

Wondgenezing en Diabetes Mellitus

“Treat the whole patient, not the hole in the patient”

Richard van Valen
Verpleegkundig specialist
Erasmus MC

Leerdoelen

- Inzicht in wondgenezing
- Inzicht in problemen met diabetes en wonden
- Inzicht in omvang probleem diabetes bij mediastinitis
- Preventieve opties
- Behandelopties bij mediastinitis
- Casus

Normale wondgenezing

Wond = verbreking van de anatomische
en functionele samenhang van het levende
weefsel

Wonden

- **Type**

- chemisch
- thermisch
- radiatie
- mechanisch

- **Veroorzaker:**

- steekwonden
- snijwonden
- bijtwonden
- schaafwonden
- scheurwond



Wonden

Onderscheid:

- Acute
 - *Simpele* snijwond/chirurgische wond
 - *Gecomplieerde* schotwond/bijtwond
- Chronische diabetische voet/ulcus cruris

Wondgenezing

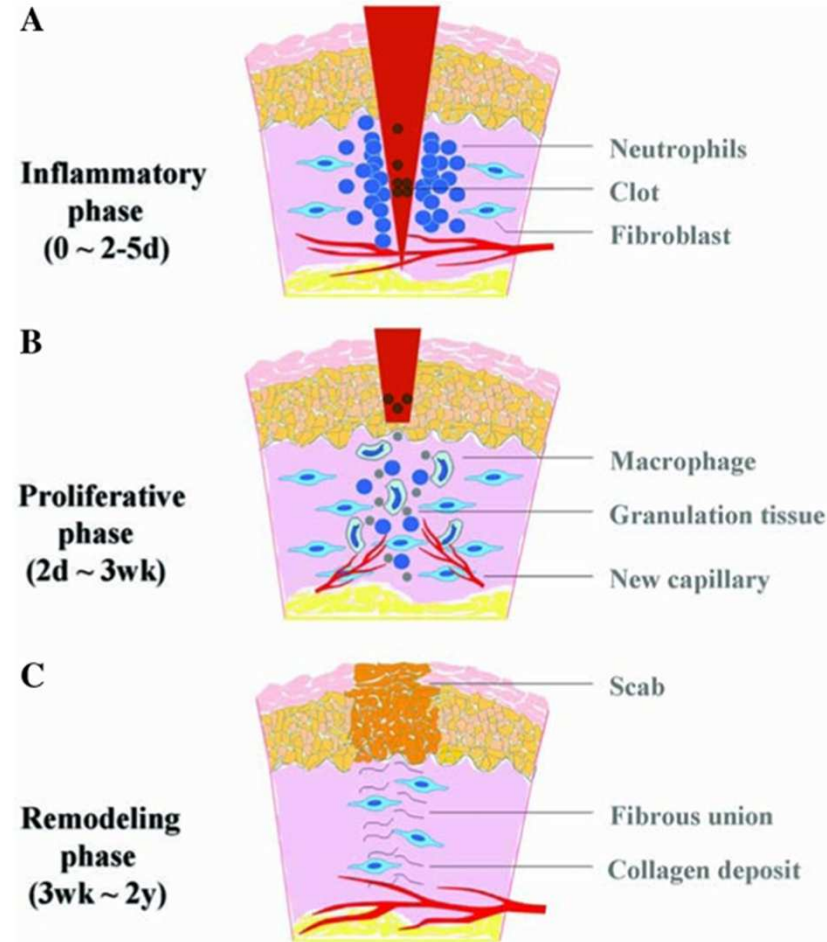
Wondgenezing:

- *Primaire wondgenezing*: eenvoudige hechting.
- *Uitgestelde primaire wondgenezing*: sluiten van de wond na 4 à 7 dagen
- *Secundaire wondgenezing*: bij grotere weefseldefecten moet granulatieweefsel het defect opvullen
- *Tertiaire wondgenezing*: voorbereiding van de wond voor plastische chirurgie



Wondgenezing

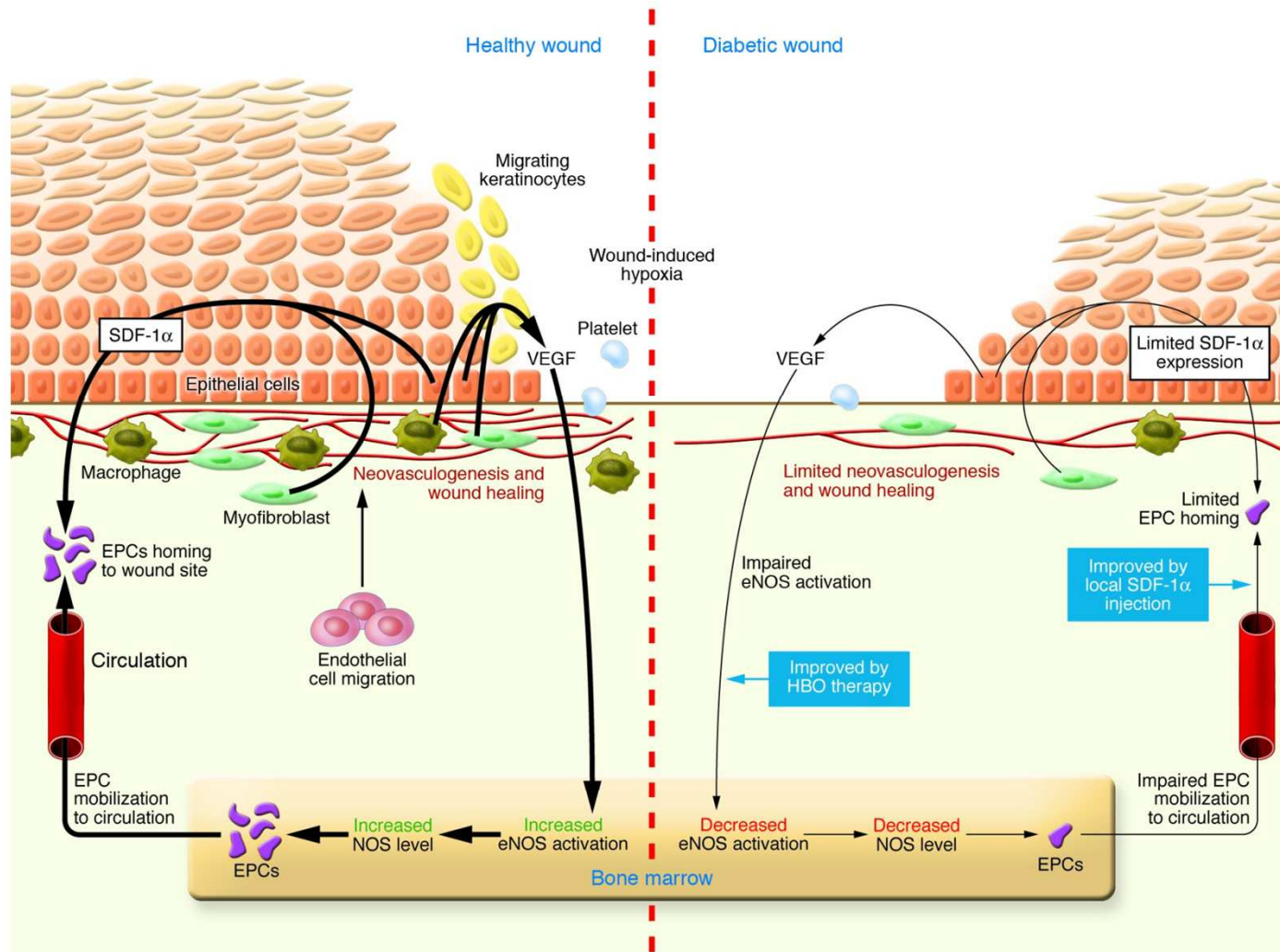
- 3 fasen
 - Ontstekingsfase
- ↓
- Proliferatiefase
- ↓
- Reconstructiefase



Diabetes en wondgenezing

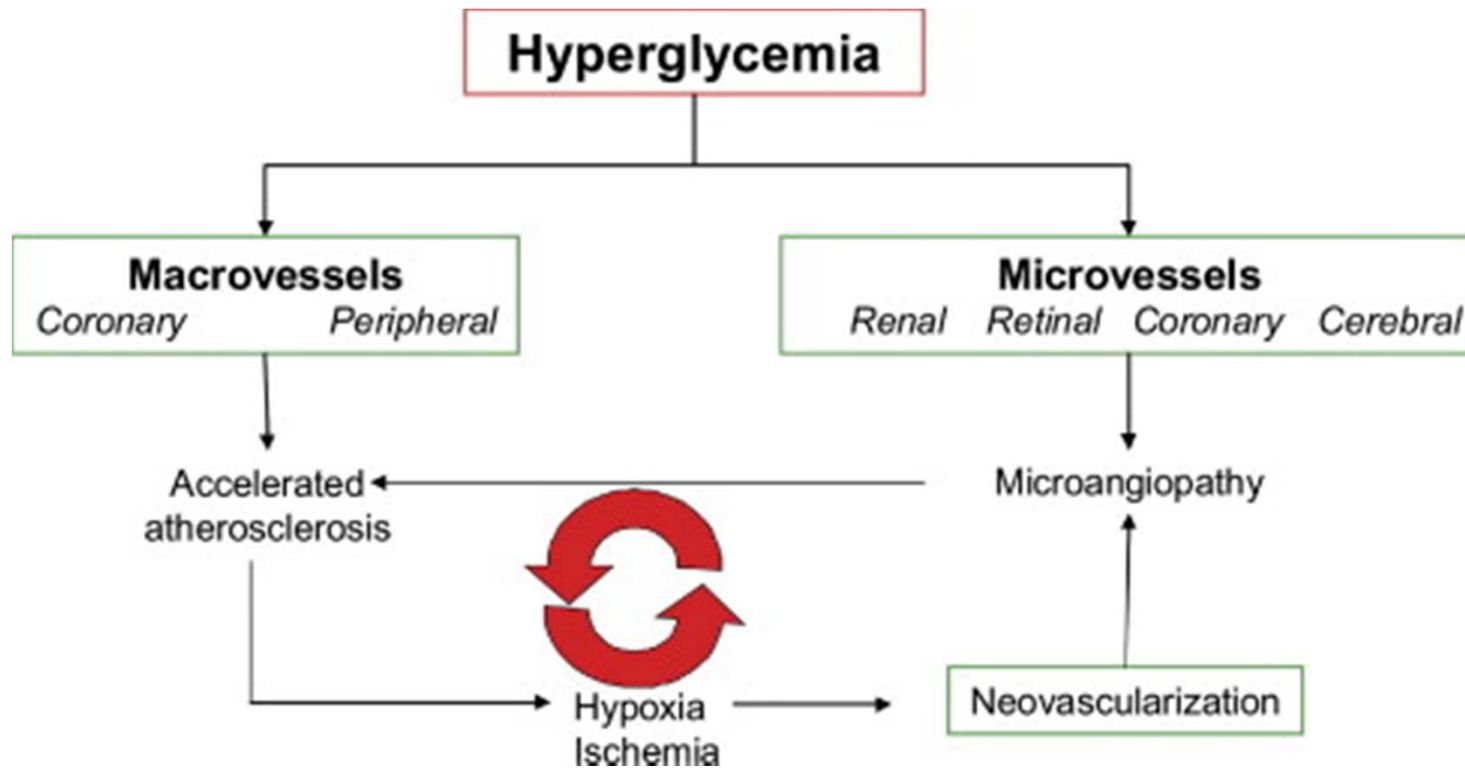
- Vertraagde wondgenezing
- Verhoogde gevoeligheid voor infecties
- Verminderde angiogenese
- Verminderde granuleuze weefsel aanmaak
- Macrophagen disfunctie
- Granulocyten disfunctie
- Chemokine disfunctie
- Etc etc

