MicroCirculation : Quand le problème est là, sous nos yeux

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Service de Cardiologie, CHUV

Patient de 57 ans, consulte son généraliste pour des DRS à l'effort

- Dyslipidémie (et refus de statine) avec LDL à 4.2 mmol/l
- Pré-diabète
- HTA partiellement contrôlée sous lisinopril
- Sédentaire
- Obésité stade I

Adressé ensuite à un cardiologue

- ETT normale
- ECG de repos normal
- Ergométrie pathologique

Adressé ensuite à un autre cardiologue pour une coronarographie

- « Absence de sténose significative »
- « Discrète athérosclérose »

Ré-adressé à son généraliste

- « Oui mais mes douleurs alors ? »
- « Je vous avais dit que je n’avait pas besoin de statine »
- « Mais je suis pas fou, je ne peux plus marcher vite tellement j’ai mal »

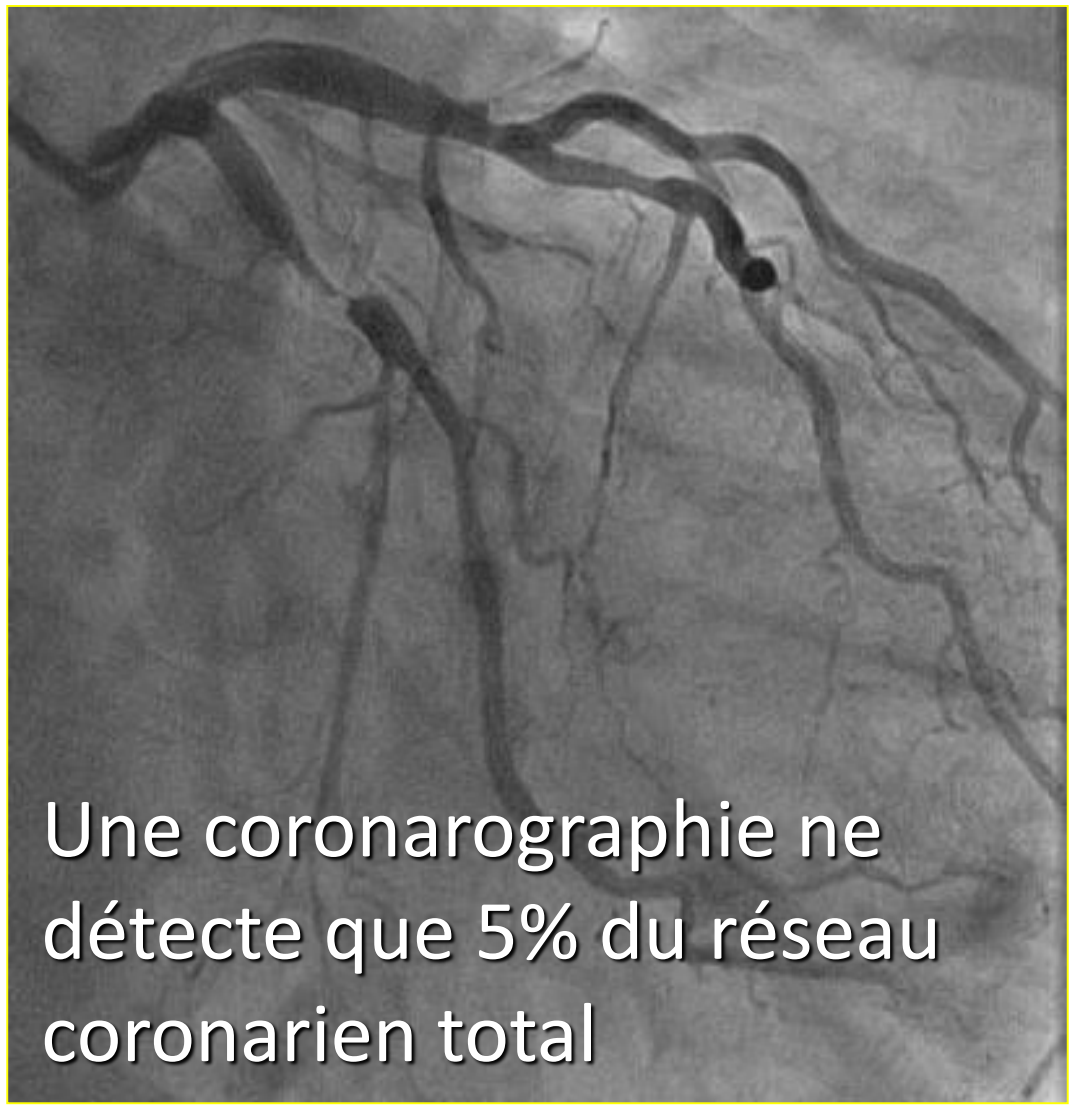
Re-consulte 3 mois après

- Cela ne va pas mieux

Re-consulte 9 mois après

- Cela ne va pas mieux

On fait quoi ?



Une coronarographie ne détecte que 5% du réseau coronarien total

Chez notre patient :

- La coronarographie a juste permis d’exclure une atteinte épicardique…
- Mais quelques mesures de plus auraient permis un bilan complet !

Dans la pratique :

ANOCA

INOCA

Dans la pratique :

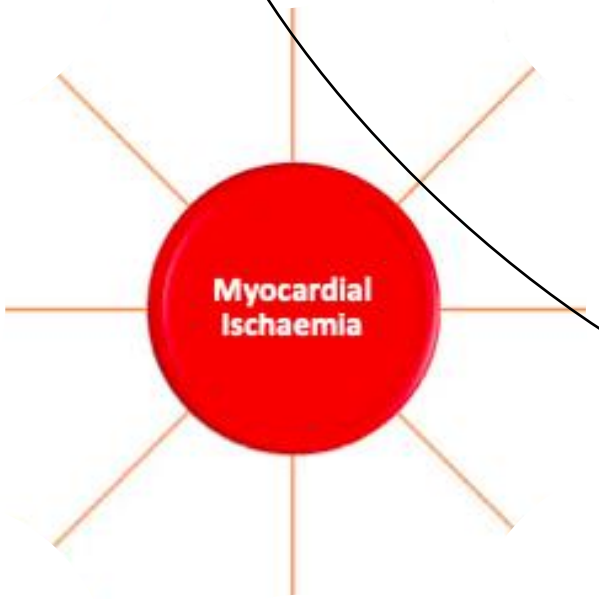
ANOCA : Non Obstructive Coronary Arteries

INOCA : Non Obstructive Coronary Arteries

Dans la pratique :

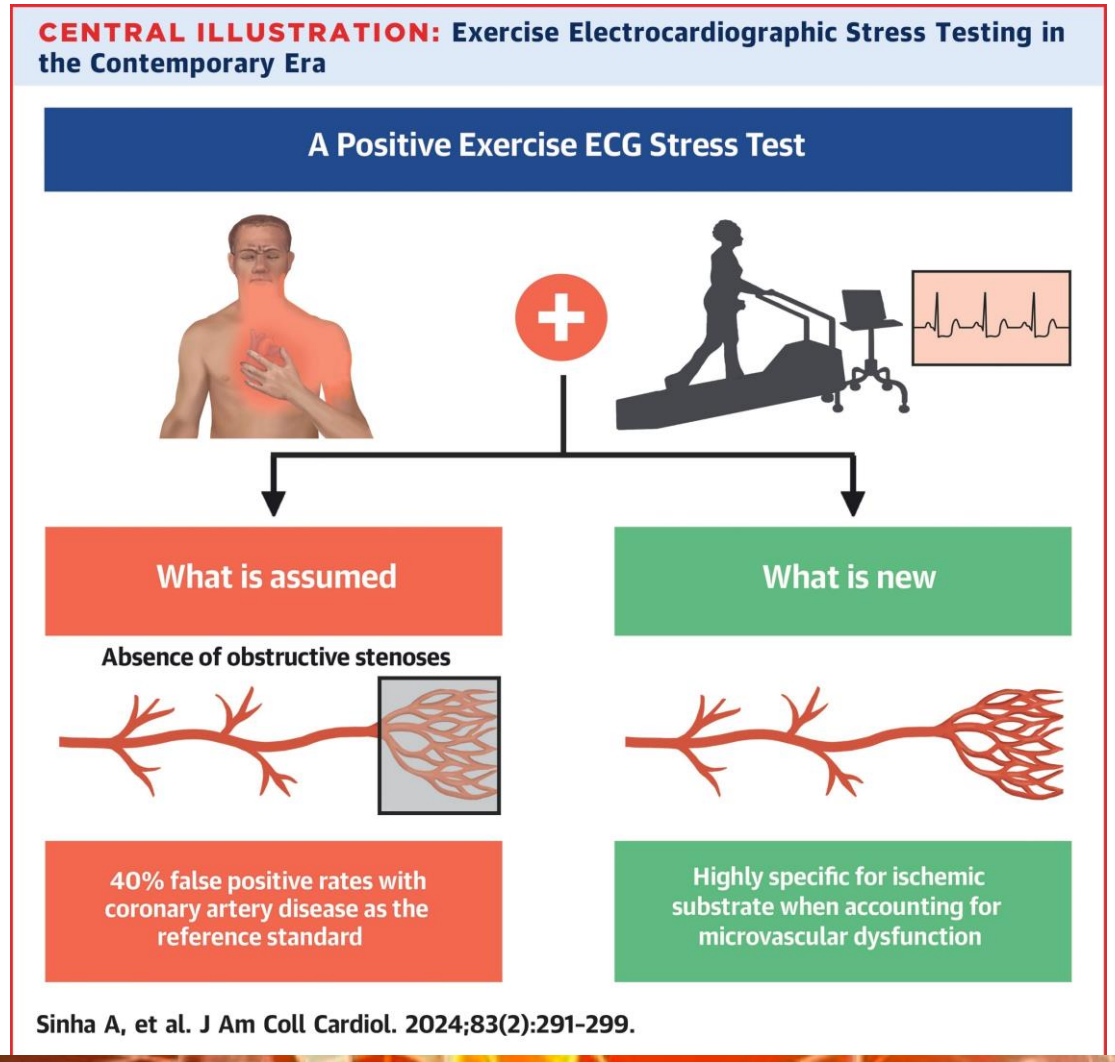
ANOCA : Angina

INOCA : Ischemia

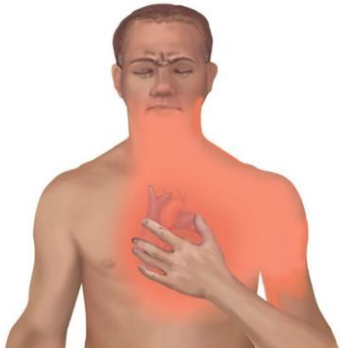


EHJ, online, https://doi.org/10.1093/eurheartj/ehaa503

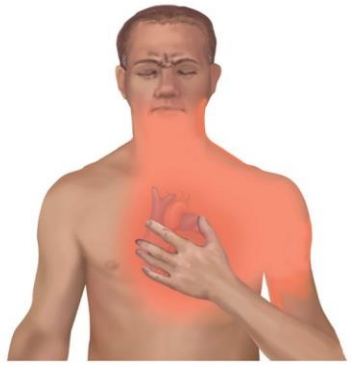
ANOCA/INOCA, does it really exist ?

