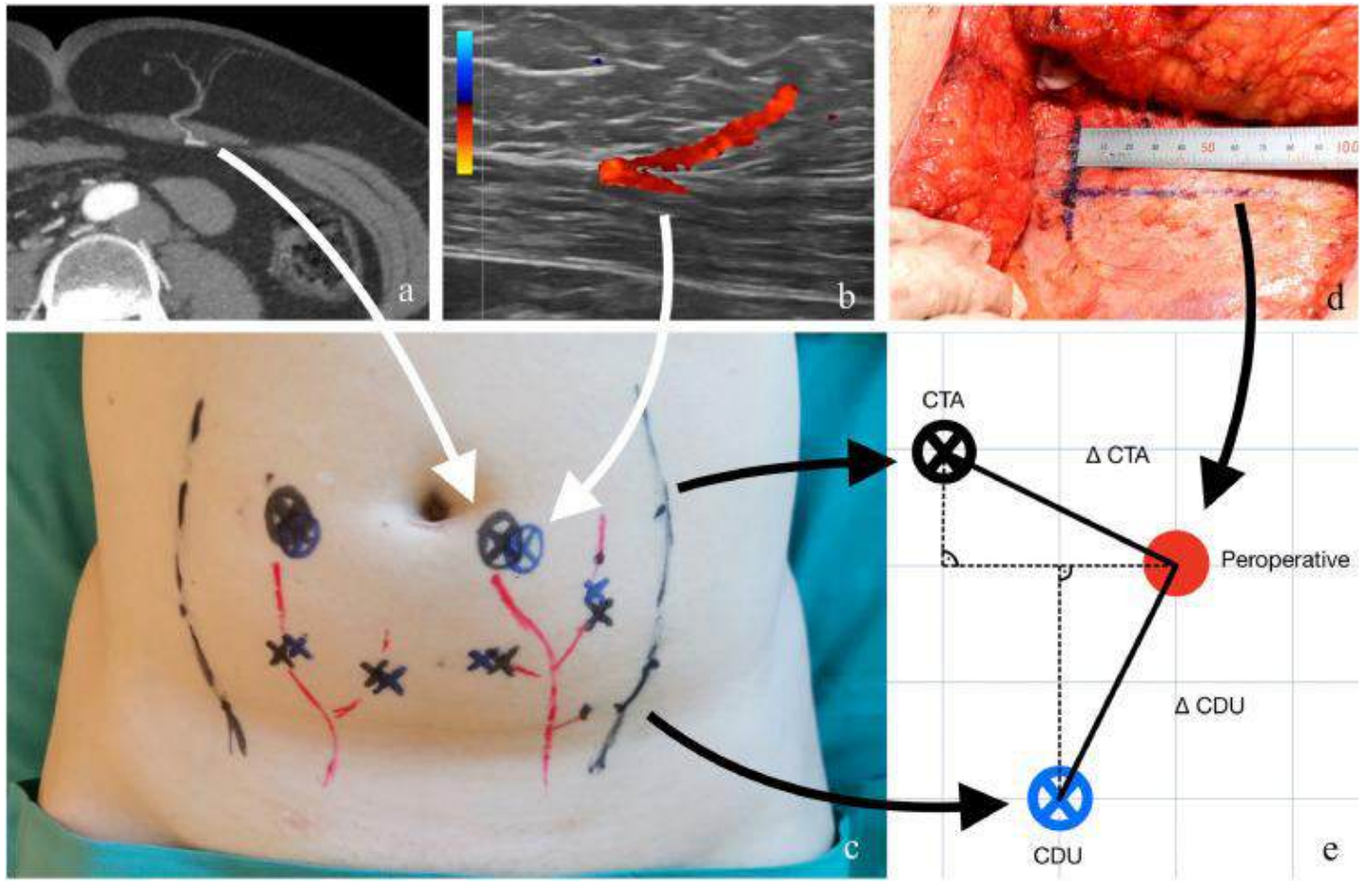