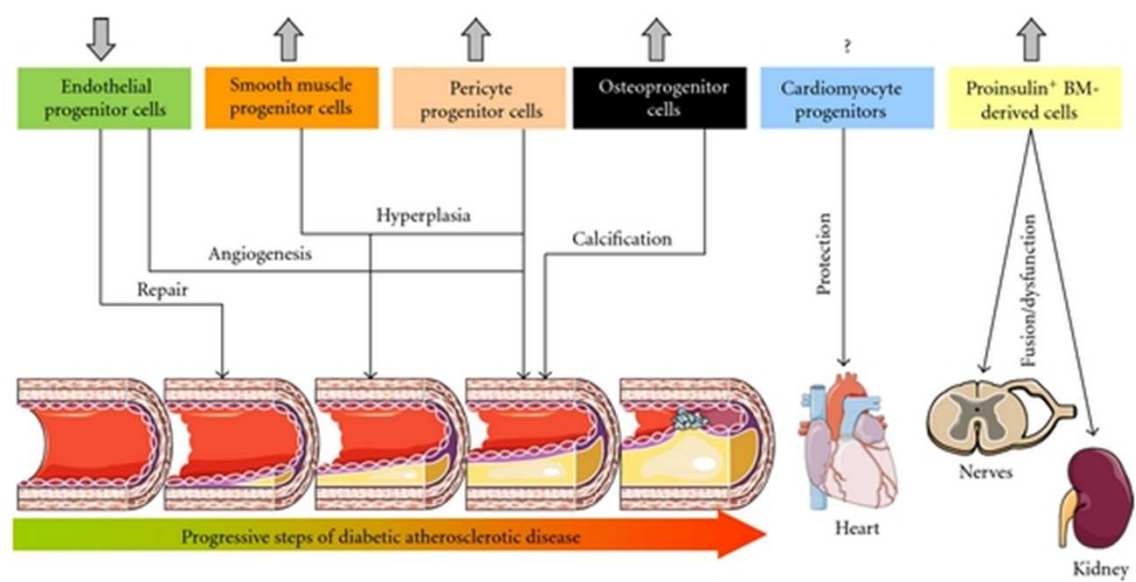
Meer dan 100 factoren!



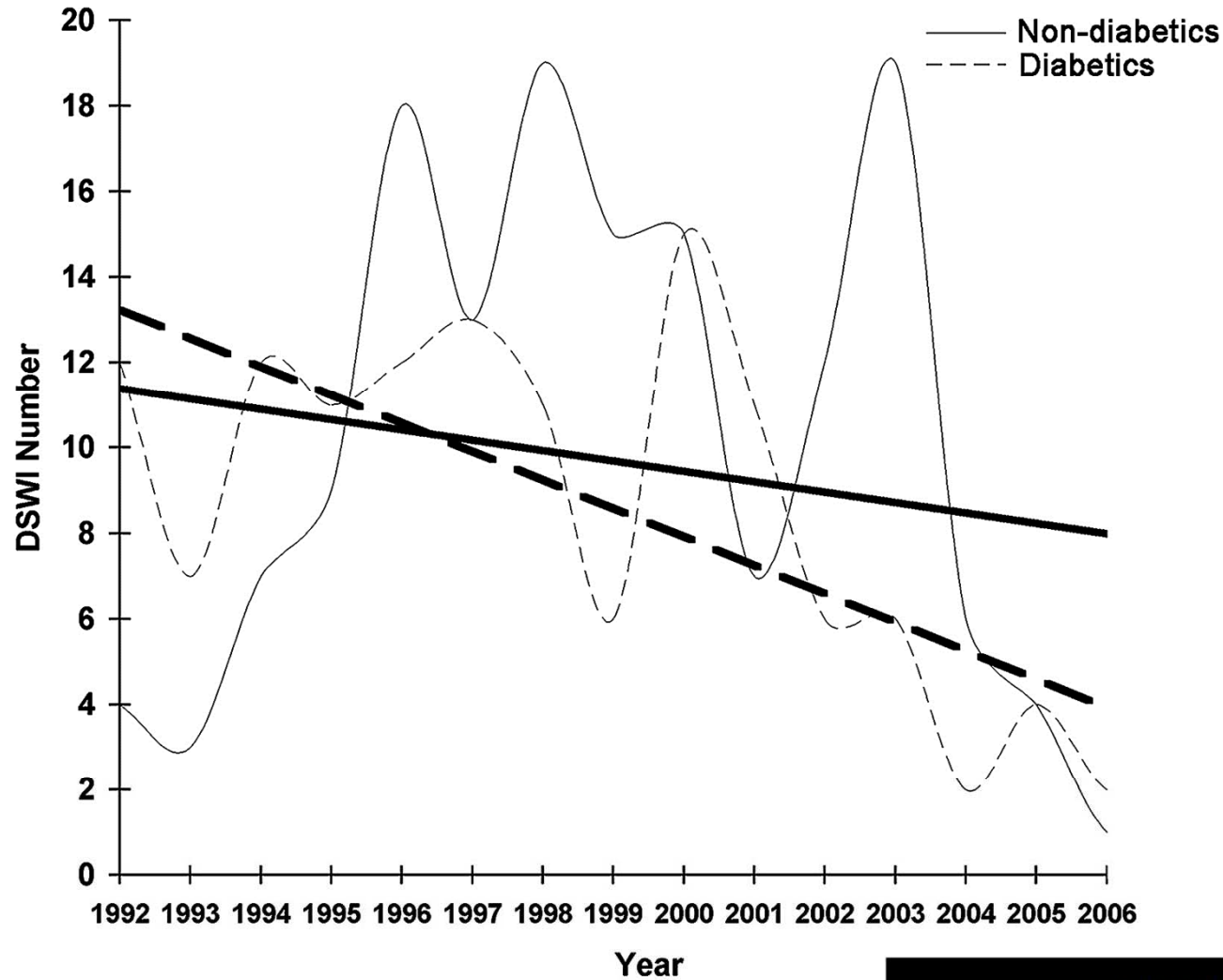
SDF-1 α = stromal cell-derived factor-1 α :chemokine: leidt naar wondgebied
 EPC = endothelial progenitor cell (nieuwvorming bloedcellen)
 NOS = NO synthase

Samengevat





Maar is het echt een probleem?



PERIOPERATIVE MANAGEMENT

Reduction in incidence of deep sternal wound infections: Random or real?

Evan Matros, MD,^a Sary F. Aranki, MD,^b Lauren R. Bayer, PA-C,^a Siobhan McGurk, BS,^b Jennifer Neuwaldler, MD,^a and Dennis P. Orgill, MD, PhD^a

Table III

Mortality and morbidities in diabetic and nondiabetic patients

Postoperative outcomes	Diabetic patients (n = 121)	Nondiabetic patients (n = 272)	P value
Hospital mortality	7 (5.8%)	10 (3.7%)	.4204
Severe hypoglycemia	3 (2.5%)	1 (.4%)	.0887
Respiratory failure	12 (9.9%)	17 (6.3%)	.2131
Hypoxemia	41 (33.9%)	75 (27.6%)	.2312
Pneumonia	24 (19.8%)	38 (14.0%)	.1767
Lung atelectasis	9 (7.4%)	14 (5.1%)	.3617
Low cardiac output syndrome	7 (5.8%)	9 (3.3%)	.2738
Atrial fibrillation	65 (53.7%)	138 (50.7%)	.6620
Ventricular fibrillation	1 (.8%)	2 (.7%)	1.0000
Acute myocardial infarction	1 (.8%)	1 (.4%)	.0943
Requirement of IABP	9 (7.4%)	14 (5.1%)	.3617
Acute renal failure	12 (9.9%)	18 (6.6%)	.3034
Stroke	4 (3.3%)	6 (2.2%)	.5048
Deep sternal wound infection	11 (9.1%)	3 (1.1%)	.0002
Sepsis	7 (5.8%)	8 (2.9%)	.2515
Reoperation for bleeding	4 (3.3%)	13 (4.8%)	.6009
Quantity of drainage (mL)	491 ± 188	468 ± 161	.2157
Total blood transfusion (mL)	785 ± 374	738 ± 312	.1963
Length of ICU stay (d)	3.3 ± .8	3.1 ± 1.2	.0948
Length of hospital stay (d)	12.0 ± 2.2	11.6 ± 2.4	.1186

IABP, intra-aortic balloon pump; *ICU*, intensive care unit.

Impact of diabetes mellitus on patients over 70 years of age undergoing coronary artery bypass grafting

Is het echter zo simpel.....

Table IV

Effect of diabetes on mortality and major morbidities

Variables	OR	95% CI	P value
Hospital mortality	1.26	.65-3.64	.6983
Respiratory failure	1.35	.60-4.15	.3216
Low cardiac output syndrome	1.45	.54-4.89	.2731
Acute myocardial infarction	1.26	.71-3.22	.1538
Acute renal failure	1.73	.74-5.82	.0825
Stroke	1.01	.98-1.03	.8749
Deep sternal wound infection	2.28	1.29-6.84	.0028
Sepsis	1.55	.61-5.21	.3148
Reoperation for bleeding	.83	.35-3.16	.1005

OR, odds ratio; CI, confidence interval.

Adjusted for age, gender, body mass index, congestive heart failure, previous myocardial infarction, previous stroke, chronic obstructive pulmonary disease, preoperative renal failure, preoperative hypertension, previous heart operation, and left ventricular ejection fraction.