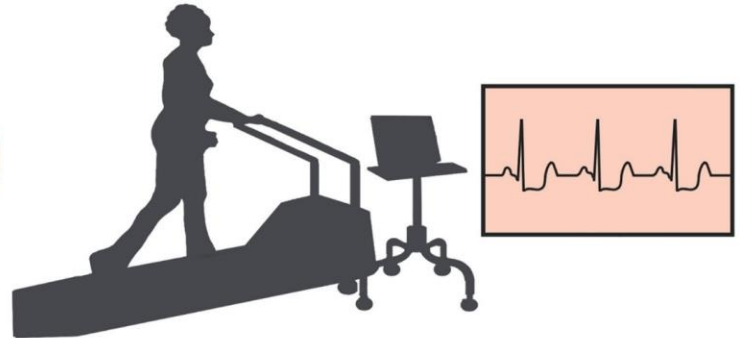


A Positive Exercise ECG Stress Test



A Positive Exercise ECG Stress Test



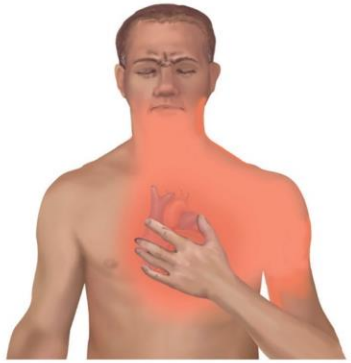


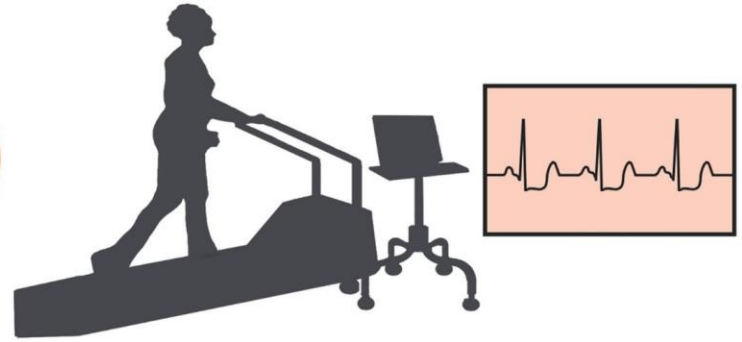
What is assumed

Absence of obstructive stenoses

40% false positive rates with coronary artery disease as the reference standard

A Positive Exercise ECG Stress Test





What is assumed

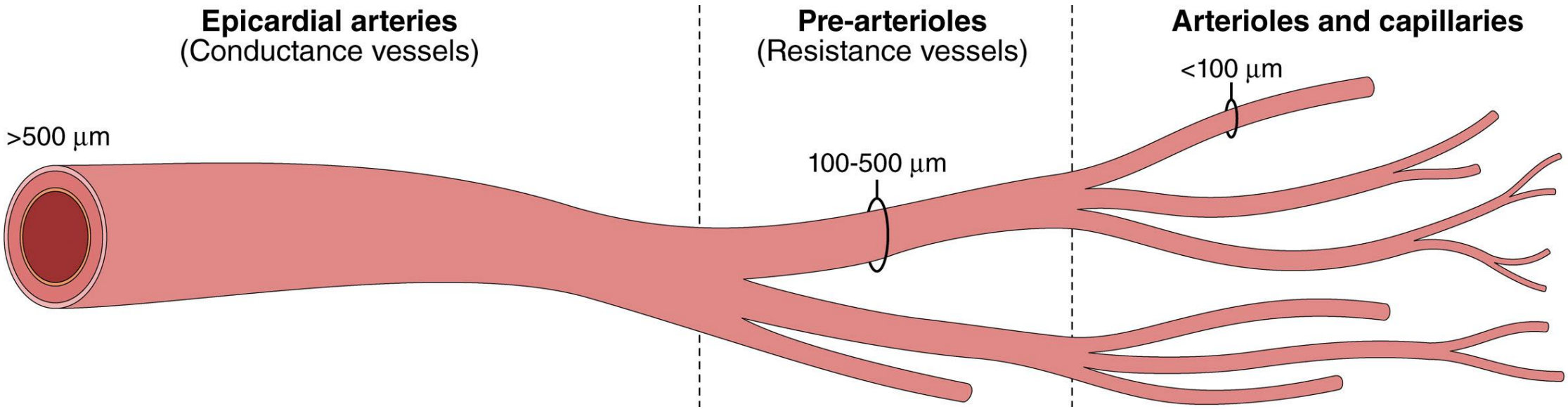
Absence of obstructive stenoses

40% false positive rates with coronary artery disease as the reference standard

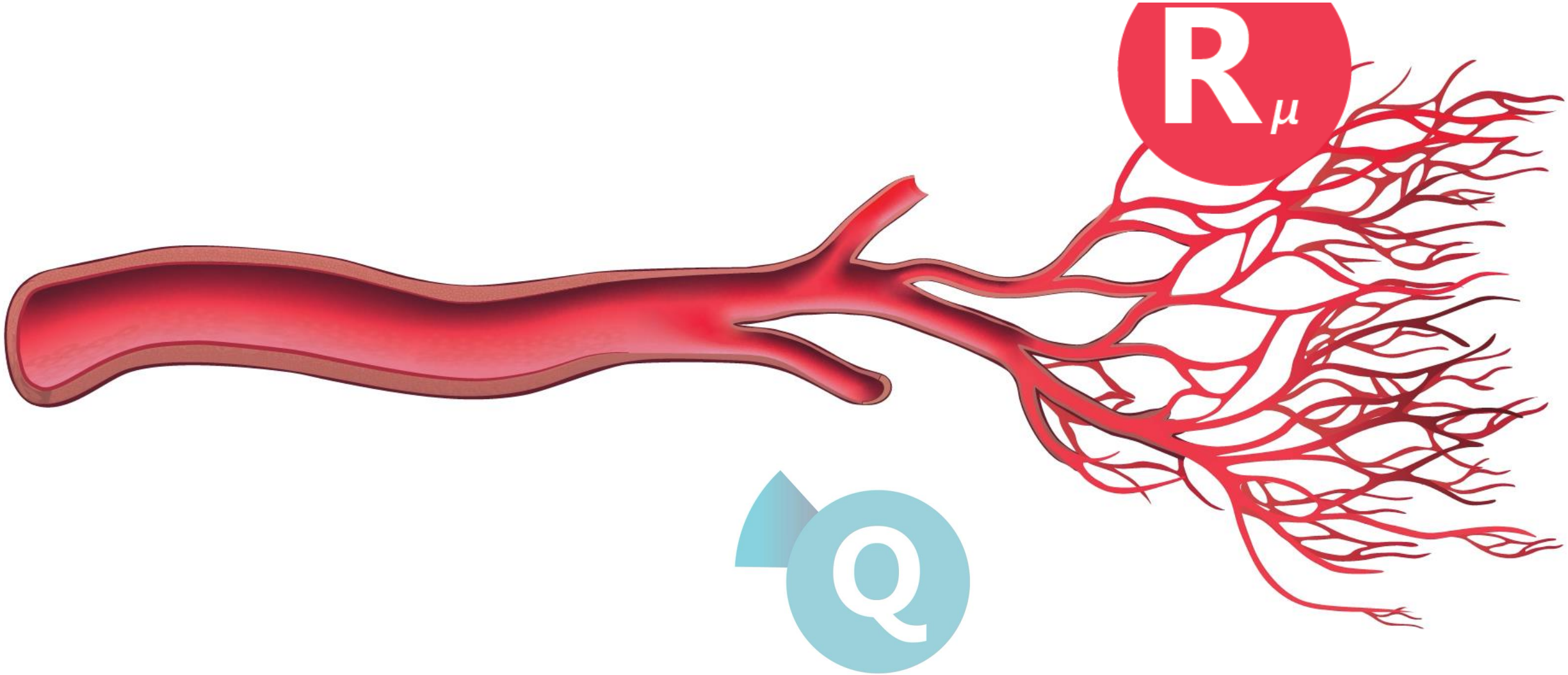
What is new

Highly specific for ischemic substrate when accounting for microvascular dysfunction