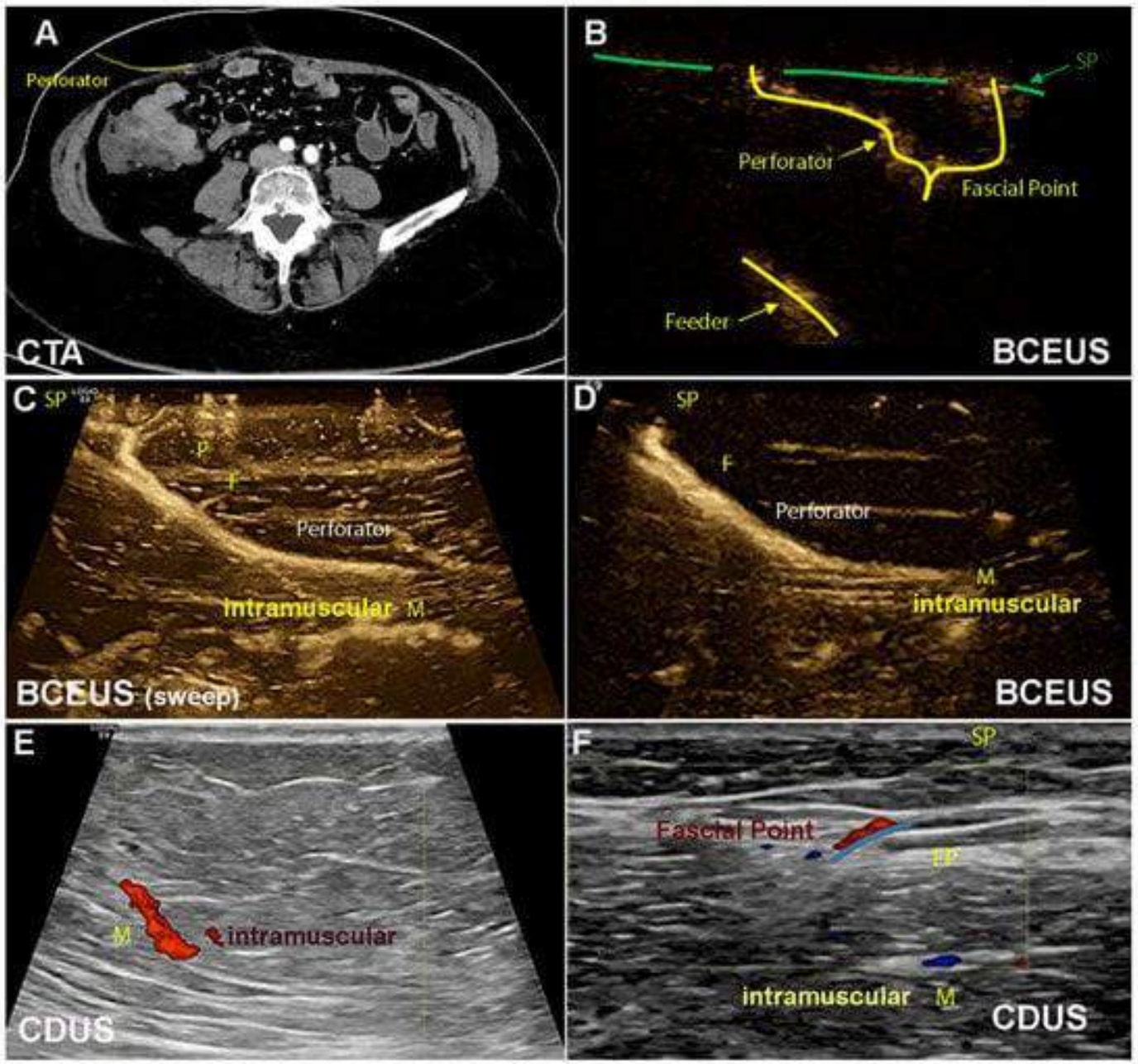
Mapping of perforators using CTA