Impact of diabetes mellitus on patients over 70 years of age undergoing coronary artery bypass grafting

Qiang Ji, MD, PhD,^a Yunqing Mei, MD, PhD,^a Xisheng Wang, MD, PhD,^a Jing Feng, MD,^a Jiangzhi Cai, MD, PhD,^a Yifeng Sun, MD,^a and Liangjie Chi, PhD^b

Table 1: Clinical characteristics of included patients (n = 1297)

Preoperative factors	n (%)
Age >70 years	622/1297 (48.0)
Diabetes mellitus	320/1297 (24.7)
Insulin-dependent	22/1297 (1.7)
Chronic obstructive pulmonary disease	115/1297 (8.9)
BMI >30-40 kg/m ²	150/1297 (11.6)
BMI >40 kg/m ²	14/1297 (1.1)
Peripheral arterial disease	120/1297 (9.3)
Previous myocardial infarction	183/1297 (14.1)
Cardiogenic shock	81/1297 (6.2)
Creatinine >2 mg/dl	78/1273 (6.1)
Terminal renal insufficiency	18/1297 (1.4)
Emergency	151/1297 (11.6)
Intra- and postoperative factors	
	n (%) mean ± SD
Operation time	266 ± 89 min
CPB duration	1294/1297 (99.8), 117 ± 117 min
CPB >200 min	79/1297 (6.1)
Aortic clamping duration	1273/1297 (98.1), 89 ± 117 min
Reoperation	101/1297 (7.8)
Bilateral internal mammary artery	63/1297 (4.9)
Intra-aortic balloon pump	61/1297 (4.7)
Revision	69/1297 (5.3)

Table 5: Risk factors for all sternal wound complications in multivariate analysis (n = 76/1297)

	OR	95% CI limits		P
		Lower	Upper	
BMI >40 kg/m ²	11.5	3.5	38.1	<0.001
DM (insulin)	5.4	1.8	16.1	0.003
Resternotomy	4.1	2.2	7.6	<0.001
Emergency	3.5	2.0	6.3	<0.001
COPD	2.2	1.1	4.4	0.021

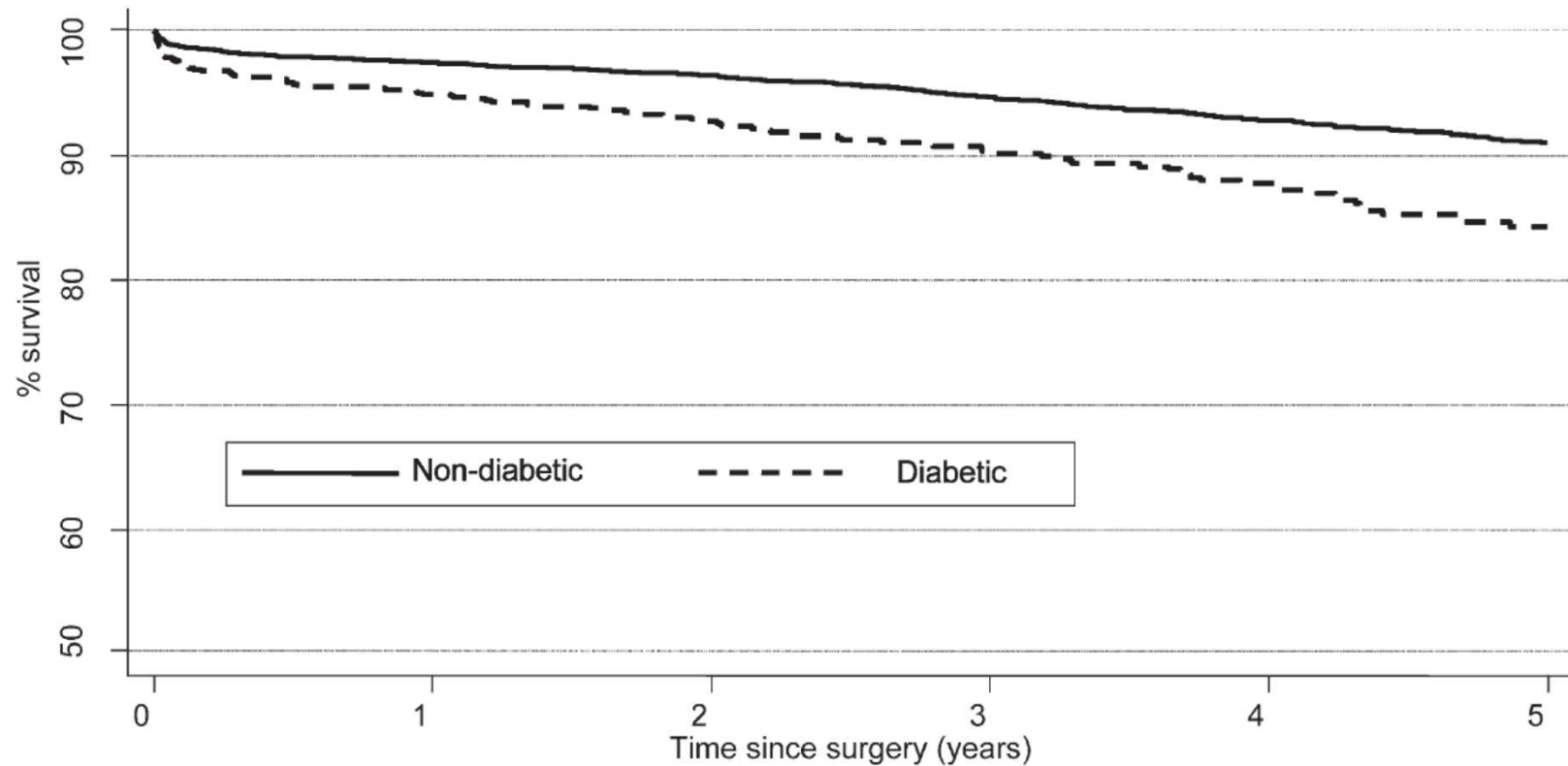
OR: odds ratio; CI: confidence interval; DM: diabetes mellitus; BMI: body mass index; COPD: chronic obstructive pulmonary disease.

Table 4: Risk factors for deep infections only (multivariate)

n = 26/1297	OR	95% CI limits		P
		Lower	Upper	
DM (insulin)	15.7	4.7	51.9	<0.001
COPD	6.7	2.7	16.9	<0.001
Resternotomy	5.1	1.9	13.7	0.001
Emergency	3.0	1.2	7.8	0.024

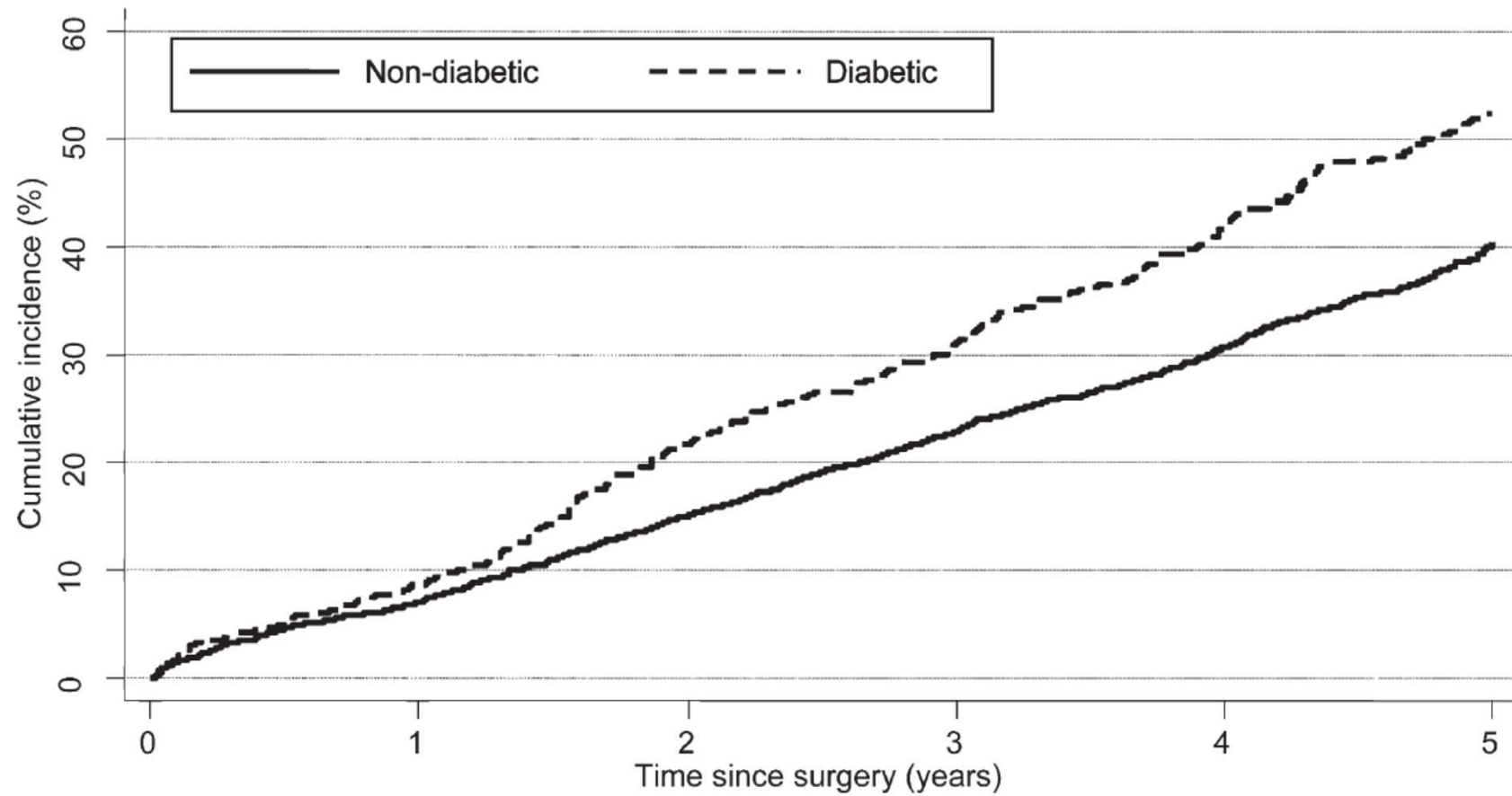
OR: odds ratio; CI: confidence interval; DM: diabetes mellitus; BMI: body mass index; COPD: chronic obstructive pulmonary disease.