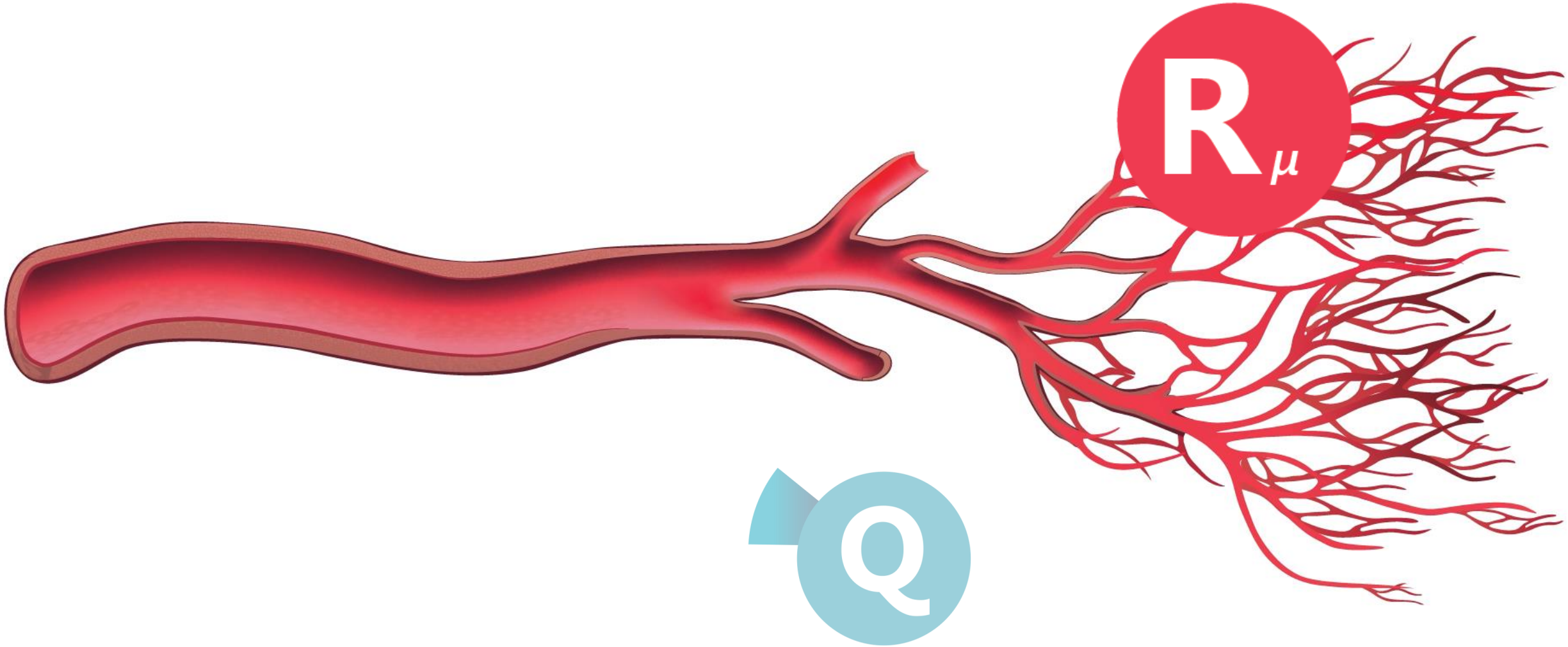
Normal MicroCirculation



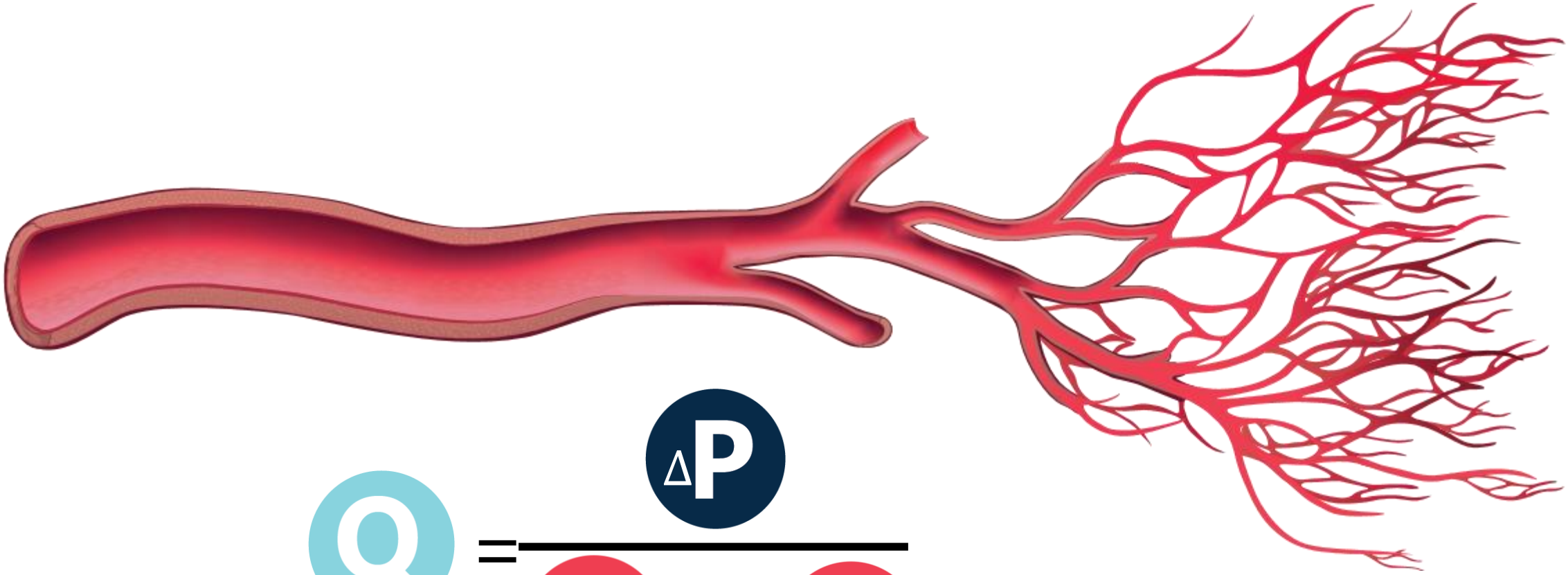
Normal MicroCirculation



Dysfunctional MicroCirculation



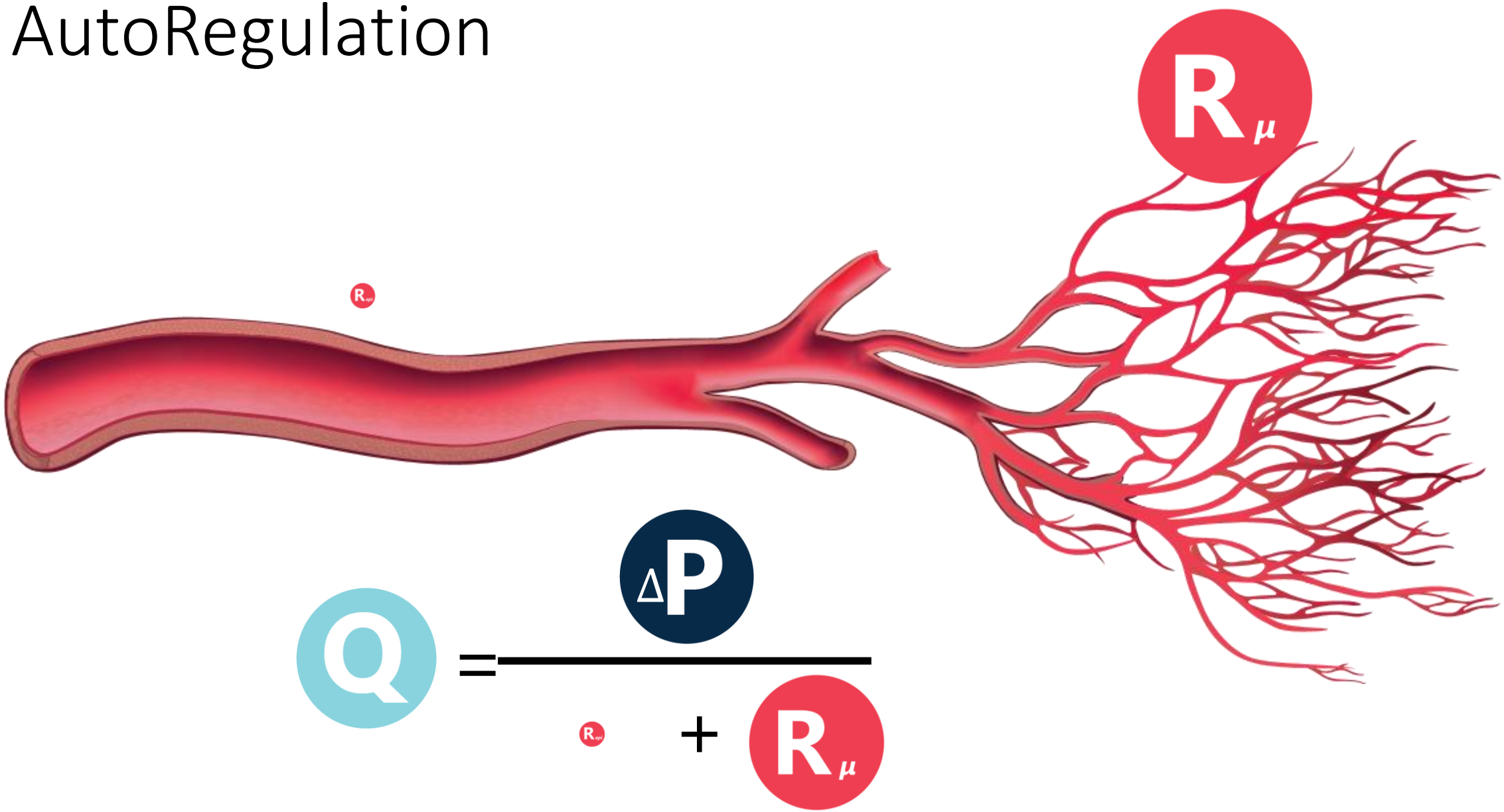
AutoRegulation



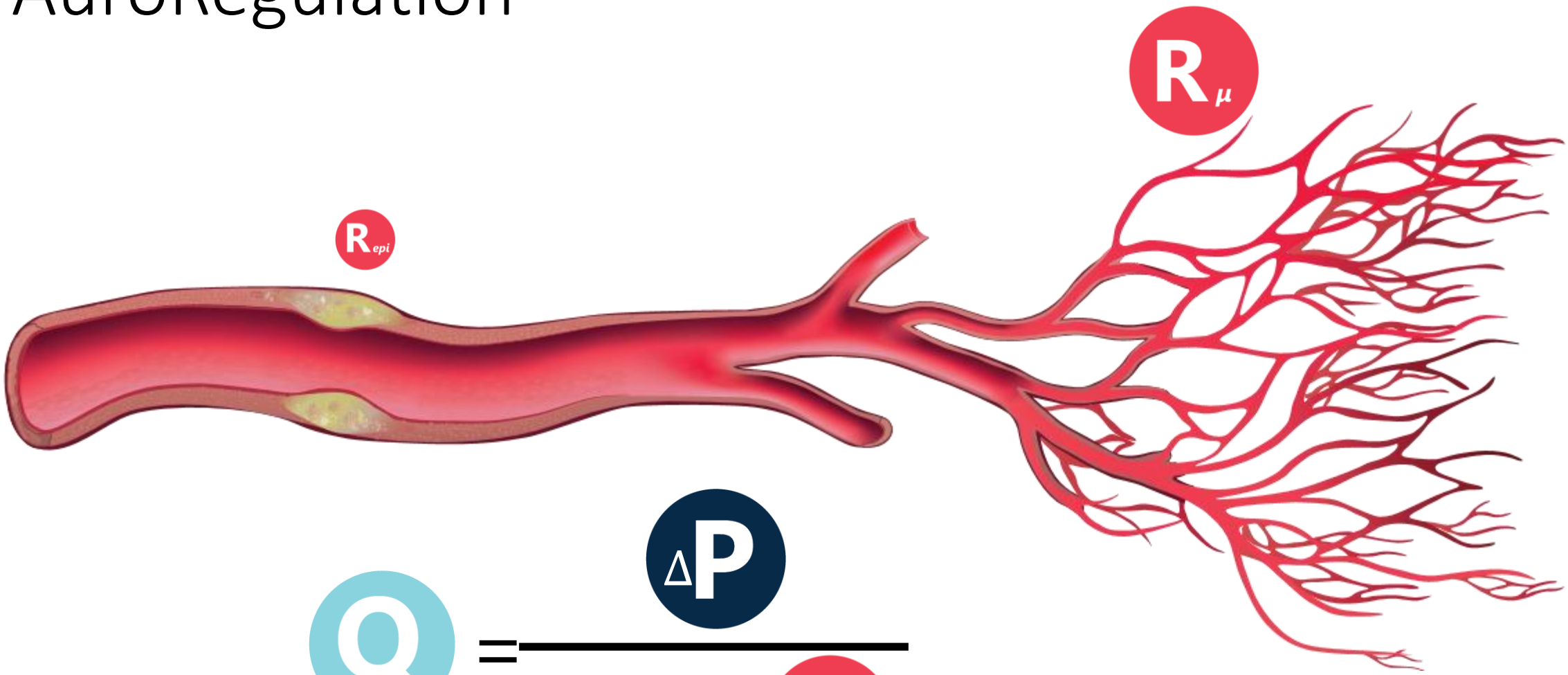
$$Q = \frac{\Delta P}{R_{epi} + R_{\mu}}$$