- 256 slice multidetector iCT scan
- Standardized DIEP protocol
- Intravenous application of an iodine contrast media (ioxohexol 150 ml)
- Distances between the center of the umbilicus and the perforator penetration points through the muscle fascia were measured in the axial and sagittal planes
- The measured distances were converted into coordinates on the x and y axes, while the center of the umbilicus was set as the point [0;0]



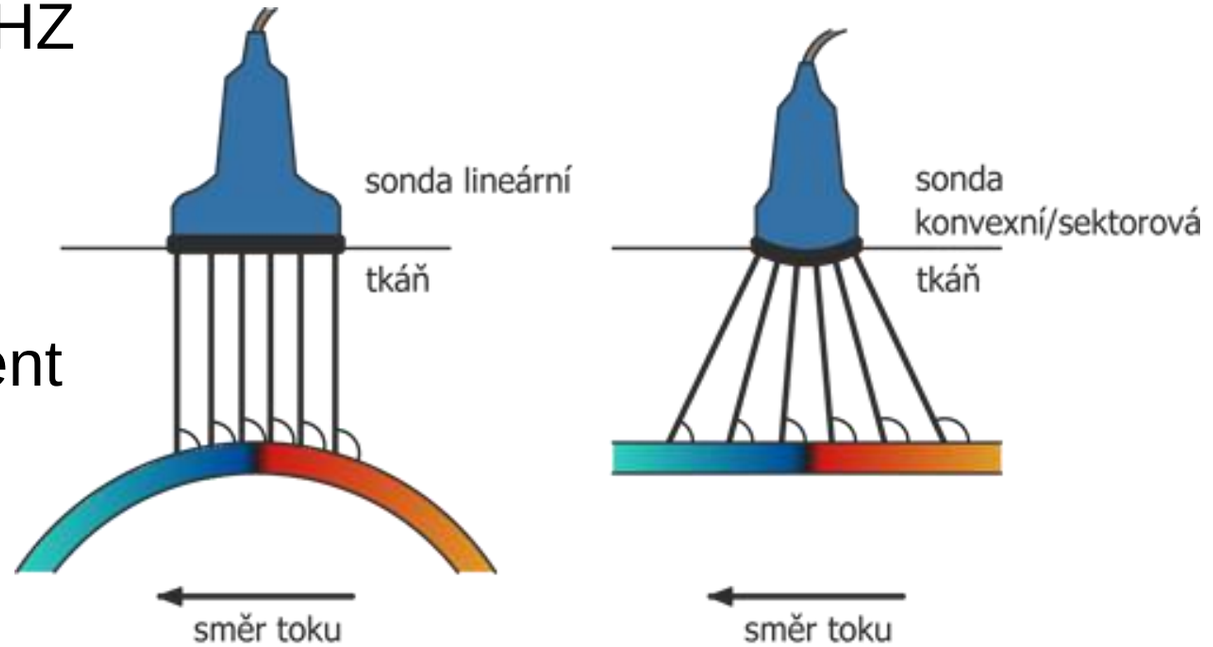
Mapping of perforators using CDU

- B mode + Color Doppler ultrasound
- Two-dimensional imaging of the tissues: hypoechoic, anechoic and hyperechoic
- Color Doppler ultrasound enables a dynamic display of the blood stream, towards the probe marked in red, away from the probe in blue
- Pros- dynamic, absence of radiation, bedside
- Cons- learning curve