Overleving op langere termijn



The effect of diabetes mellitus on patients undergoing coronary surgery: A risk-adjusted analysis

Chanaka Rajakaruna, MRCS, Chris A. Rogers, PhD, Chinthaki Suranimala, MRCS, Gianni D. Angelini, MD, FRCS, and Raimondo Ascione, MD, FRCS



The effect of diabetes mellitus on patients undergoing coronary surgery: A risk-adjusted analysis

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TABLE 4. The effect of diabetes on clinical outcomes

Outcome	Adjusted* effect size		
	OR	95% CI	P value
In-hospital death	1.63	0.92-2.88	.089
Myocardial infarction	1.03	0.63-1.70	.899
Atrial fibrillation	1.10	0.89-1.37	.360
Chest infection	0.91	0.65-1.28	.602
Neurologic complications	2.01	1.37-2.96	<.001
Infective complications	1.27	0.85-1.91	.238
Renal complications	1.63	1.17-2.29	.004
Gastrointestinal complications	1.76	0.99-3.12	.054
Multisystem failure	1.56	0.75-3.23	.234

The effect of diabetes mellitus on patients undergoing coronary surgery: A risk-adjusted analysis

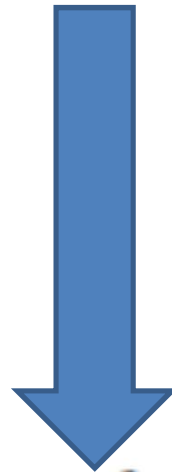
Chanaka Rajakaruna, MRCS, Chris A. Rogers, PhD, Chinthaki Suranimala, MRCS, Gianni D. Angelini, MD, FRCS, and Raimondo Ascione, MD, FRCS

Daarnaast: sowieso ouder worden en ↑ insuline resistentie

- Leeftijd: Maximale insuline secretie daalt
- Beta cel dysfunctie: minder gevoelig voor glucose, minder afgifte van insuline
- Insuline-resistentie: verminderde gevoeligheid voor insuline
 - Niveau van doelorganen (spierweefsel)
 - Gecombineerd met hypertensie, centrale vetverdeling, hypertriglyceridemie

Dus zelfs al je nog geen diabeet bent.

In conclusion, in diabetic patients preoperative HbA_{1c} levels predict insulin sensitivity during cardiac surgery and, possibly, outcome. Independent of the patient's diabetic state, intraoperative insulin resistance is associated with an **increased risk of** complications after surgery.



increased risk of complications

TABLE 4. OR of outcomes for every decrease in insulin sensitivity by $1 \text{ mg} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$

Outcome	OR (95% CI)	P value
Major complications	2.23 (1.30–3.85)	0.004
Death	2.33 (0.94–5.78)	0.067
IABP	1.55 (0.66–3.66)	0.318
Dialysis	1.79 (0.52–6.18)	0.359
Stroke	2.60 (0.64–10.5)	0.181
Severe infection	4.98 (1.48–16.8)	0.010
Minor infection	1.97 (1.27–3.06)	0.003

The ORs were adjusted for potential confounders. CI, Confidence interval; IABP, intraaortic balloon pump.

Maar goed om je te realiseren.....



Dit is voor de betreffende patiënt een ramp!

Venectomie, een onderschat probleem



- Infectieuze problemen relatief frequent voorkomend (1 tot 24%)
- Risico-factoren:

Table 3. Multivariate analysis of independent risk factors associated with HSSI: 3445 cases excluding duration of surgery and postoperative stay >72 hours

Variable	P value	Odds ratio (95% CI)
Age	.003	1.03 (1.01-1.06)
Diabetes	<.001	2.45 (1.56-3.84)
Renal insufficiency	<.001	3.31 (1.84-5.97)
BMI > 30 (kg/m ²)	<.001	2.38 (1.52-3.75)

American Journal of Infection Control
October 2009

Harvest surgical site infection following coronary artery bypass grafting: Risk factors, microbiology, and outcomes

Mamta Sharma, MD,^{1,2} Mohamad G. Falih, MD, MPH,^{1,3,4} Dorine Berriel-Cass, RN, MA,⁴ Susan Meisner, RN,⁴ Louis Saravolatz, MD,^{1,2} and Riad Khatib, MD^{1,2}
Detroit, Michigan

Verschil endoscopic versus open?

Meta-analysis of Lower Leg Wound Infection

Figure 1 summarizes the results of the lower leg wound infection analysis. Nine of the 17 studies showed a significant difference between the MIVH and CVH techniques. Seventeen studies included in this meta-analysis showed a significant reduction of wound infection in favor of the MIVH group (fixed-effect MIVH techniques, was 0.073, which translates into 0.14-0.25) the number of patients needed to treat to prevent 1 significant infection (NTT = 1/ARR) of 14.

assess study heterogeneity (Figure 6A) shows one study²⁰ with the highest OR that was outside the ± 2 SDs but did not affect homogeneity. The incidence of wound infection in the MIVH group was 56/2231 (2.5%) versus 294/2984 (9.9%) in the CVH group. The combined OR was 0.19 (95% CI = 0.14-0.28) in favor of MIVH ($z = 8.93$; $P = .001$). The absolute risk reduction (ARR) in this case, the difference in the incidence of infections between CVH and MIVH techniques, was 0.073, which translates into the number of patients needed to treat to prevent 1 infection (NTT = 1/ARR) of 14.

Figure 1. 1
publication. 1
Test for heter

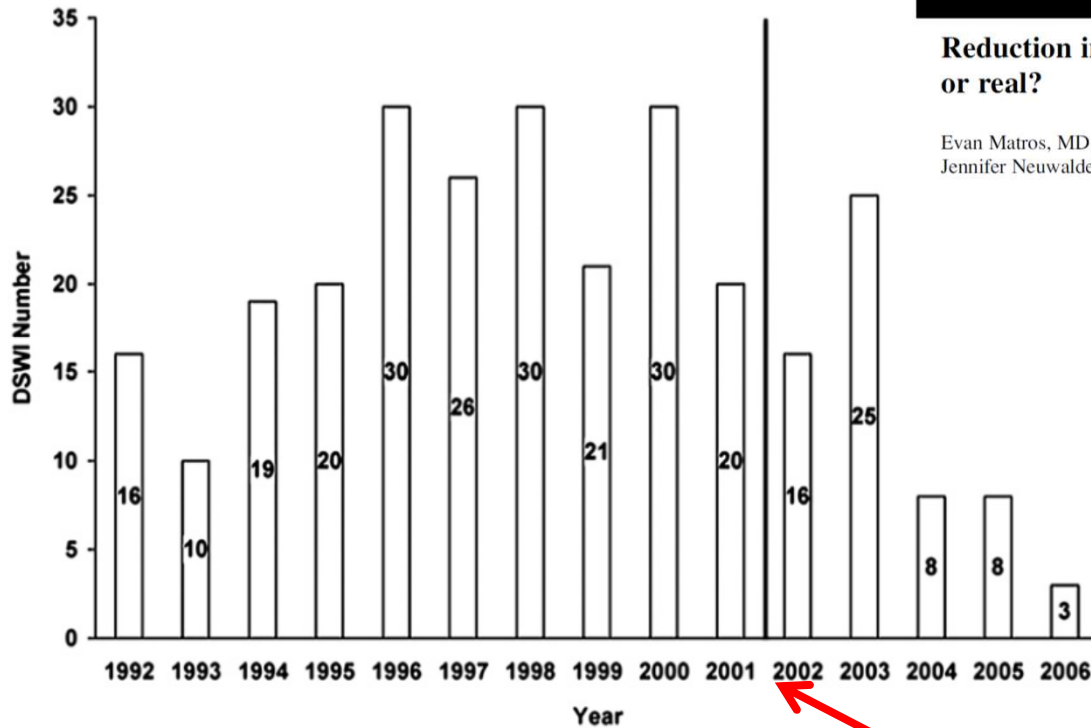
1 by date of

Hoe beperken we het probleem?

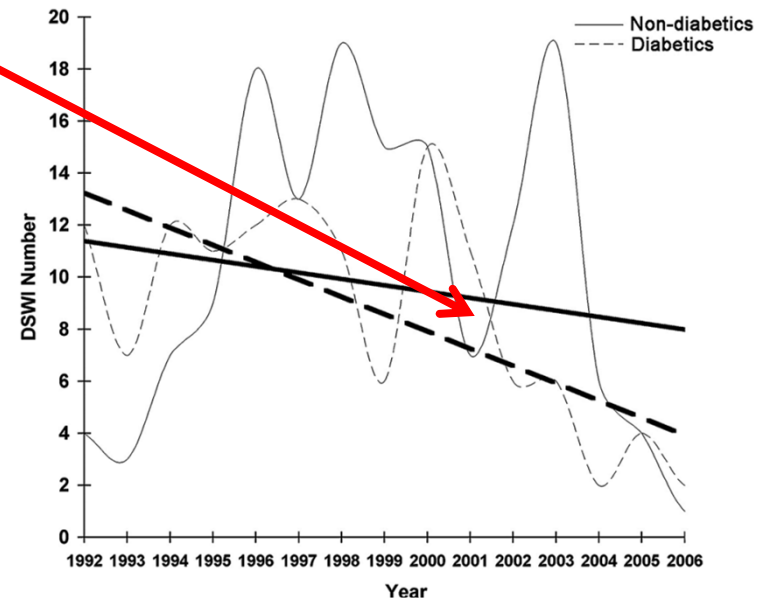


Reduction in incidence of deep sternal wound infections: Random or real?

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insulin resistance as well.¹⁰ Accordingly, our institution initiated a protocol of postoperative intravenous administration of insulin in 2000 (regular use was not achieved until 2002), followed in 2003 by a protocol intraoperative intravenous administration of insulin, with improvements in postopera-