No stenosis

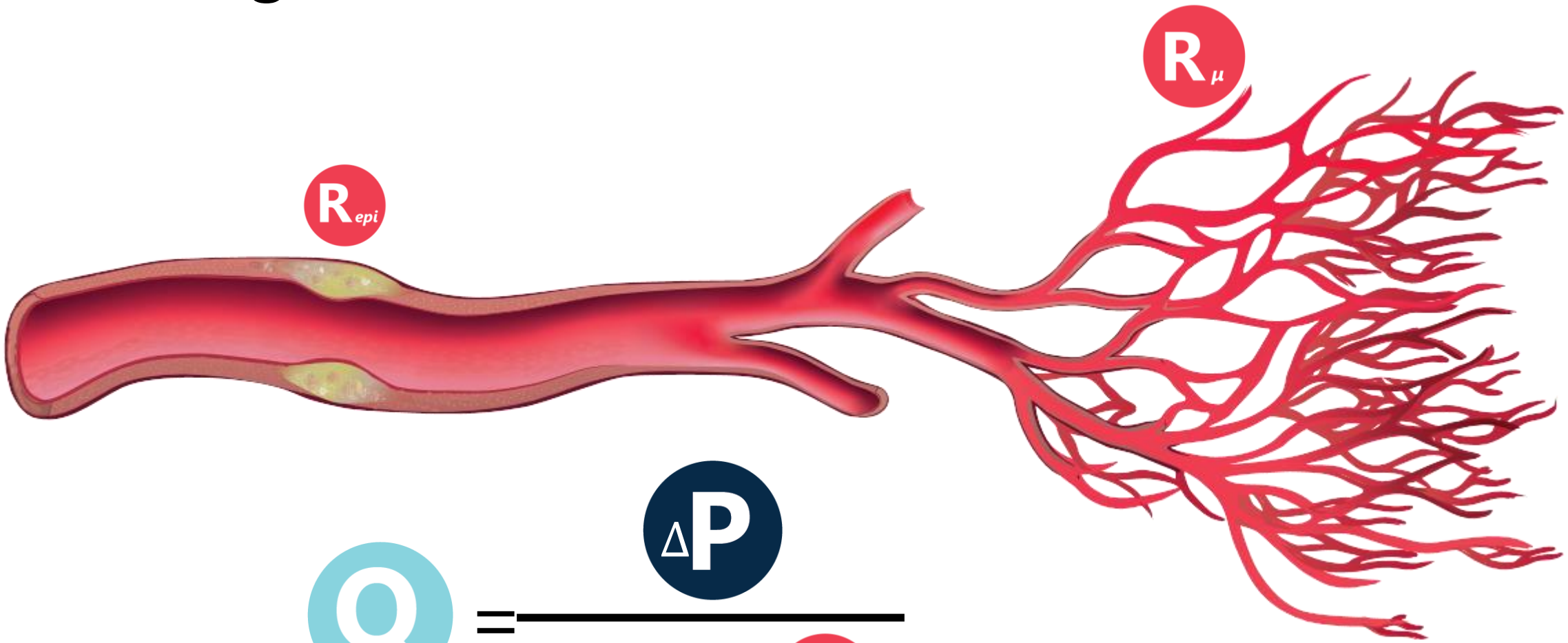
AutoRegulation



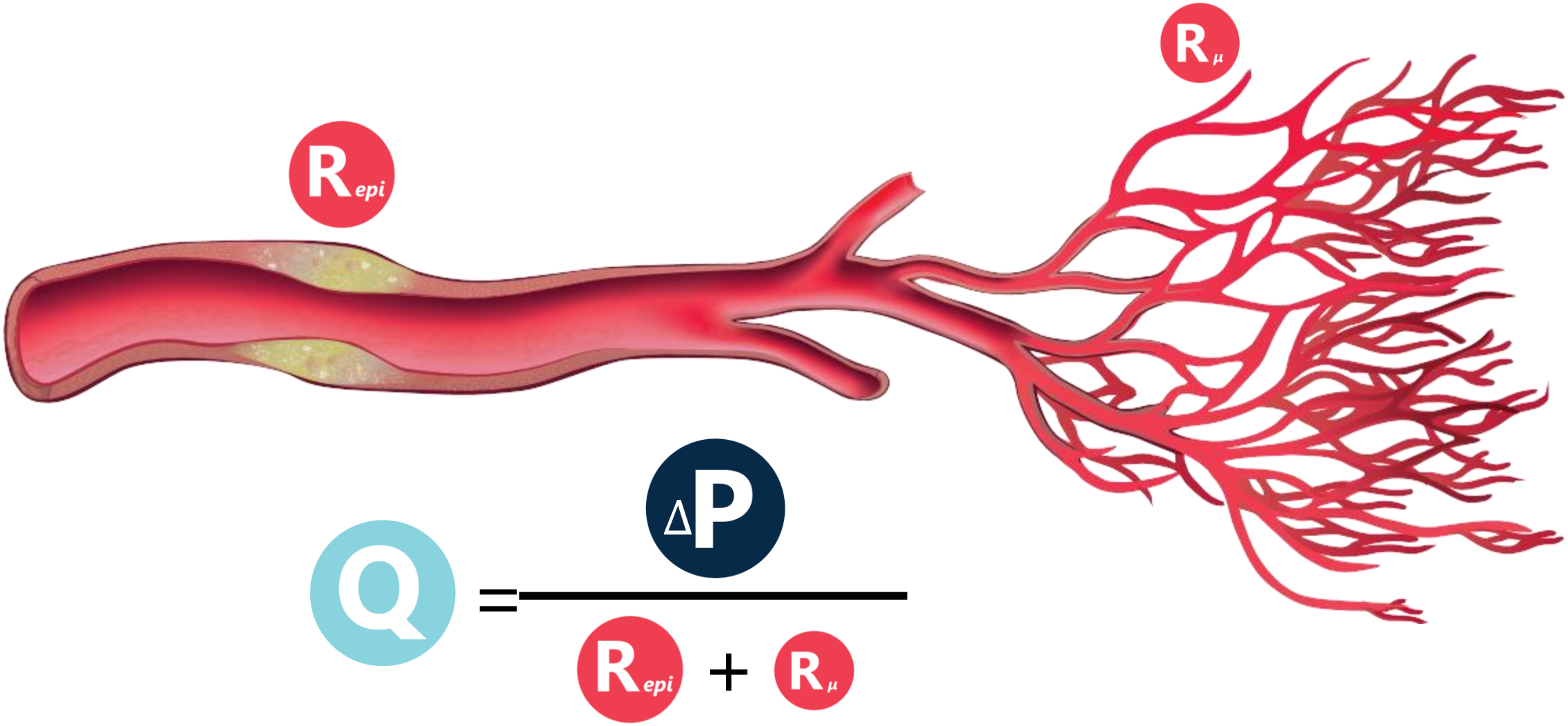
AuroRegulation



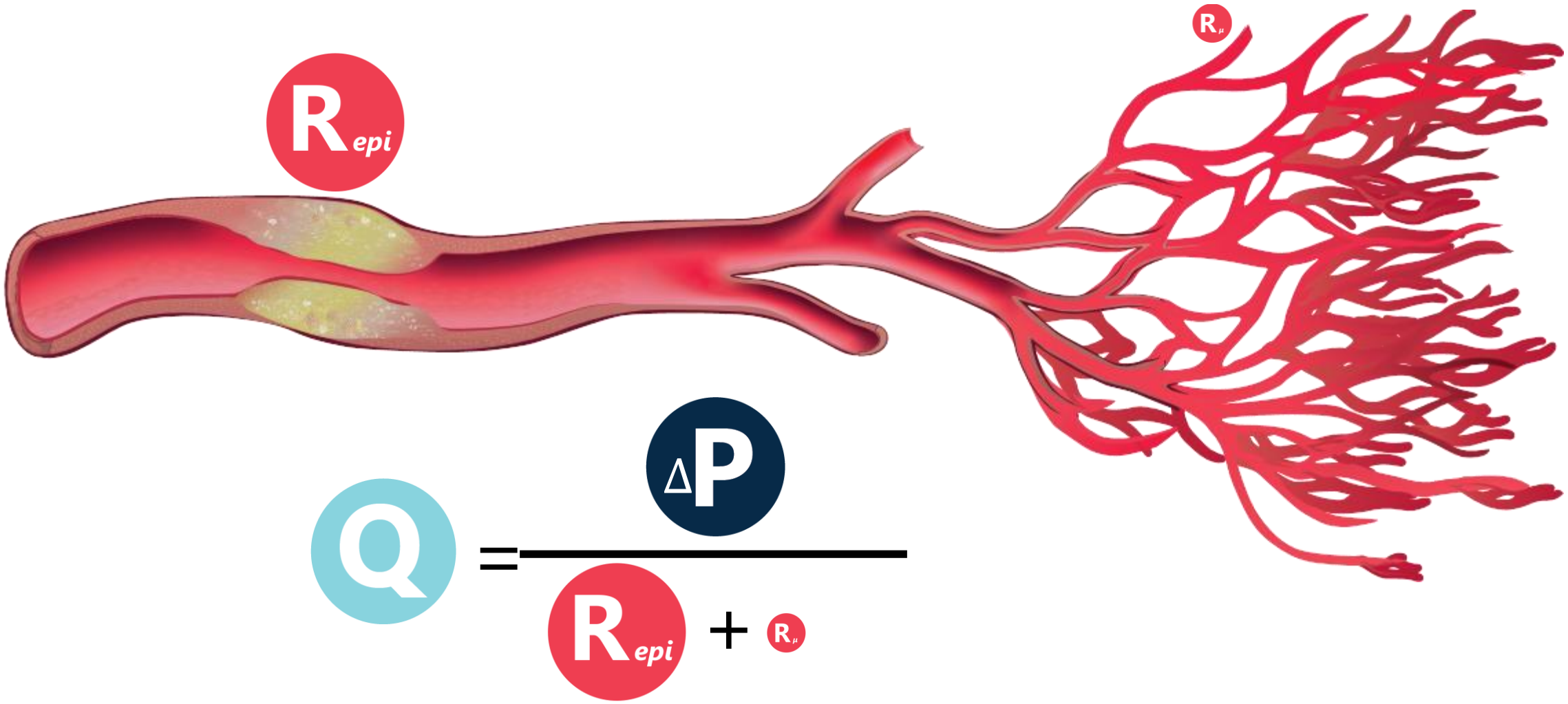
AutoRegulation



AutoRegulation

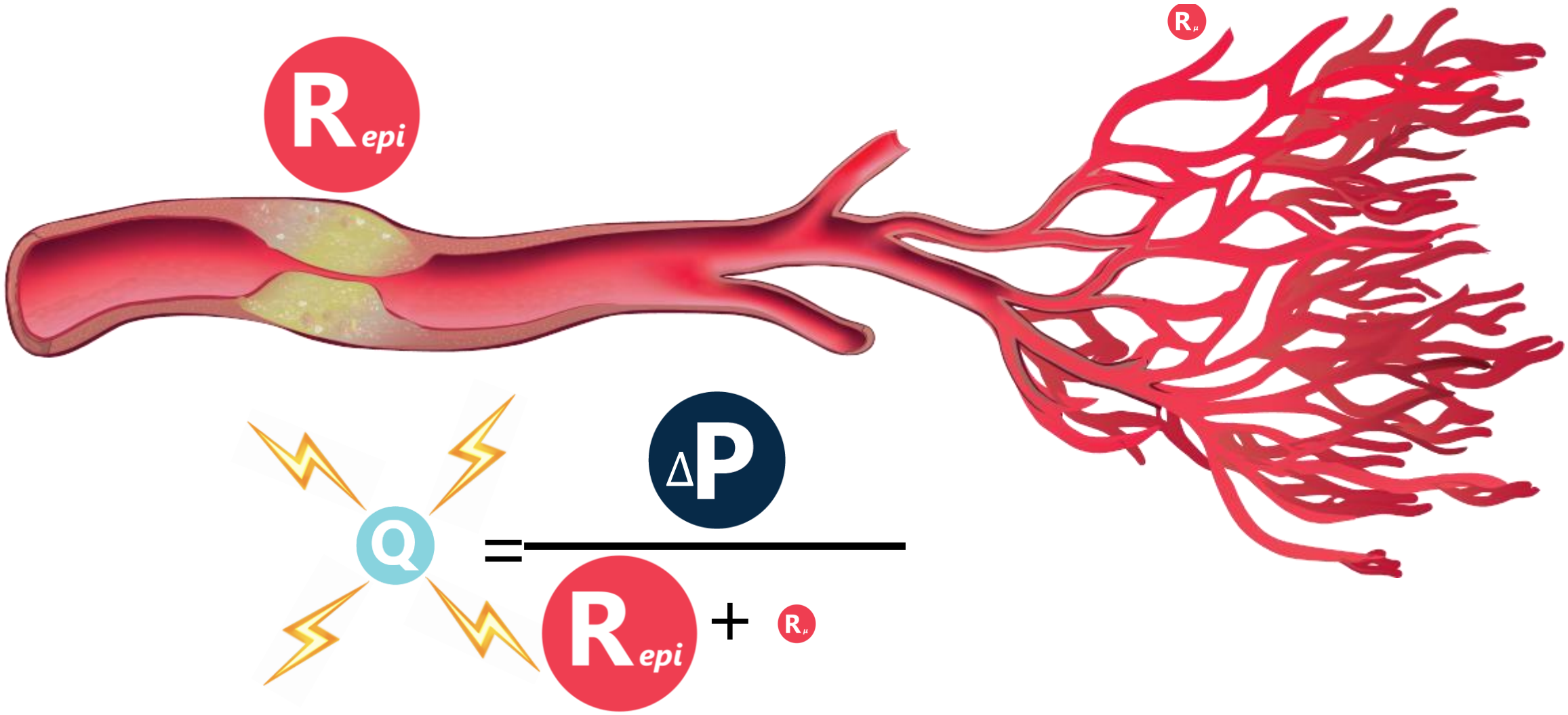


AutoRegulation



Severe Stenosis

AutoRegulation

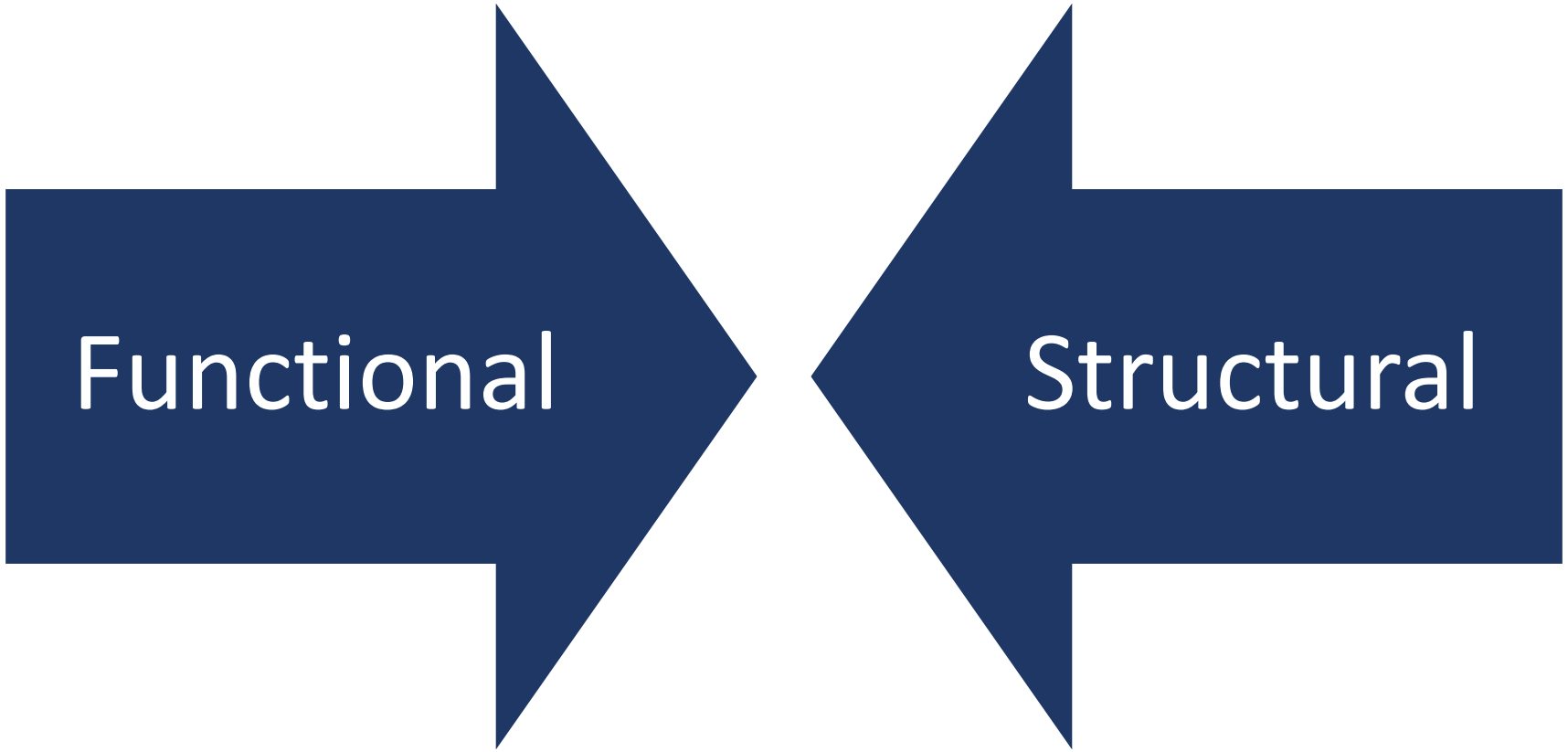


$$CFR = \frac{\text{Flux (débit) en hyperémie}}{\text{Flux (débit) au repos}}$$

Atteinte de la microcircultion :

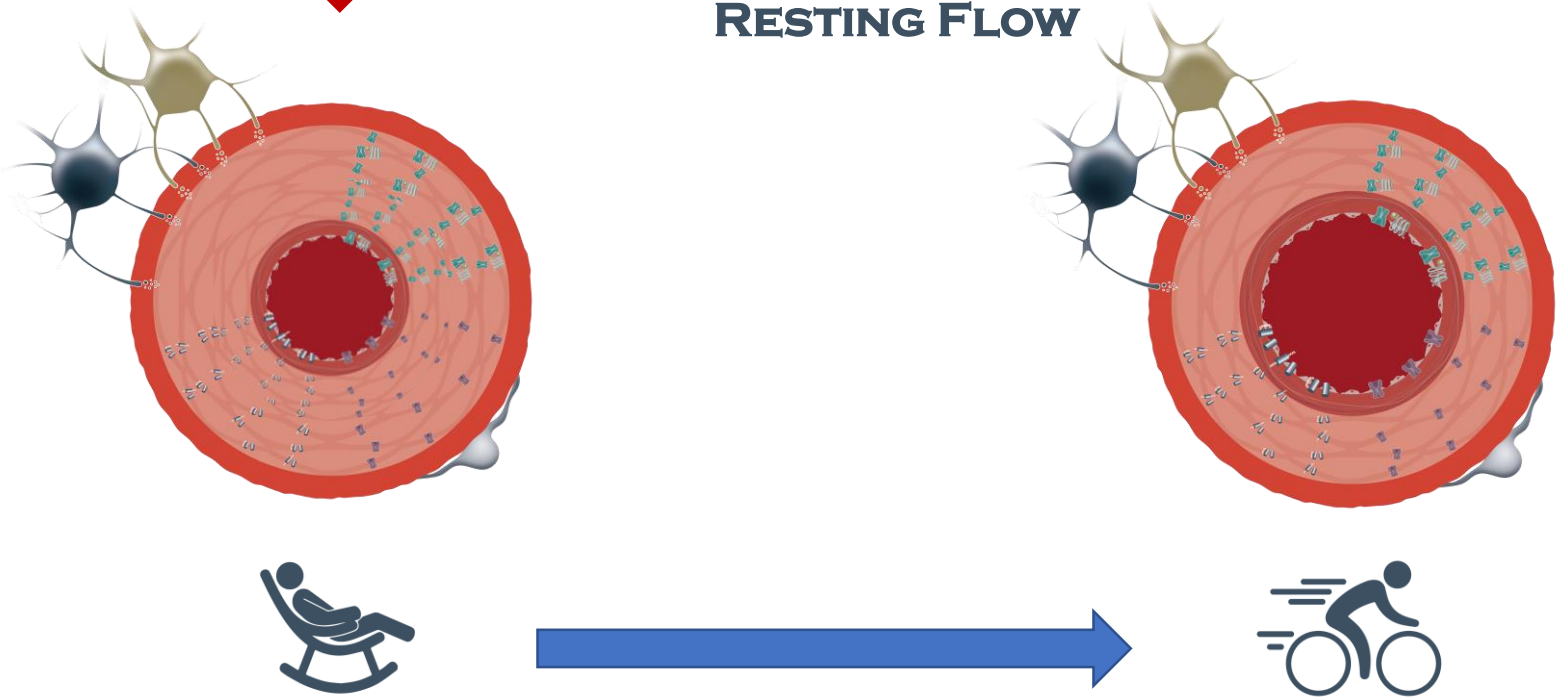
CFR < 2.5 avec coronaires ‘normales’

Endotypes



Strucural CMD

$$\text{CFR} = \frac{\text{Maximal (hyperemic) Flow}}{\text{Resting Flow}}$$



eNOS dysfucntion?