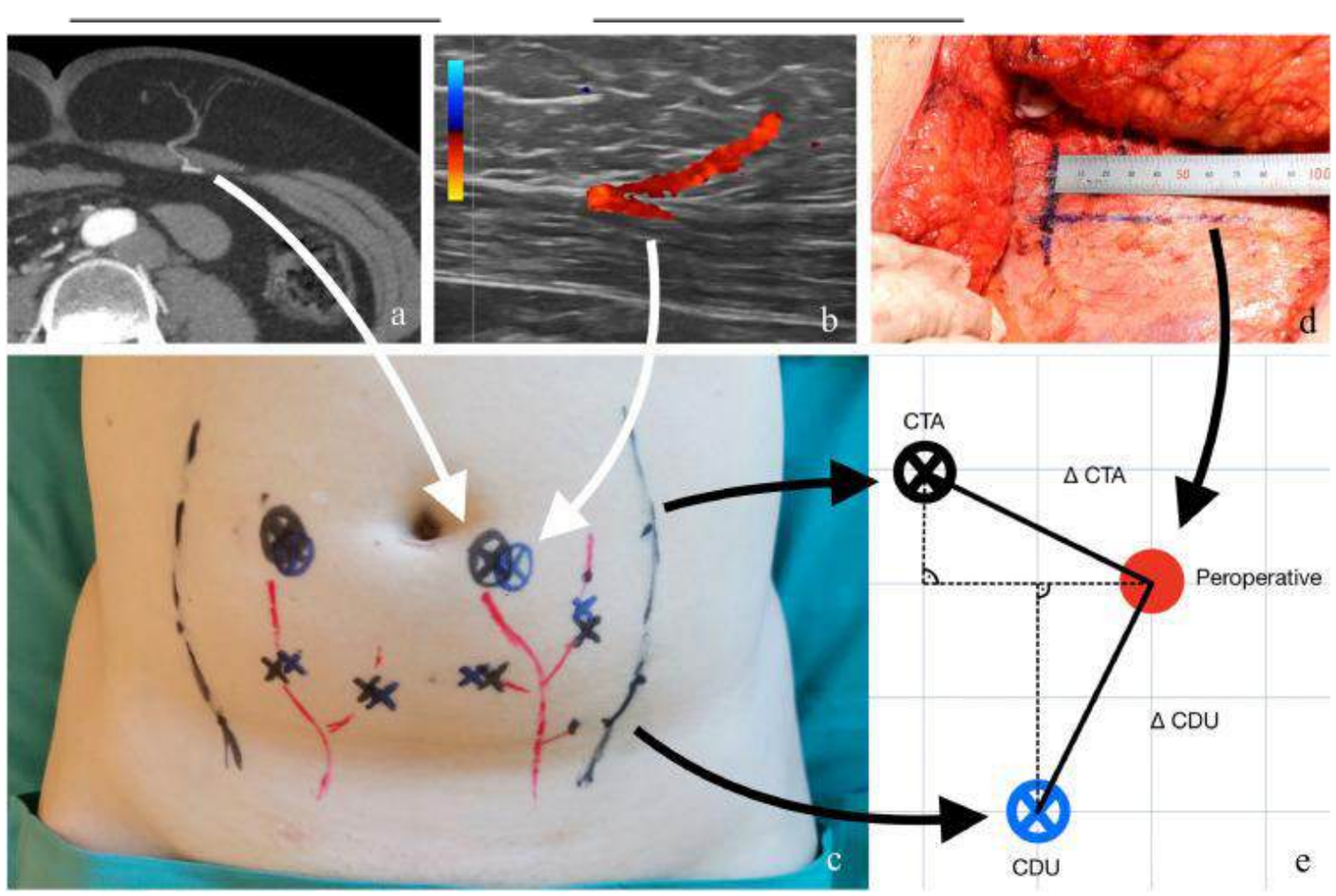


Mapping of perforators using CDU

- High-frequency linear probe 4-11MHZ
- Musculoskeletal imaging mode
- Comfortable conditions for the patient
- Perforator diameter ≥ 2 mm



- Measuring and marking the position where the perforator penetrates rectus fascia
- Statistical analysis of the results



Color Doppler ultrasound and computed tomographic angiography for perforator mapping in DIEP flap breast reconstruction revisited: A cohort study

B. Mijuskovic • M. Tremp • M.M. Heimer • ... D.J. Schaefer • M.D. Haug • E.A. Kappos
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Published: July 06, 2019 • DOI: https://doi.org/10.1016/j.bjps.2019.06.008 • Check for updates

- Retrospective study
- 98 women, 125 DIEP flaps
- Both CTA and CDU were performed prior to the surgery, and both imaging entities were thoroughly examined by the surgical team
- A significantly stronger correlation was found between CDU and intraoperative findings of perforator detection
- CTA identified on average 3.2 perforators per patient, CDU identified 5.6 perforators per patient >1mm
- Biased
- not sure if it was a double blinded trial