Optimaliseren, optimaliseren, optimaliseren

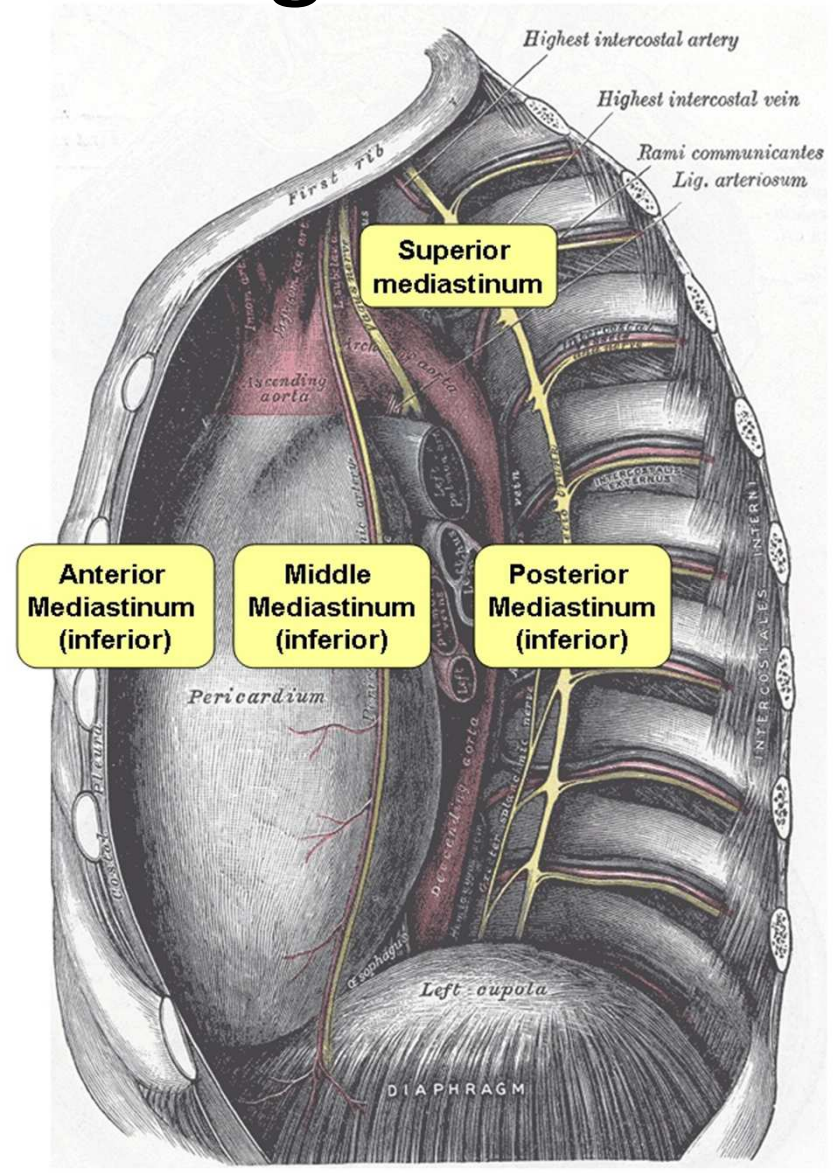
- Stricte glucose-regulatie
- Voorkomen ondervoeding
- Corrigeren hypoxie
- Corrigeren anemie
- Adequate drainage
- Antibiotische behandeling (altijd noodzakelijk?)

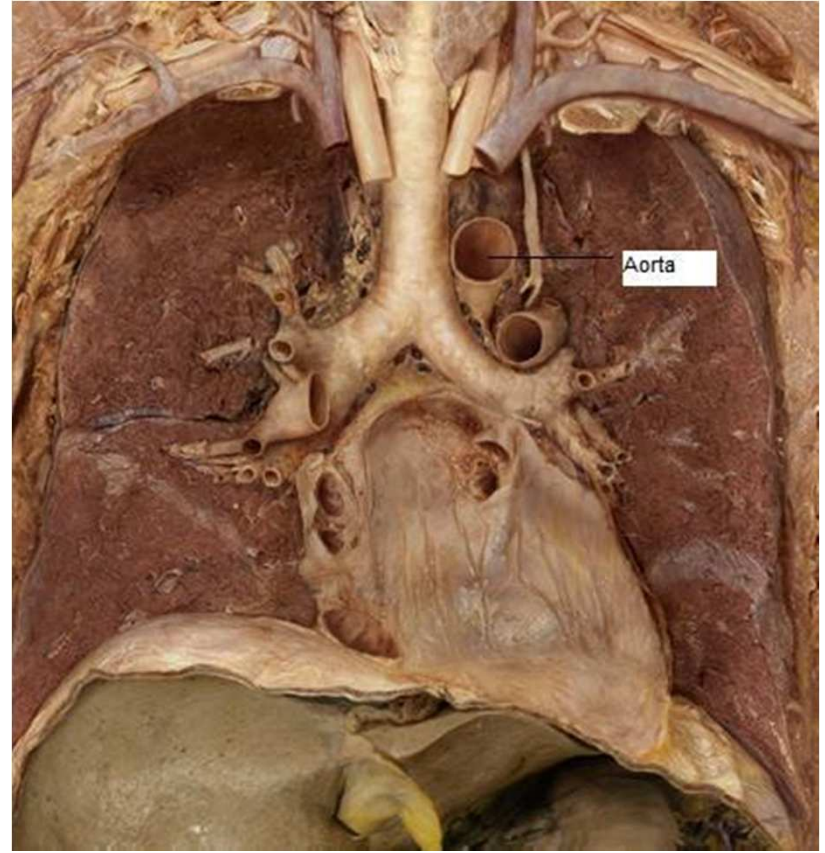
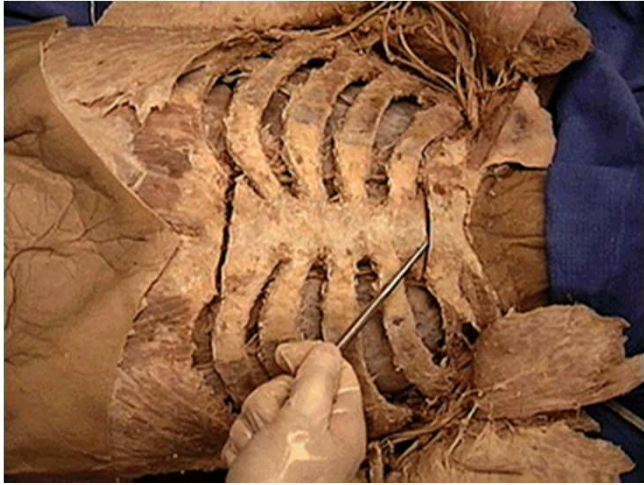
En als het dan toch fout gaat?

Mediastinitis.....

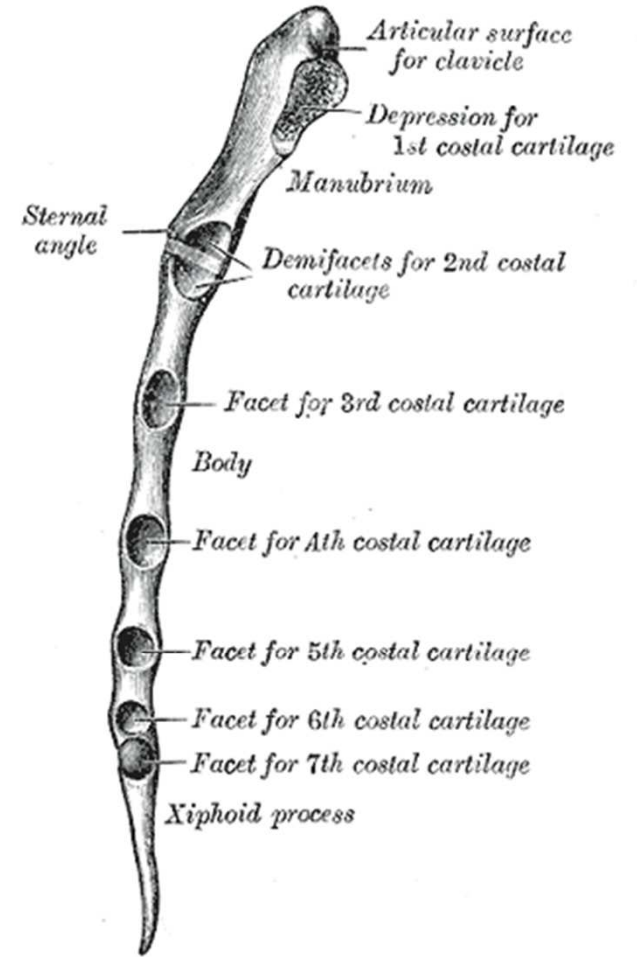
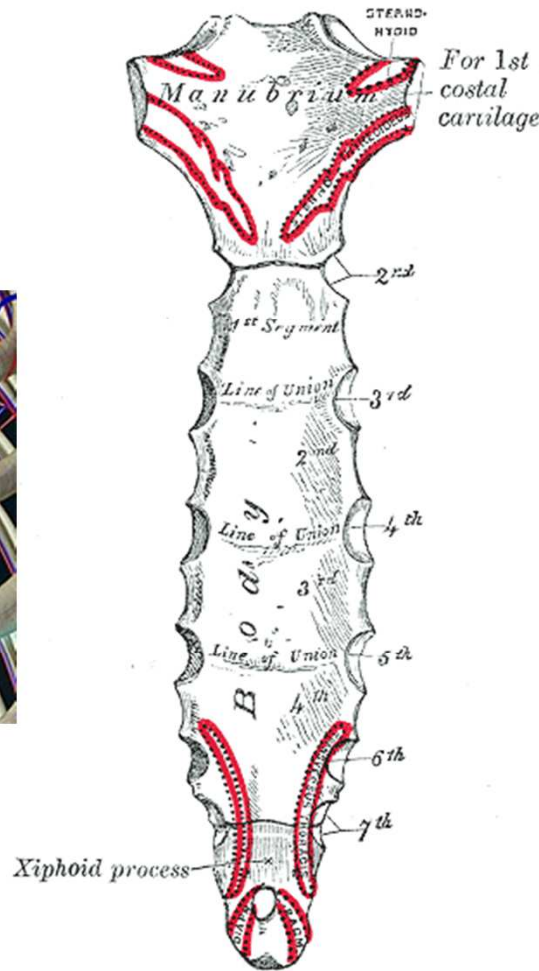
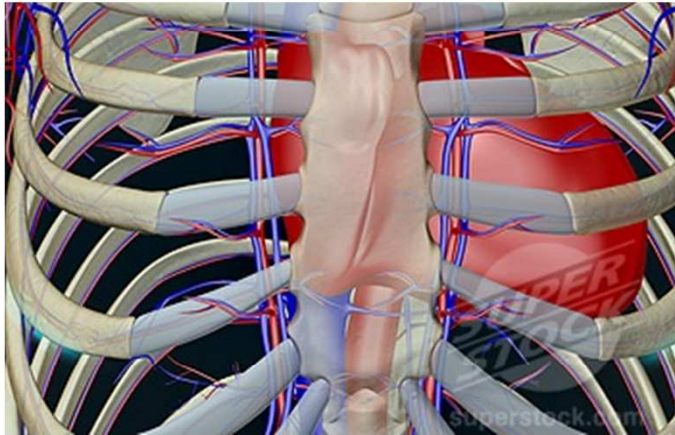
Ter herinnering