- Intimal thickening
- VSM hypertrophy
- Microvascular rarefaction
- Perivascular fibrosis

Structural CMD: CFR <2.5 and IMR >25

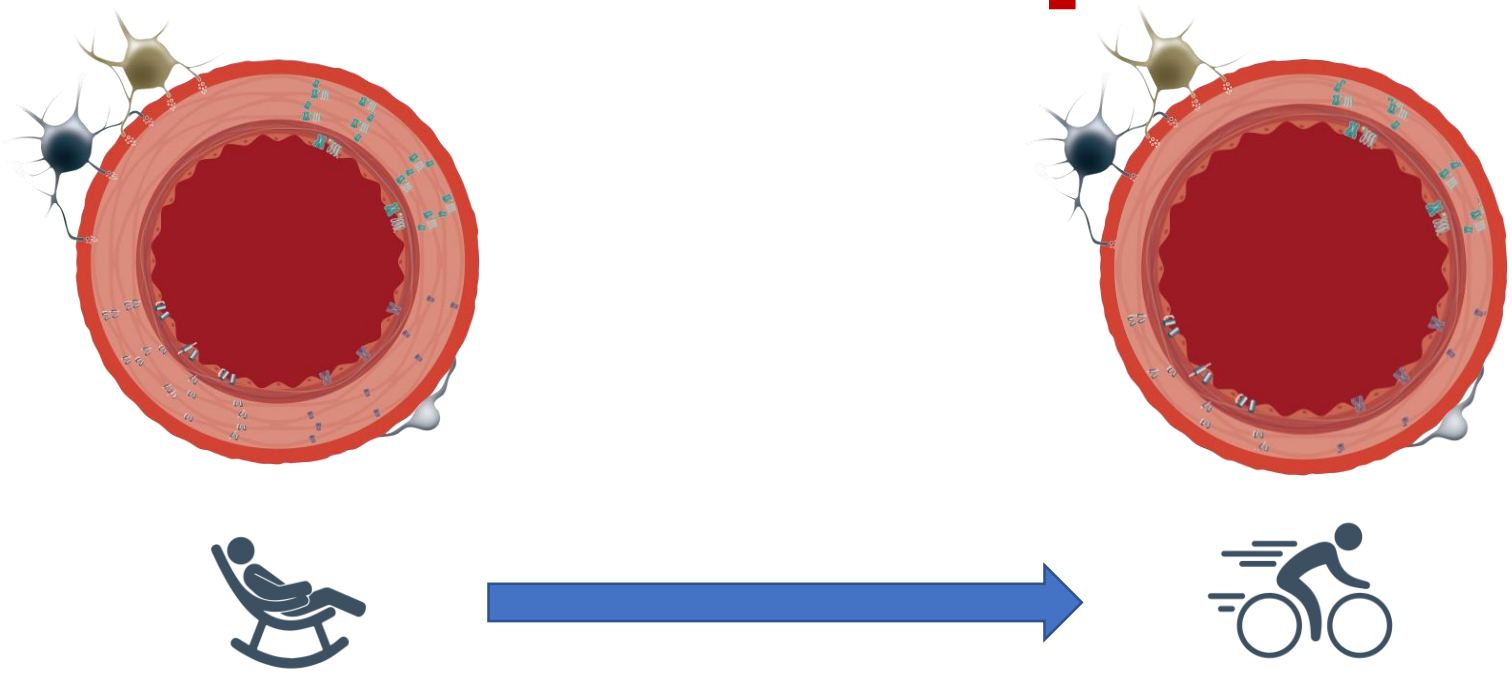
Functional CMD

Low CFR has different causes: CMD endotypes

$$\downarrow \text{CFR} = \frac{\text{Maximal (hyperemic) Flow}}{\text{Resting Flow}} \uparrow$$

NOS dysregulation?

Increased MVO_2?



Functional CMD: CFR <2.5 and IMR ≤25

Comment mesurer le flux ?