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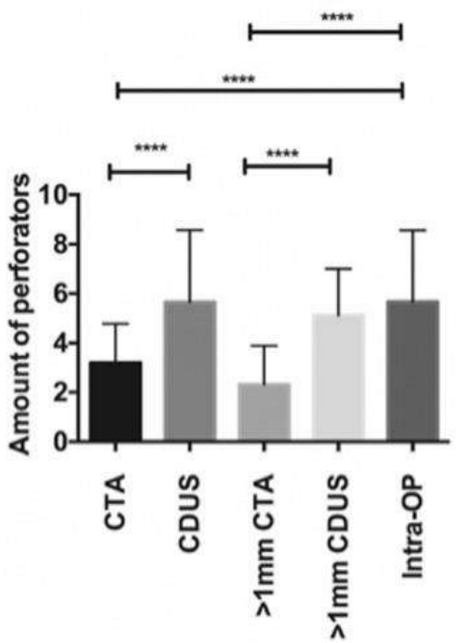

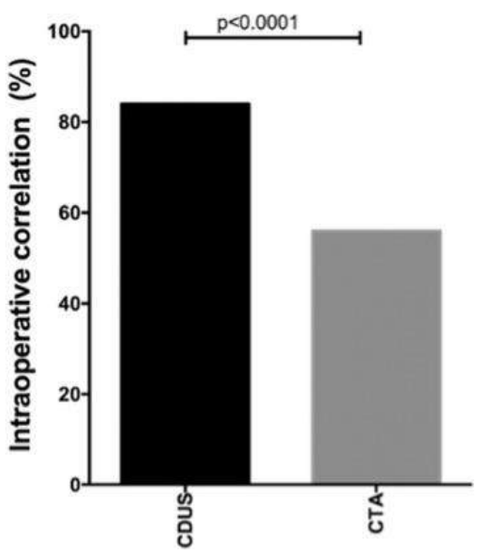

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Color Doppler ultrasound versus CT angiography for DIEP flap planning: A randomized controlled trial

Adam Bajus • Libor Streit • Tomáš Kubek • ... K. Can Bayezid • Lukáš Kunovský • Luboš Dražan •
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Published: July 22, 2023 • DOI: https://doi.org/10.1016/j.bjps.2023.07.042 •

- prospective study
- 22 women, 30 DIEP flaps in the group CTA + CDU, 51 perforators
- 27 women, 39 DIEP flaps in the group CDU, 62 perforators
- Z hlediska věku, hmotnosti, výšky, BMI ani tloušťky podkoží nebyly mezi pacientkami zařazenými do skupin CDU a CTA+ CDU shledány statisticky významné rozdíly
- Median time of perforator mapping CDU 71 minutes vs. CTA 48 minutes
- The average measurement deviation in ΔCDU (0.6 cm), which was significantly lower than the average ΔCTA+CDU (1.0 cm)
- CDU is not inferior to CTA + CDU in localizing and selecting relevant DIEA perforators