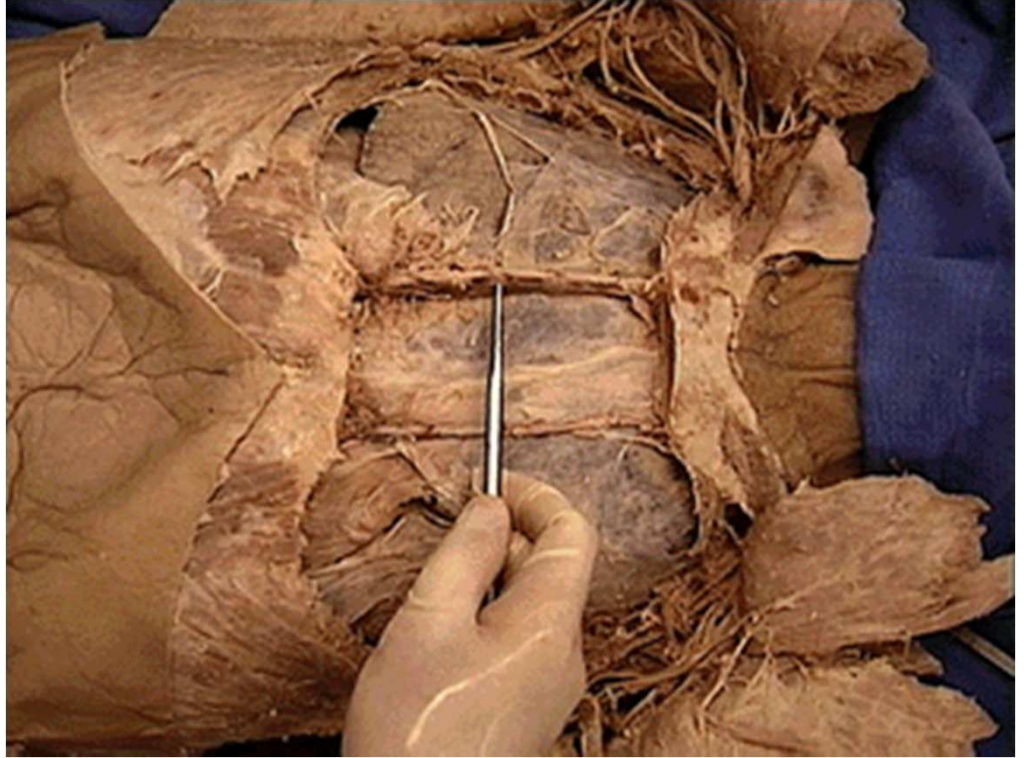
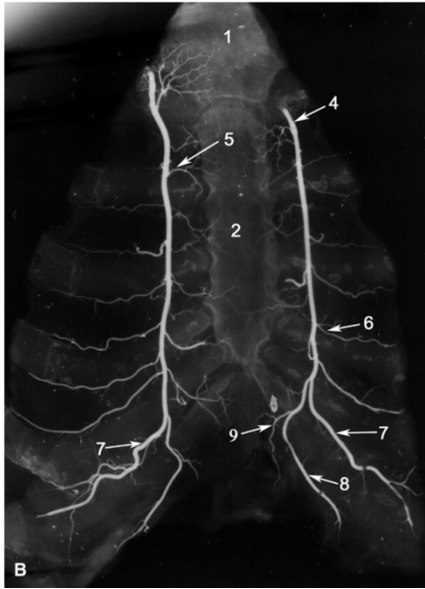
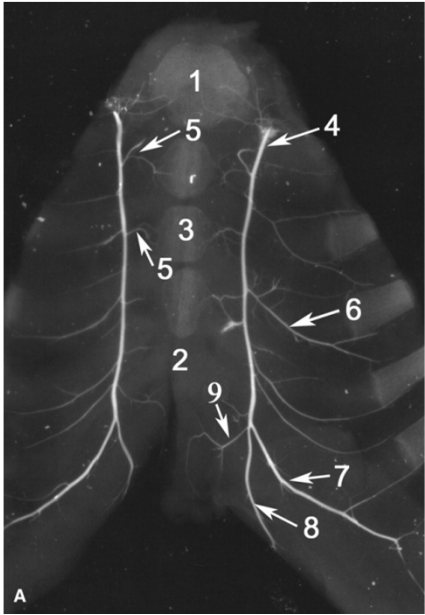
- Het mediastinum





- Het sternum



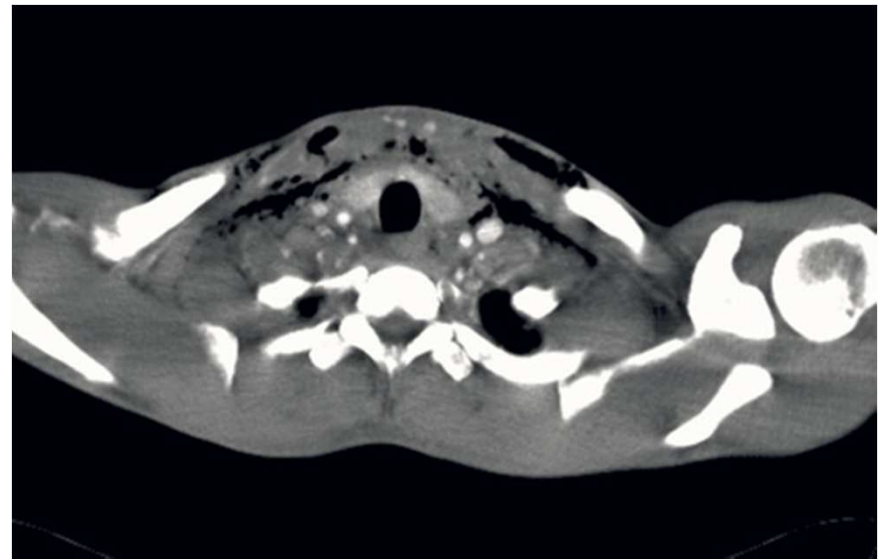


Mediastinitis

- *Een inflammatoir proces in het mediastinum, waarbij wordt voldaan aan minimaal een van de onderstaande vereisten:*
 - *-Een geïsoleerd micro-organisme in ofwel een wondkweek of mediastinaal weefsel,*
 - *- Aanwijzingen voor mediastinitis gedurende chirurgie,*
 - *- Een van de volgende symptomen: Pijn aan de wond of de borstkast, sternum instabiliteit, of koorts in combinatie met purulente afscheiding van het mediastinum of een positieve wonden/of bloedkweek.*

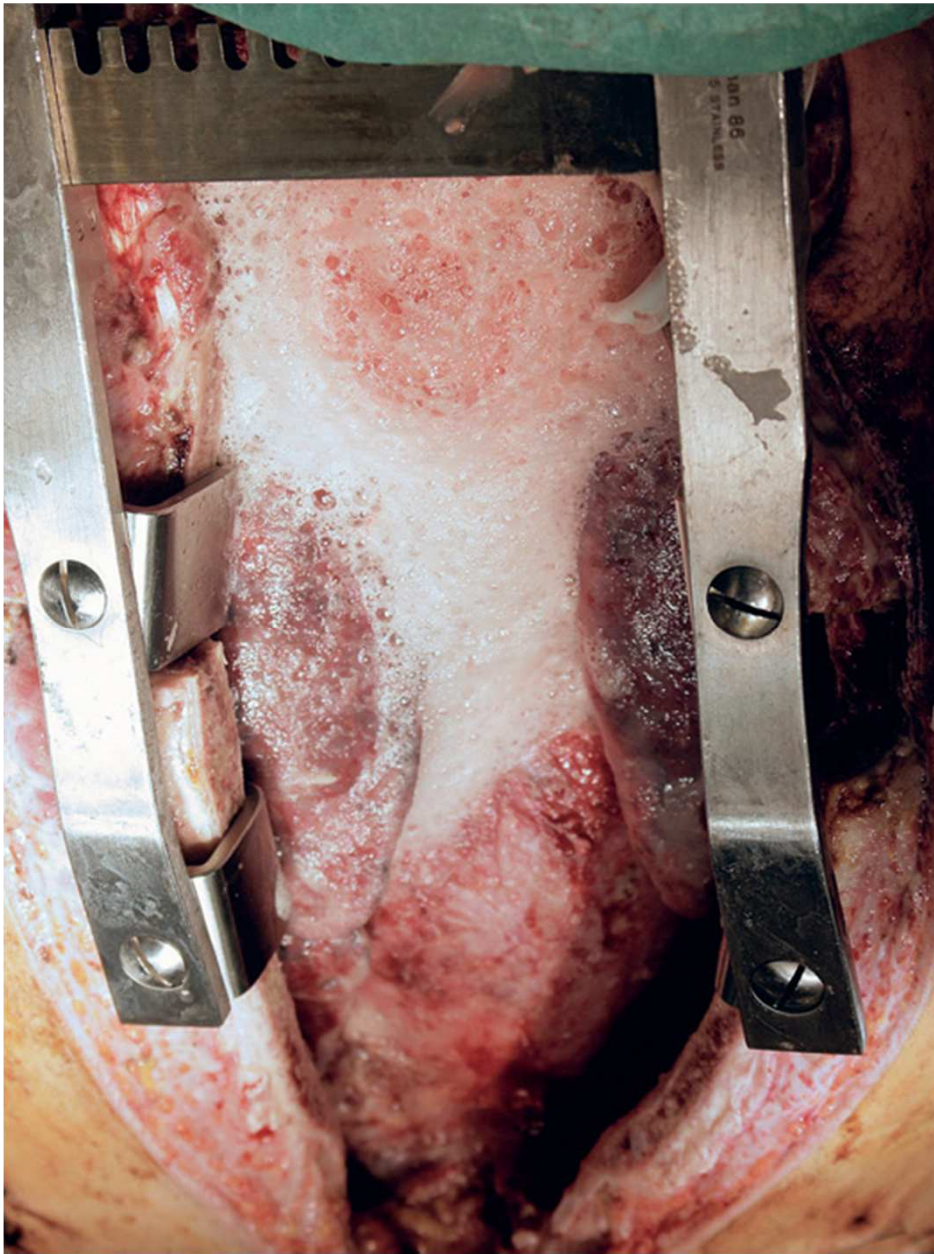
Klassieke mediastinitis (niet na chirurgie)

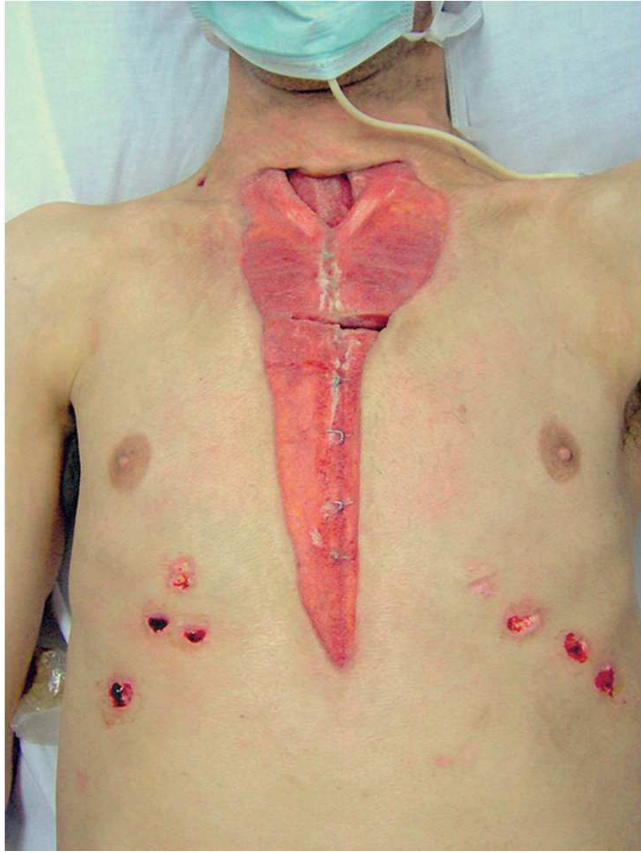
- Perforatie
- Uitbreidend (of afdalend proces (slokdarm of mondholte)
- Sclerotiserend proces