Bolus Thermodilution

IMR

Fast

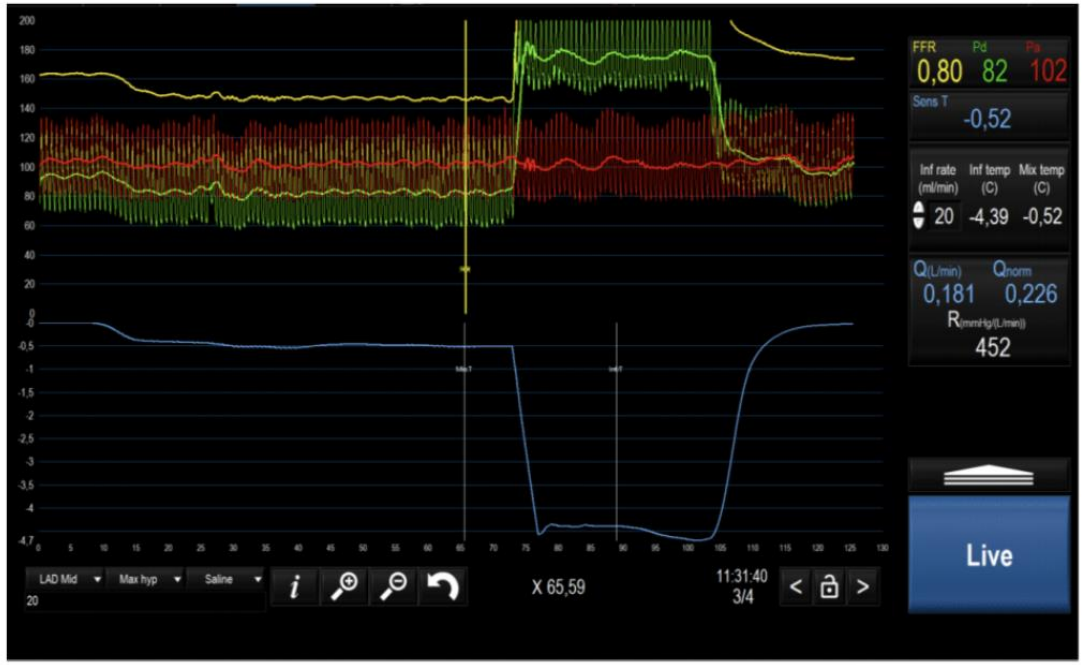
Easy

Precision +

Accuracy +

Continuous Thermodilution

Absolute Flow & Resistance



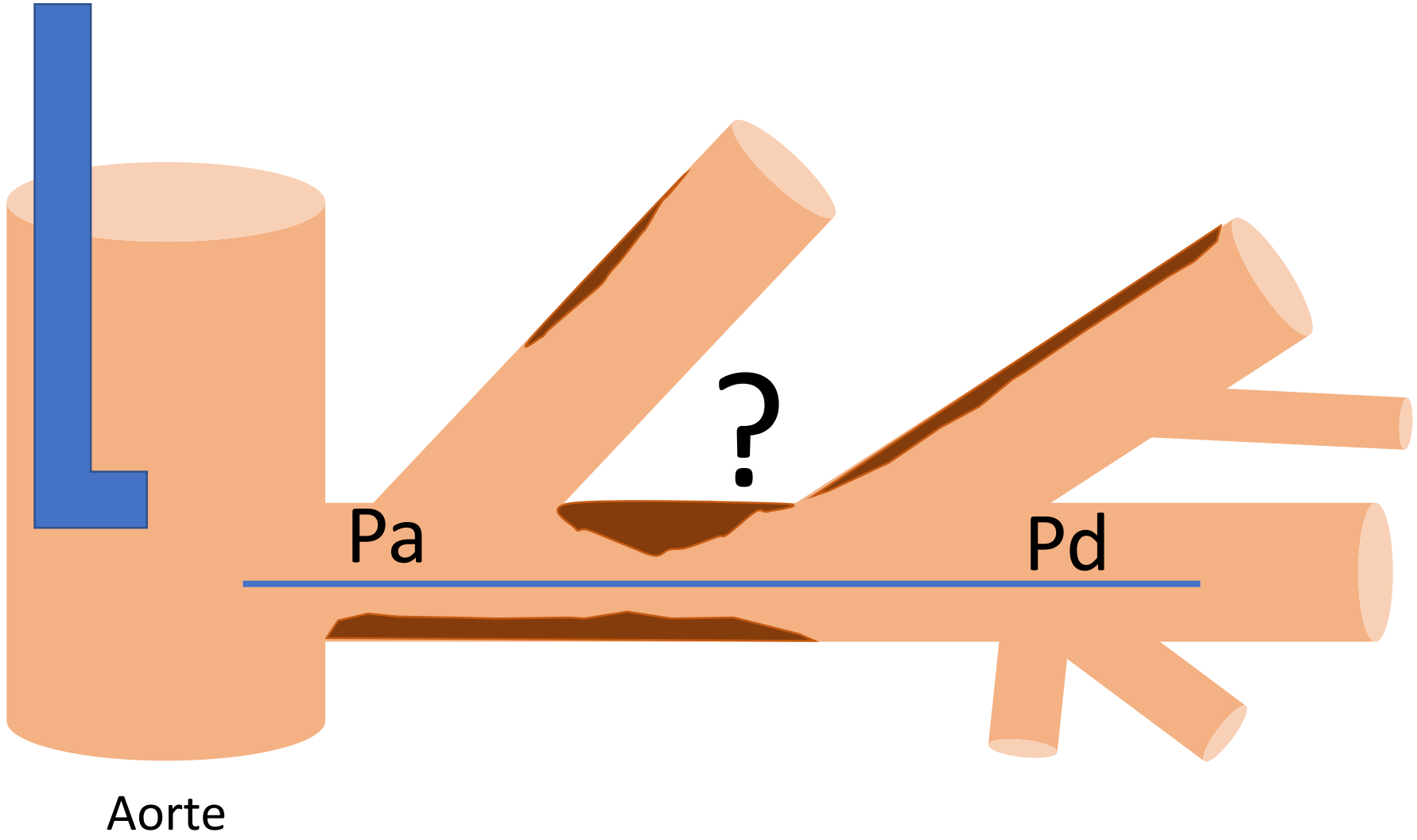
Precision +++

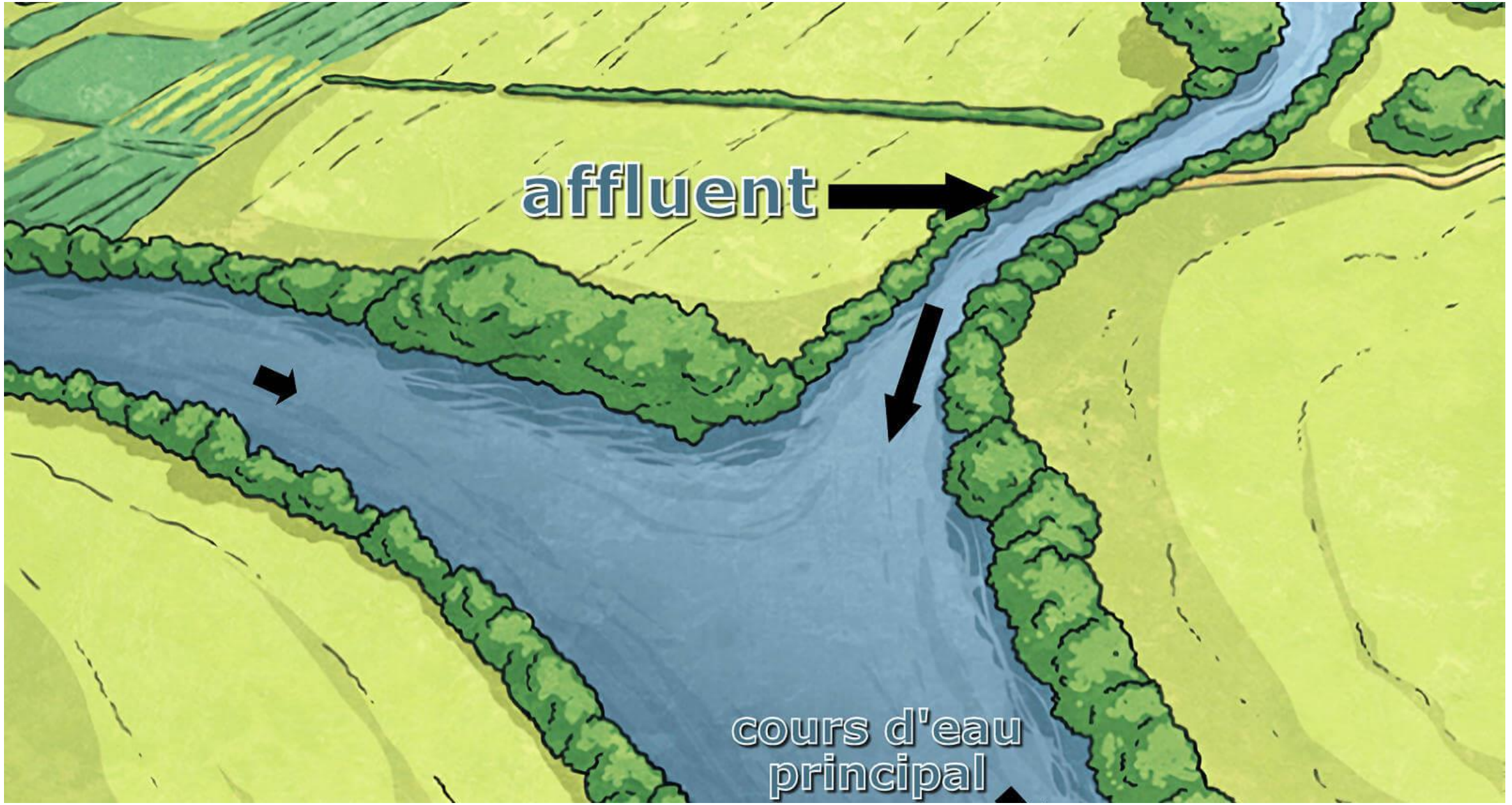
Accuracy +++

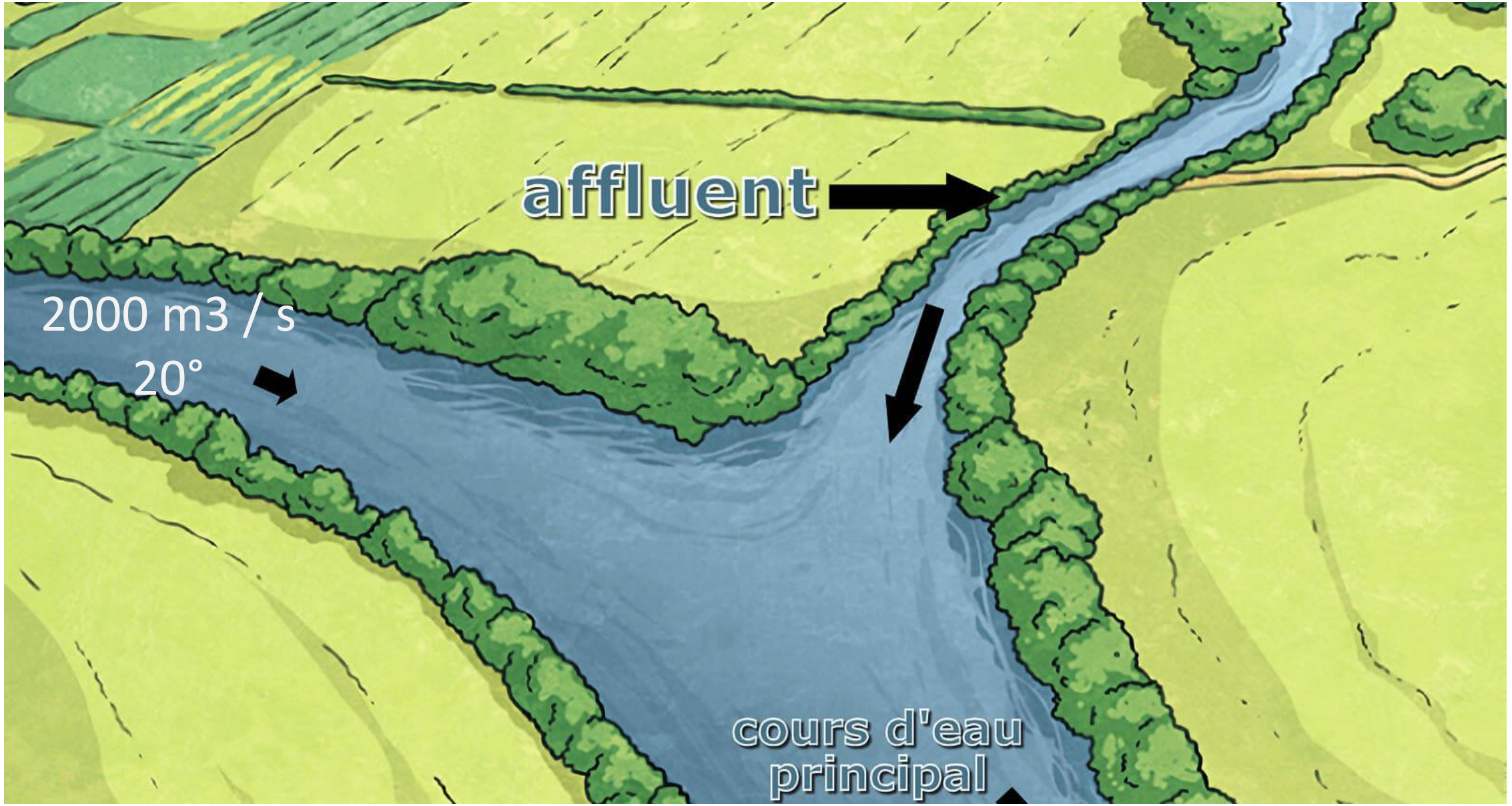
4-5 min

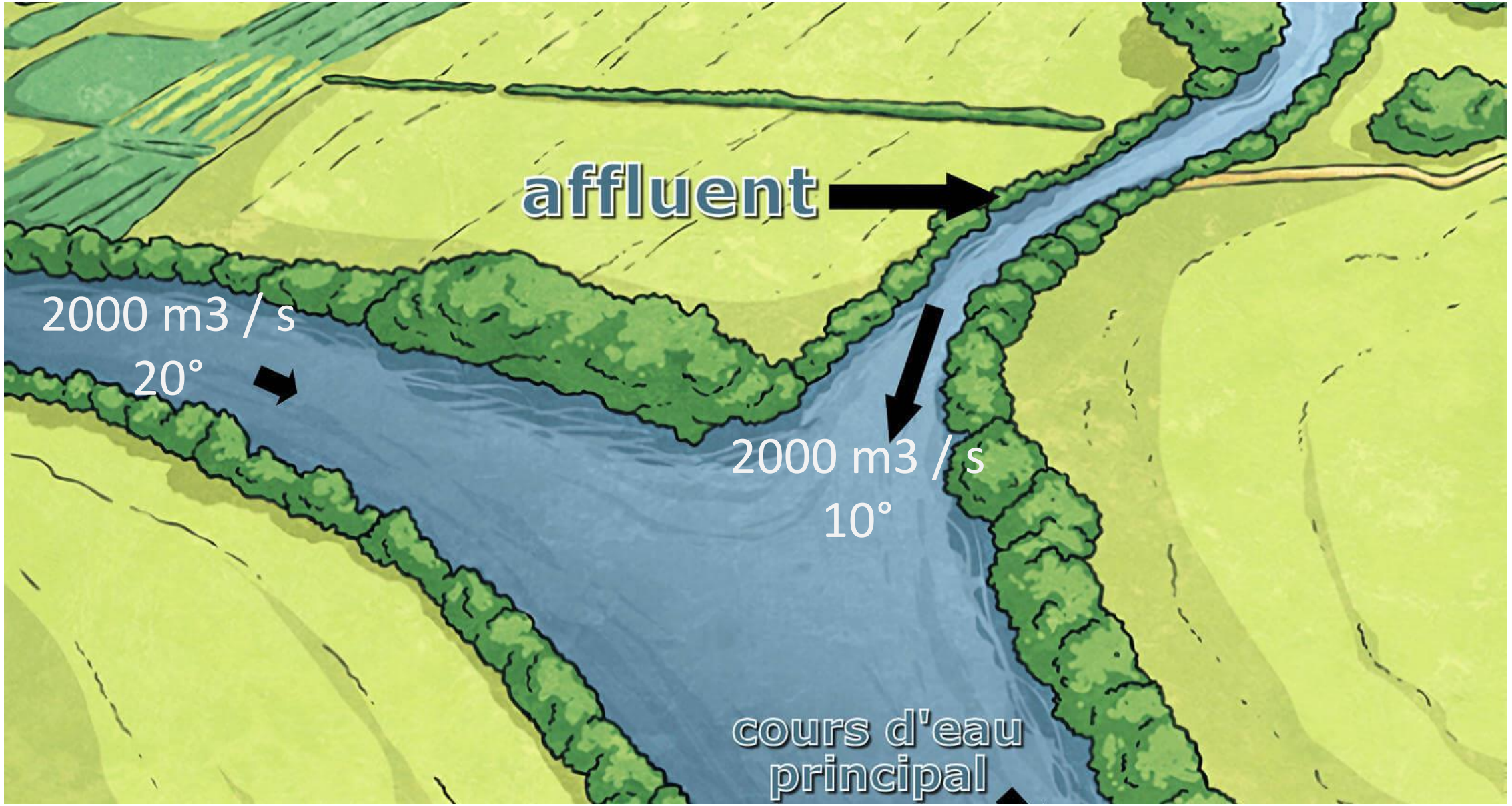
Cost

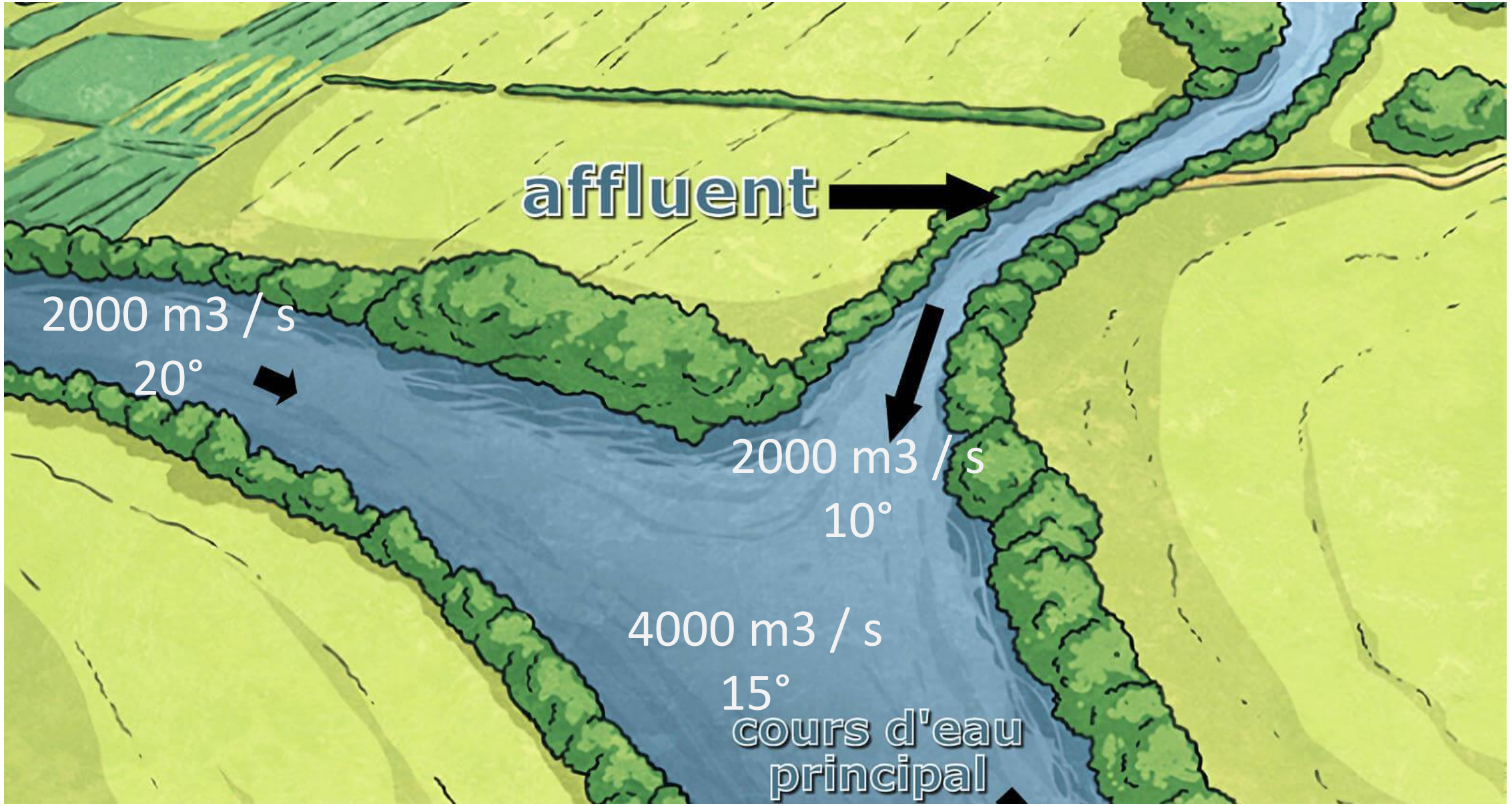
Game changer : RayFlow

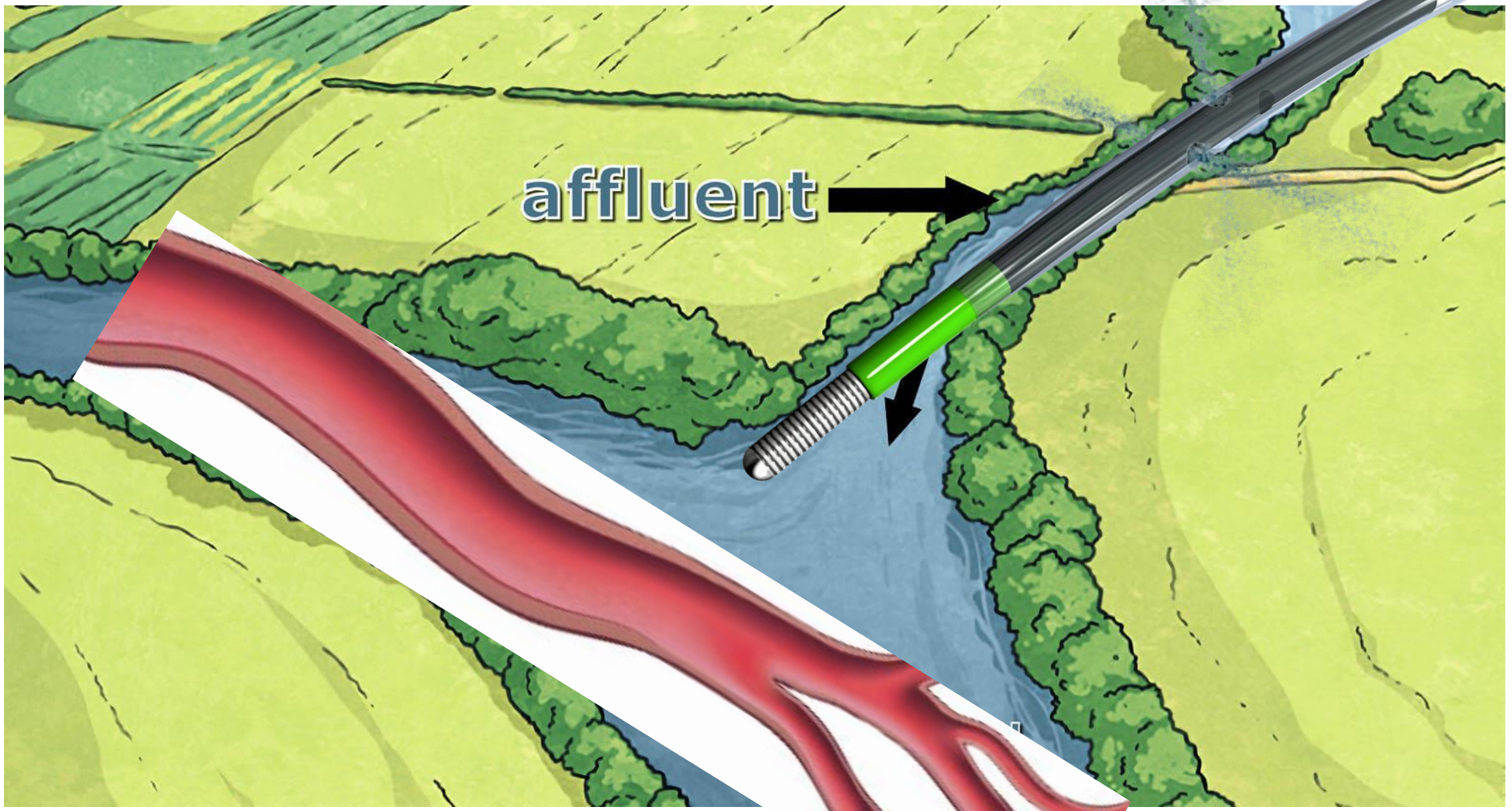

?
Pa
Pd
Aorte

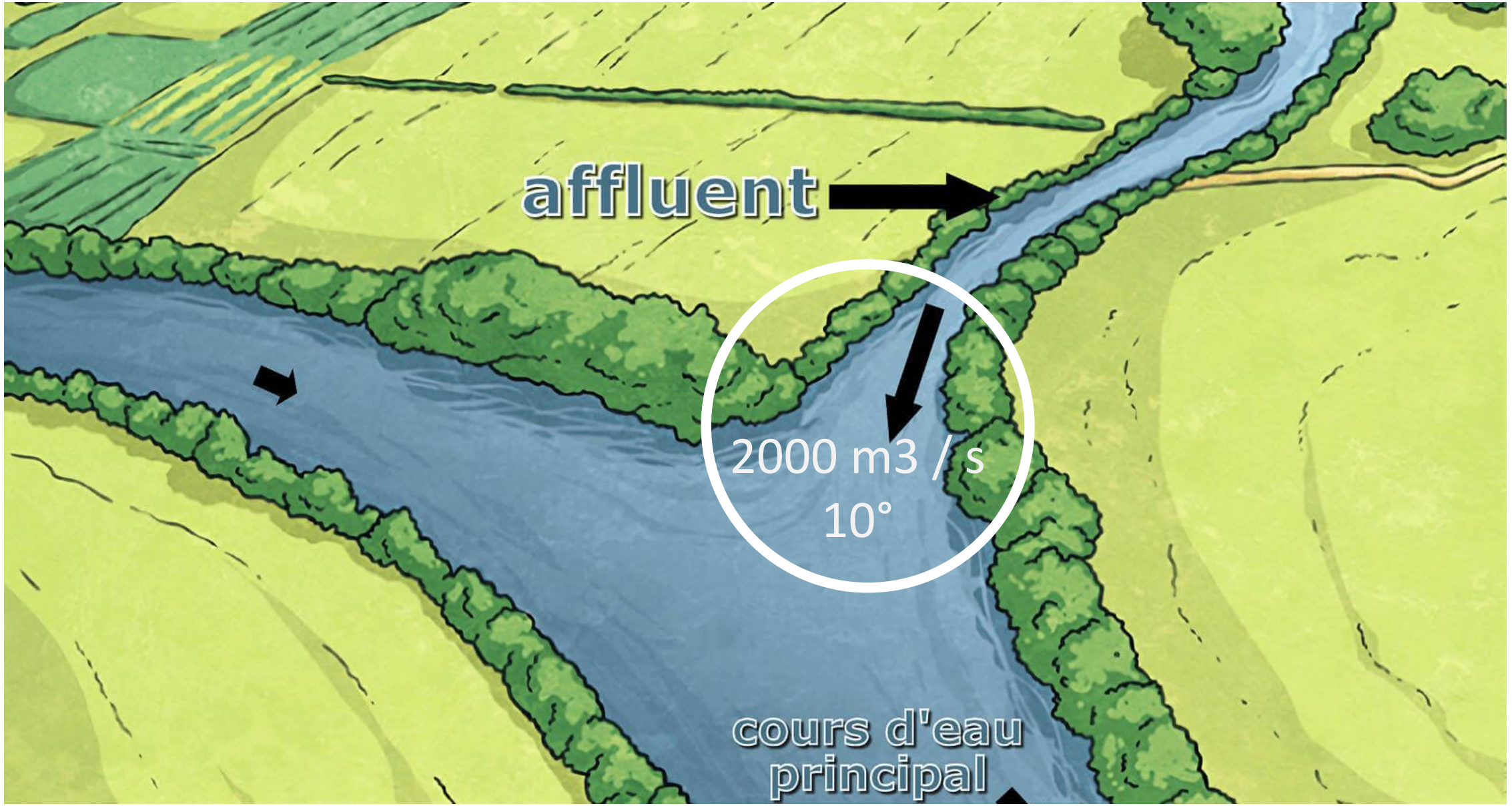

affluent
cours d'eau
principal

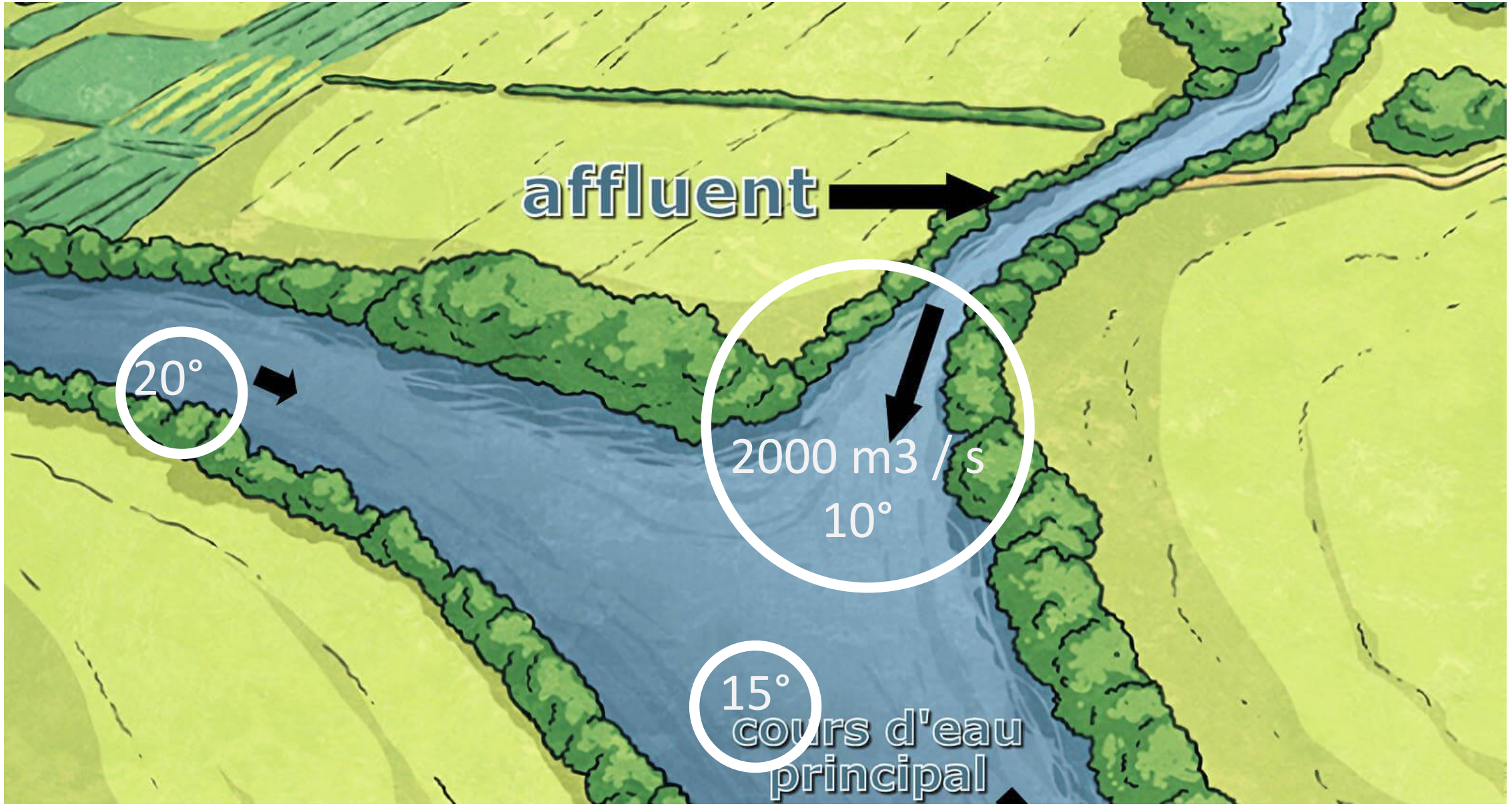

affluent
2000 m3 / s
20°
cours d'eau
principal

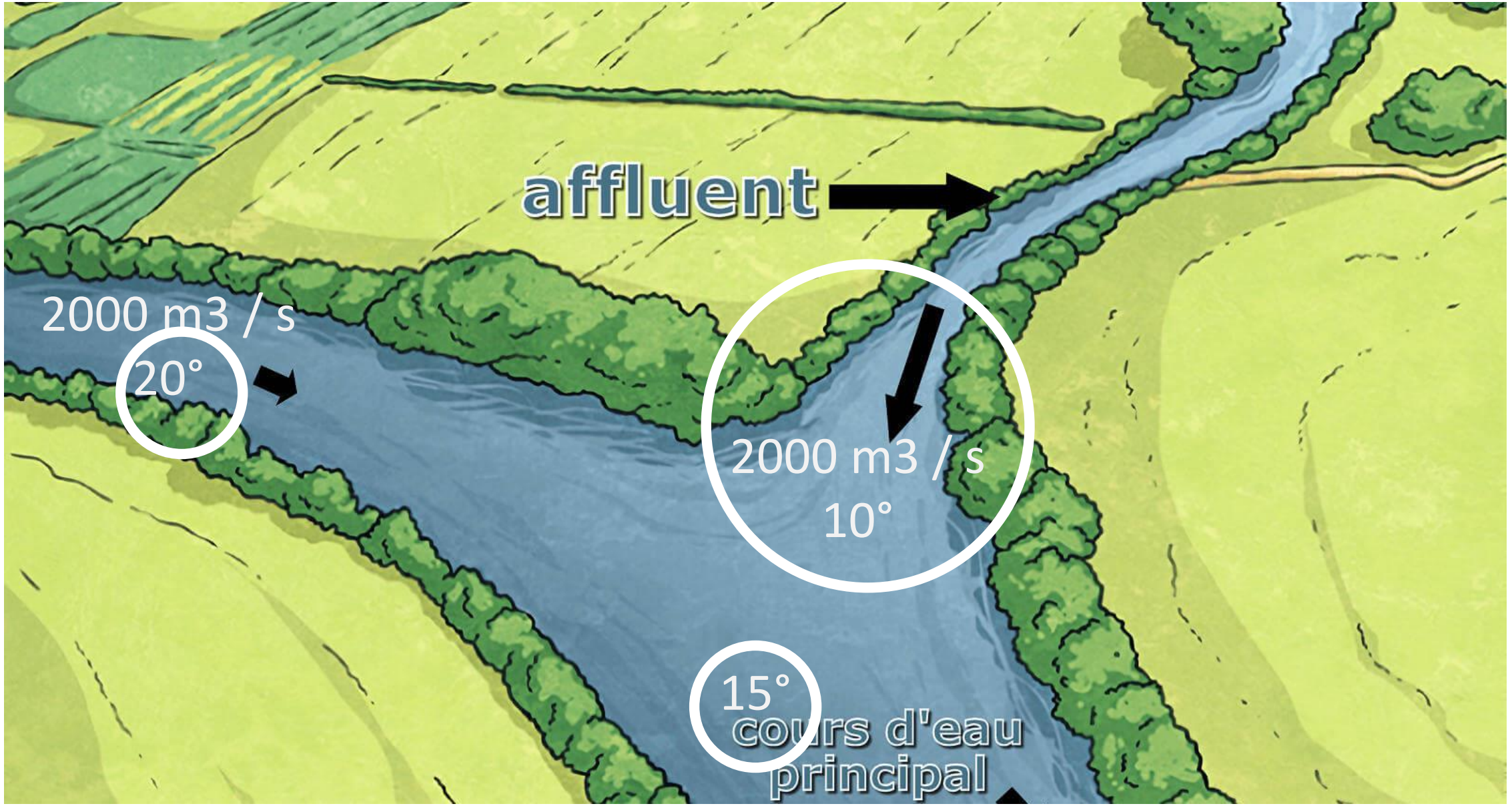

affluent
2000 m3 / s
20°
2000 m3 / s
10°
cours d'eau
principal

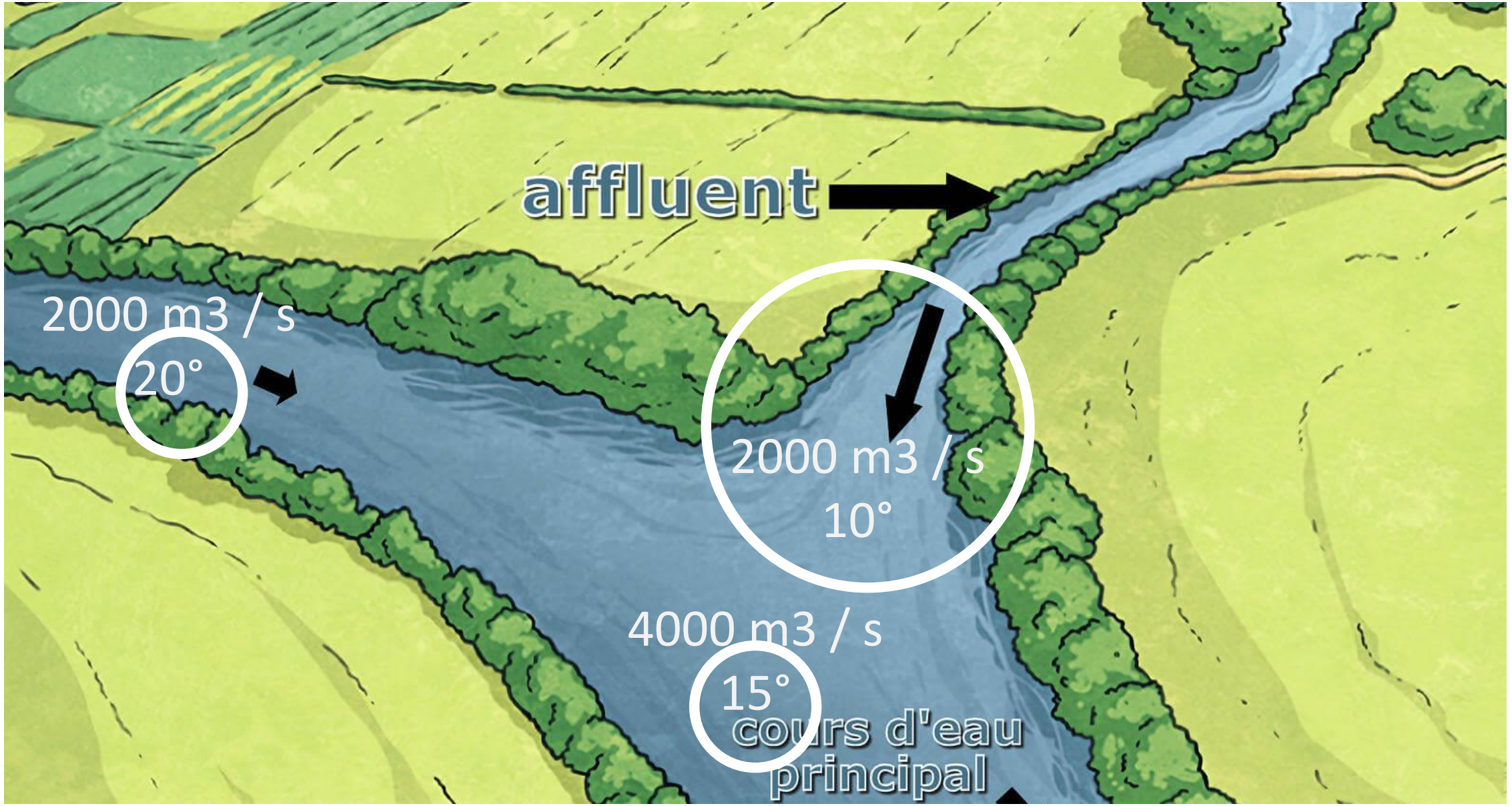

affluent
2000 m3 / s
20°
2000 m3 / s
10°
4000 m3 / s
15°
cours d'eau
principal


affluent


affluent
2000 m3 / s
10°
cours d'eau
principal


affluent
20°
2000 m3 / s
10°
15°
cours d'eau
principal


affluent