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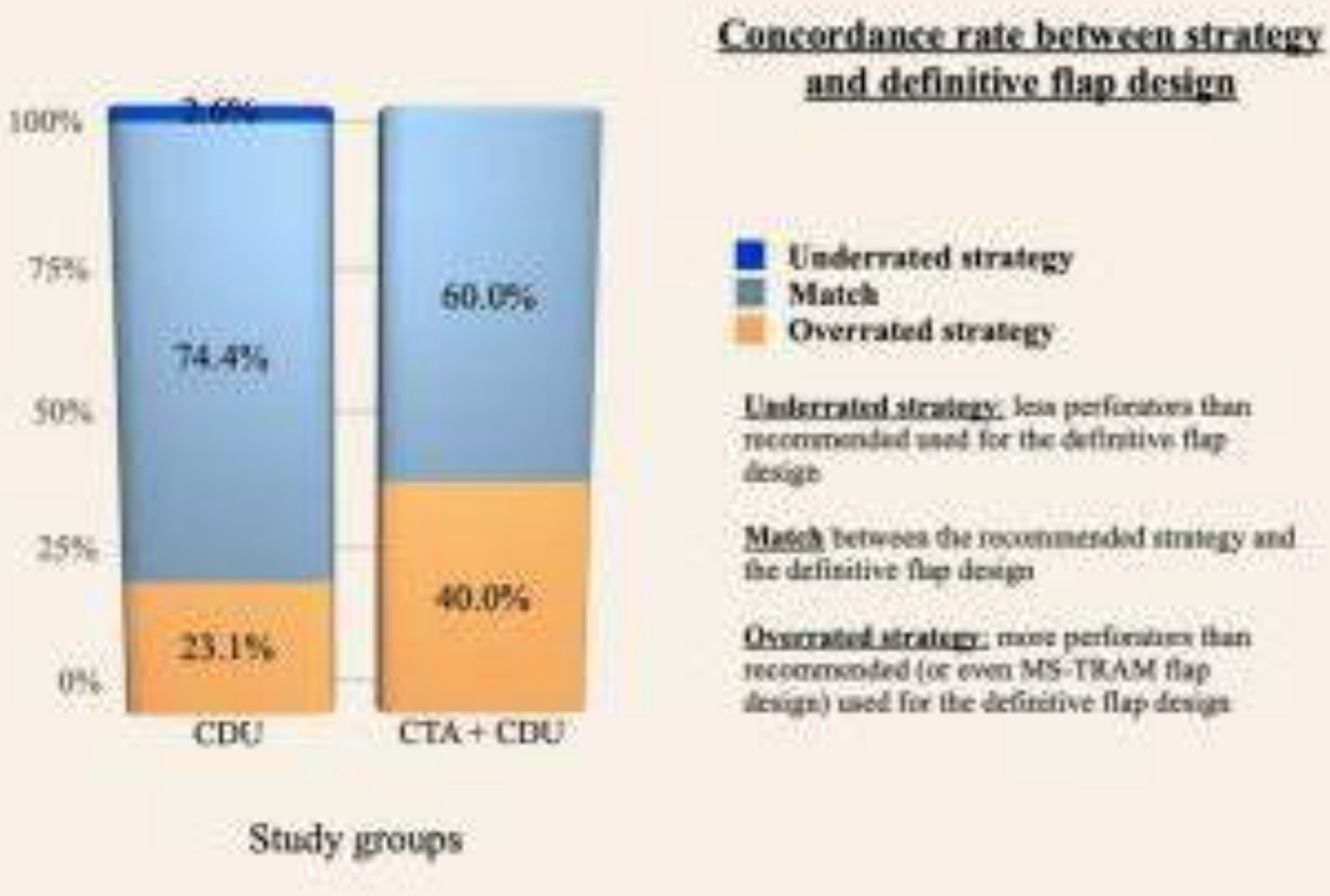

The accuracy of different modalities of perforator mapping for unilateral DIEP flap breast reconstruction: A systematic review and meta-analysis

John Kiely • Mayank Kumar • Ryckie G. Wade

Published: December 09, 2020 • DOI: https://doi.org/10.1016/j.bjps.2020.12.005 •

- Meta-analysis and systematic review
- **21 articles, 1146 patients**
- **Six methods were described; handheld doppler, colour doppler (duplex) ultrasonography, computed tomography angiography, magnetic resonance angiography (MRA), direct infrared thermography with and without doppler**
- **Colour doppler (Duplex) ultrasonography had the lowest agreement mean 74% whilst MRA had the highest agreement mean 97%**
- **Biased**

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Conclusion

- Preoperative selection of the dominant perforator of DIEP flap is crutial
- Preoperative perforator mapping significantly reduces surgical time and improves flap harvest safety
- CDU perforator mapping is accessible, safer, and golden standard on requires a learning curve
- CDU is not inferior to CTA in localizing and selecting relevant DIEA perforators

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Thank you for your attention

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