2000 m3 / s
20°
2000 m3 / s
10°
15°
cours d'eau
principal

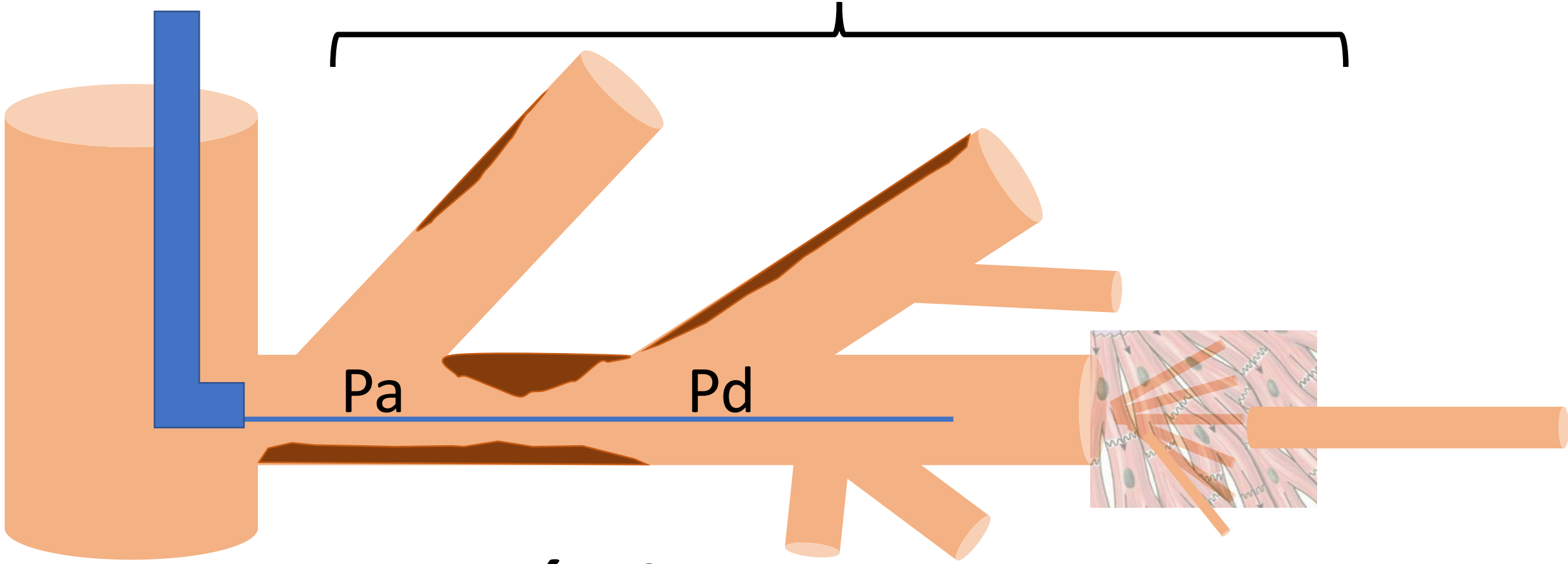

affluent
2000 m3 / s
20°
2000 m3 / s
10°
4000 m3 / s
15°
cours d'eau
principal

Pression ✓

Débit ✓

Résistance

Rtotal



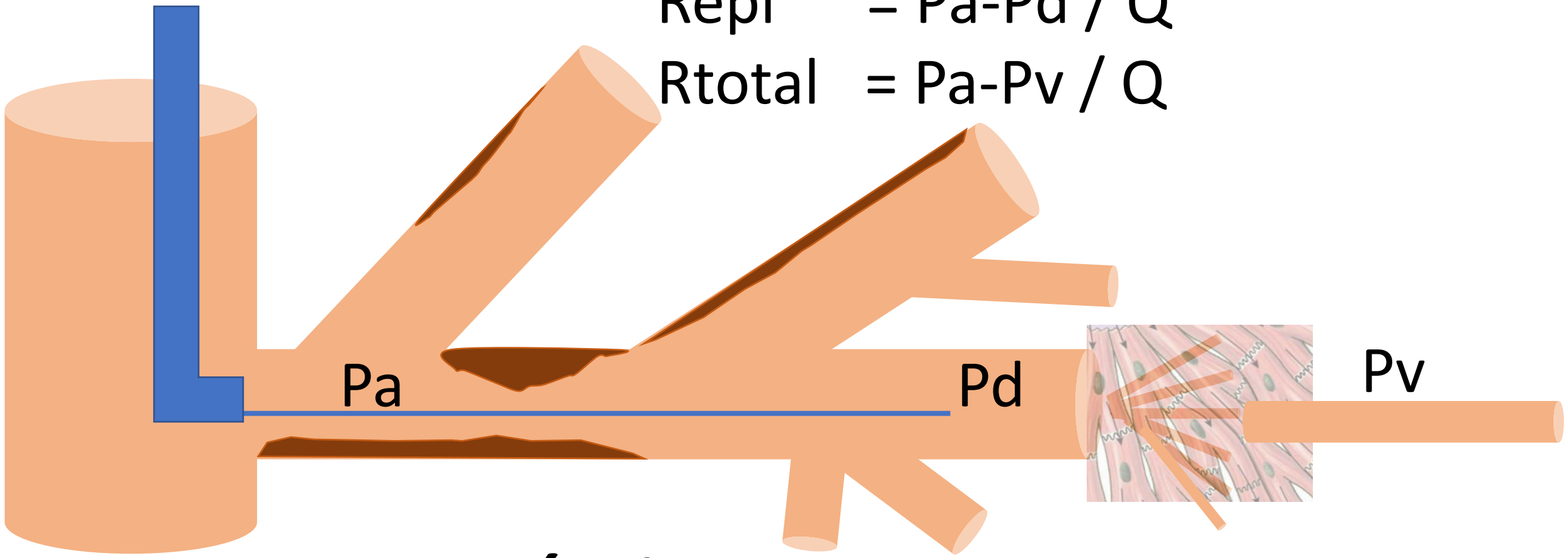
Répi

Rmicro

Rmicro = Pd-Pv / Q

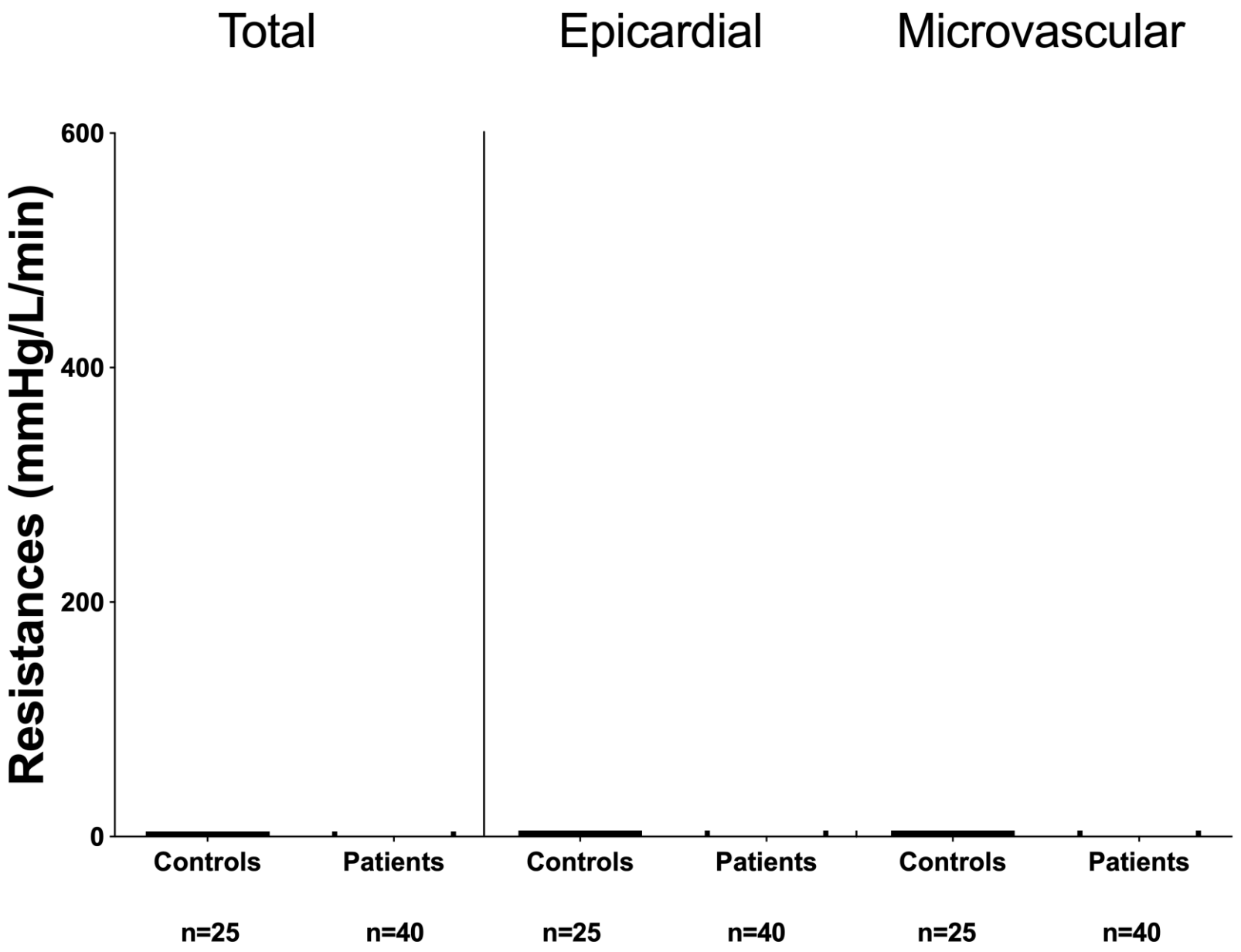
Répi = Pa-Pd / Q

Rtotal = Pa-Pv / Q



Répi

Rmicro



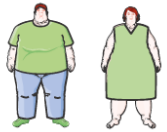
Fournier et al EuroIntervention, 2021

Management of INOCA

1. Lifestyle factors

Nutrition

Exercise

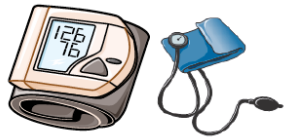


Weight management

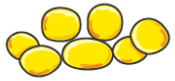
Smoking cessation

Coping with stress

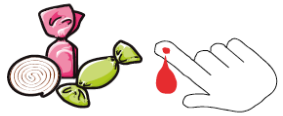
2. Risk factor management



Hypertension

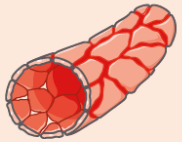


Dyslipidaemia



Diabetes mellitus

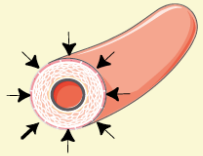
3. Antianginal medication



Microvascular angina

1. Betablocker
2. Calcium channel blocker
3. Nicorandil
4. Ranolazine
5. Ivabradine
6. Trimetazidine

Consider statins and ACEI/ARB



Vasospastic angina

1. Calcium channel blocker
2. Long-acting nitrate
3. Nicorandil

Effect of **S**tate-of-the-Art **T**reatment on Symptoms, **A**bsolute Coronary Artery Flow, and **R**esistance among patients with **I**schemia and **N**on-**O**bstructive **C**oronary **A**rteries

(STAR-INOCA Study)

STAR-INOCA

- **Primary Outcome**
  - Coronary microcirculation measurements from baseline to after titration of state-of-the-art therapy
- **Secondary Outcome**
  - Quality of life, measured by the difference in Seattle Angina Questionnaire and EuroQol-5D scores between baseline and post-titration

STAR-INOCA

- **Study design**
  - Prospective, single-arm interventional study
- **Sample size:**
  - 40 patients with INOCA/ANOCA diagnosis

STAGE 1

Statin
BB
ACEI

2 months

SAQ + EuroQuol 5

Negative

2nd ICA

STAGE 2

Ca-antagonist

1 month

SAQ + EuroQuol 5

Negative

2nd ICA

STAGE 3

Ranolazine

1 month

SAQ + EuroQuol 5

2nd ICA

MERCI