Overgenomen uit Ned. Tijdschrift
Tandheelkunde (juni 2007)

Voorbeeld klassieke mediastinitis





Post Sternotomie Mediastinitis

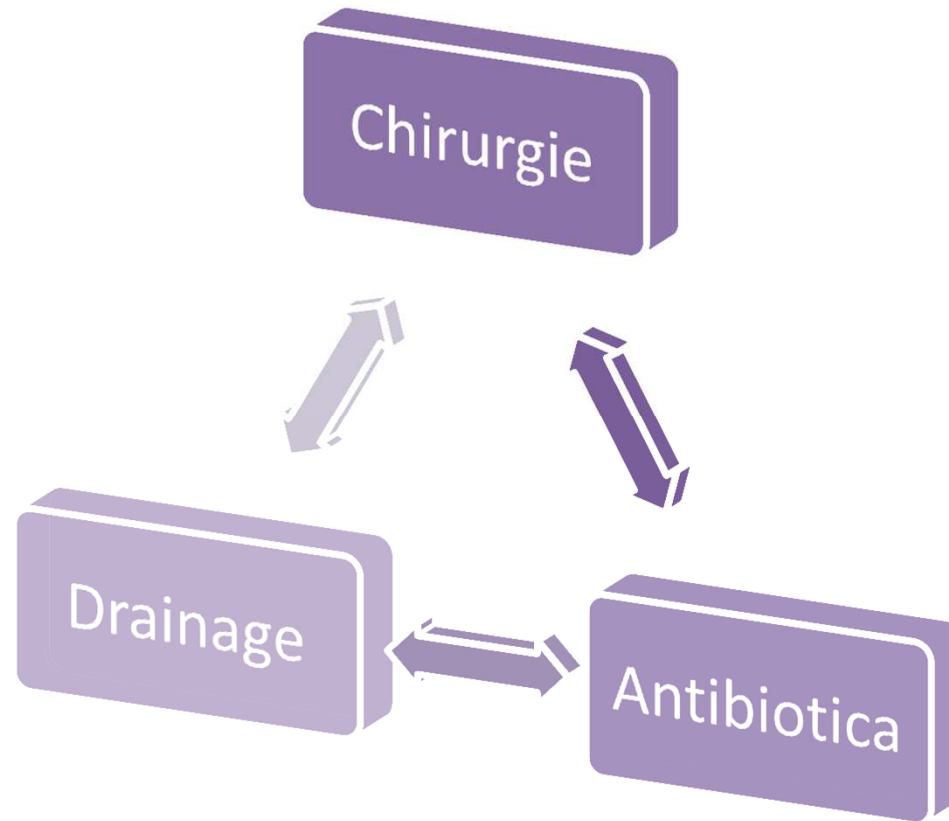
- Presentatie kan binnen enkele dagen tot maanden na chirurgie
- Veelal algehele malaise, koorts, pijnklachten (schouder en sternaal)
- Crepitaties van het sternum
- Roodheid, zwelling, vochtafscheiding
- In extreme gevallen sepsis met respiratoire insufficiëntie
- Mortaliteit wisselt per studie maar gemiddeld 10 tot maximaal 40%

Prevalentie

Situatie in Zweden (= vergelijkbaar Nederlandse situatie)

Procedure	Totaal aantal (%)	Alle infecties		Oppervlakkige infecties		Mediastinitis	
		N	%	N	%	N	%
CABG	2108 (70.1)	224	10.6	145	6.9	79	3.7
Klep	527 (17.5)	38	7.2	30	5.7	8	1.5
CABG + Klep							
Overige	238 (7.9)	20	8.4	13	5.5	7	2.9
Totaal	135 (4.5)	9	6.7	6	4.4	3	2.2
	3008 (100)	291	9.7	194	6.4	97	3.2

Behandelopties



Chirurgie

Debrideren

Avitaal weefsel weghalen

Voorkomen van holte-vorming

Inspectie mogelijkheden zijn maximaal

Pijnbestrijding is optimaal

Bij calamiteiten altijd direct hulp on-site.

Antibiotica

Bij onbekende verwekker breed inzetten

Vroeg beginnen (zeker bij kunstmateriaal)

Lang doorzetten (osteomyelitis, chondritis)

Kweken loont!!!!

Drainage

Drainage via:

- Open drainage (gazen)
- Redon drains
- Negatieve druk therapie

Drainage

Open drainage

Voordeel:

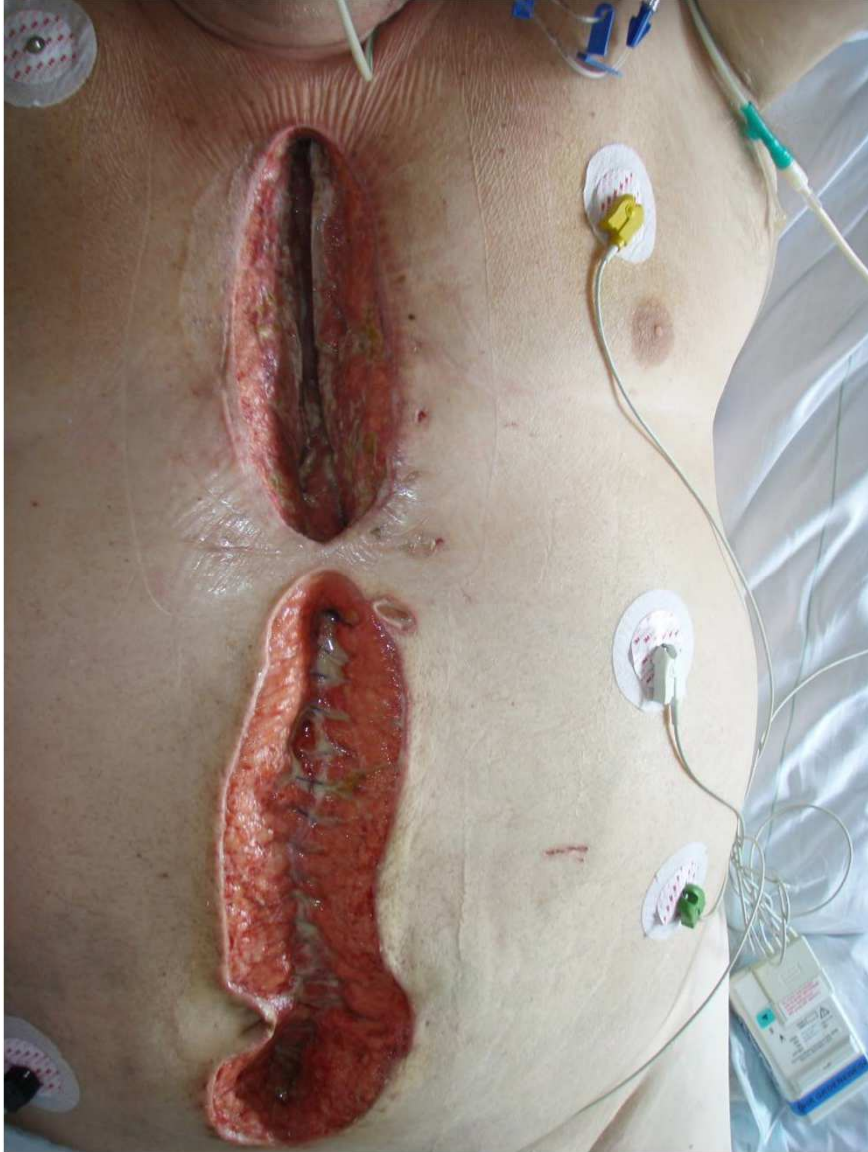
- Directe inspectie mogelijk
- Zeer ruime vochtafvoer

Nadelen

- Arbeidsintensief
- Beschadiging hart en structuren mogelijk
- Pijn bij patient bij wissels



Vervolg open drainage



Drainage

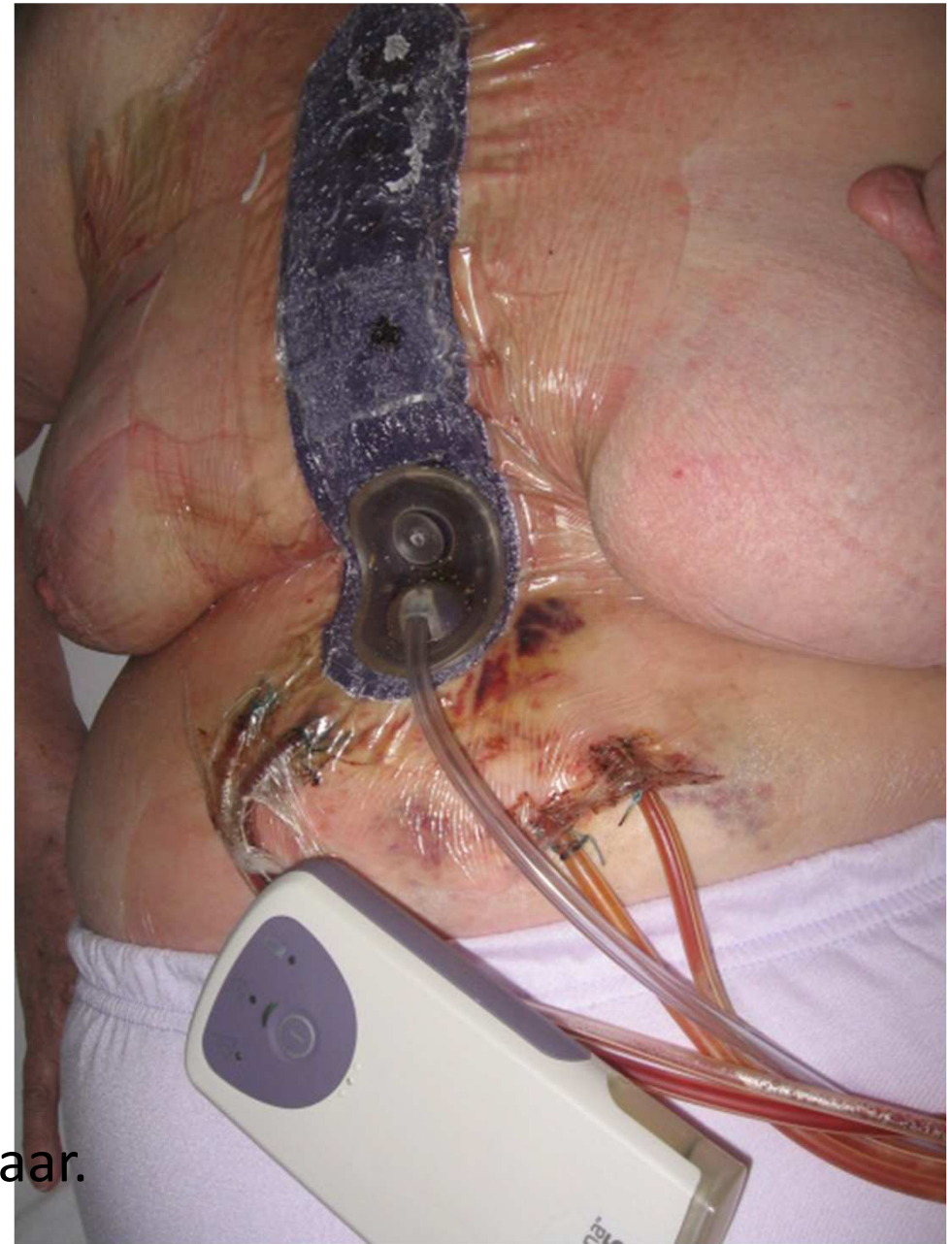
Redondrains:

Voordelen:

- Voorkomen caviteiten onder gesloten wond.
- Kunnen lang in situ blijven
- Patientvriendelijk

Nadelen:

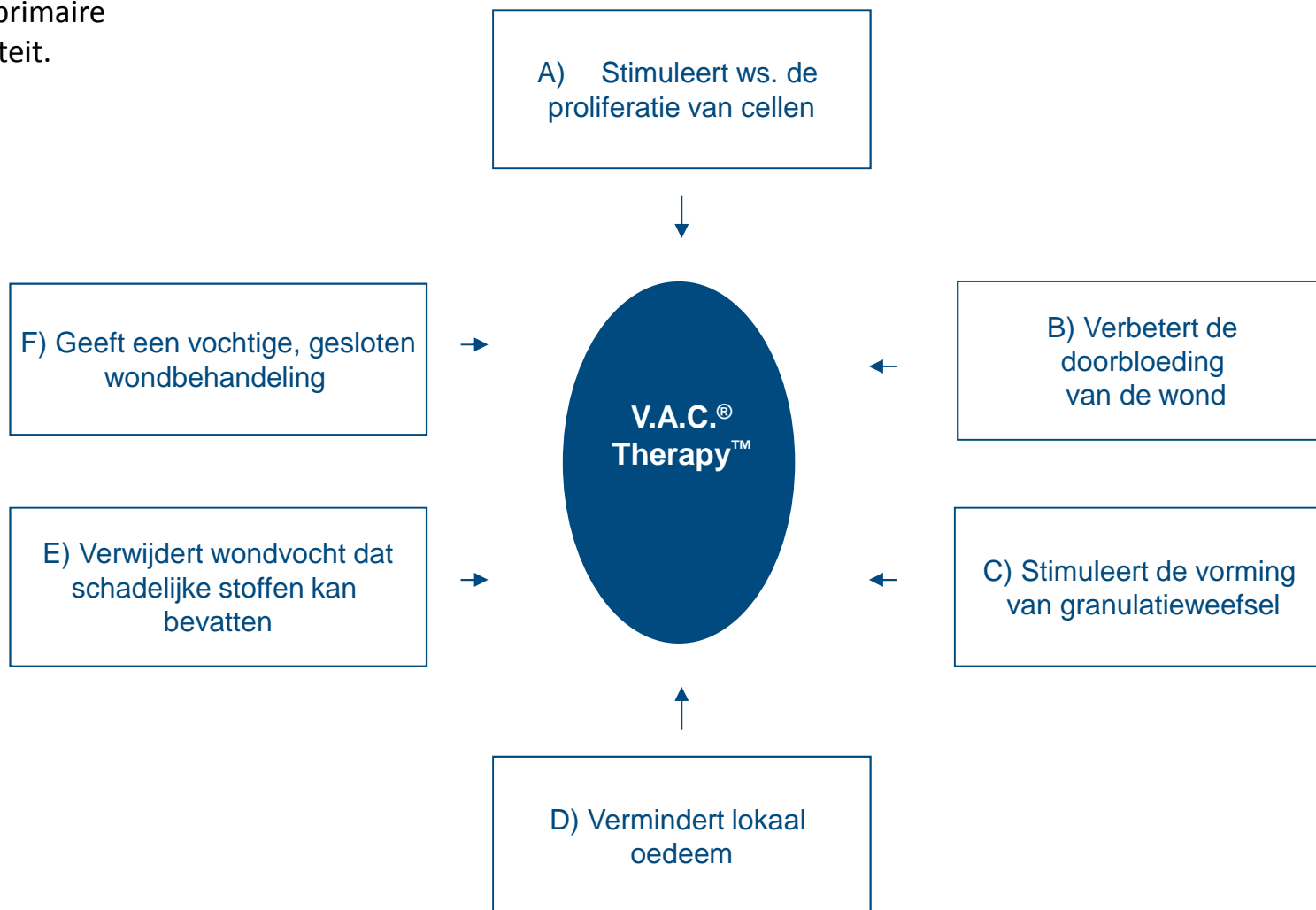
- Geen directe inspectie mogelijk
- Draineert beperkt gebied.
- Zelden intra-thoracaal goed inzetbaar.



Negatieve druk therapie

Tegenwoordige primaire behandelmodaliteit.

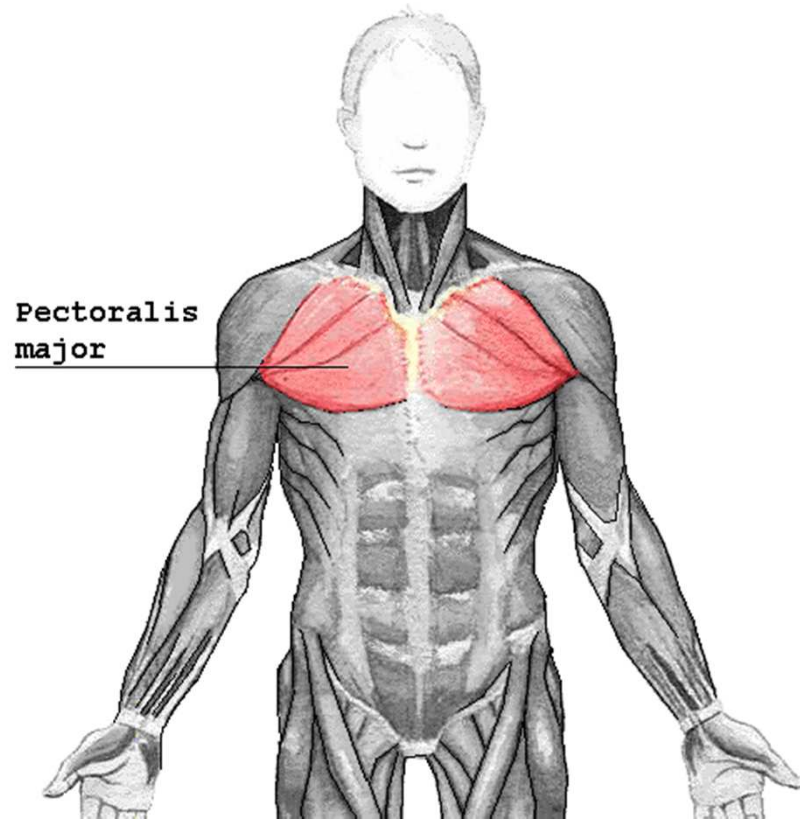
Principes:



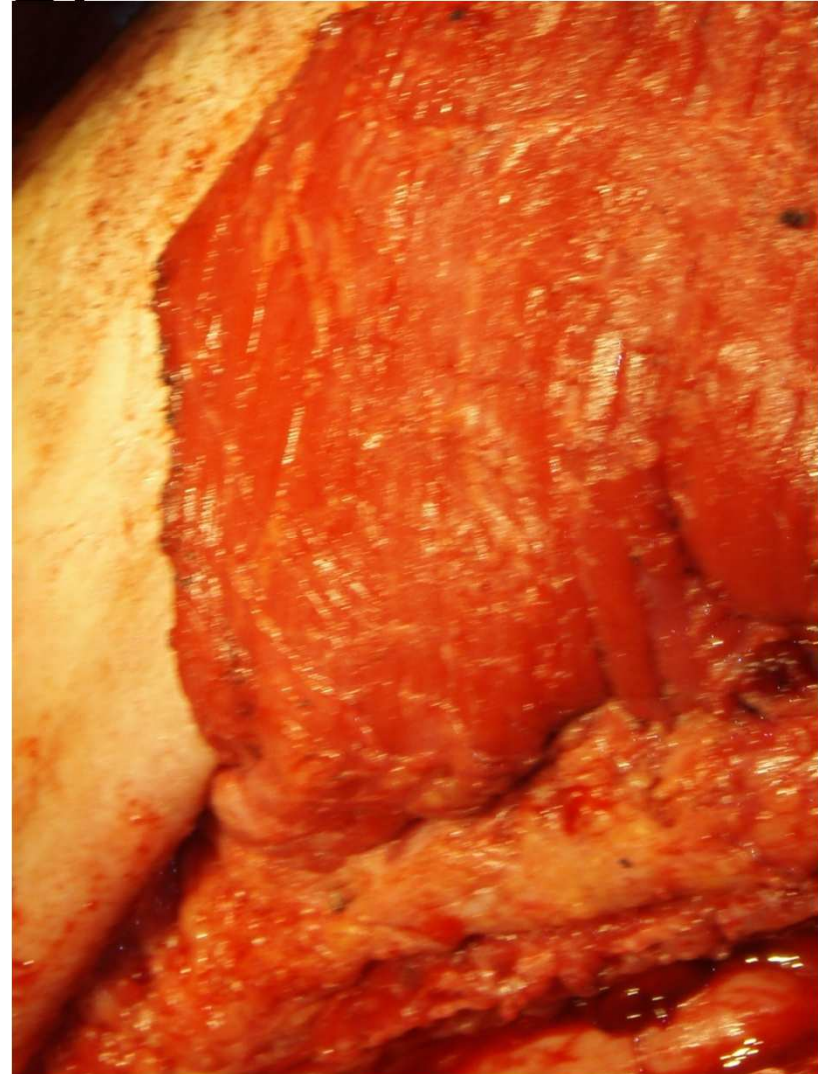
En als de wond gesloten kan
worden....

Verschillende opties om wonden te
sluiten en wat van belang is bij
diabeten.

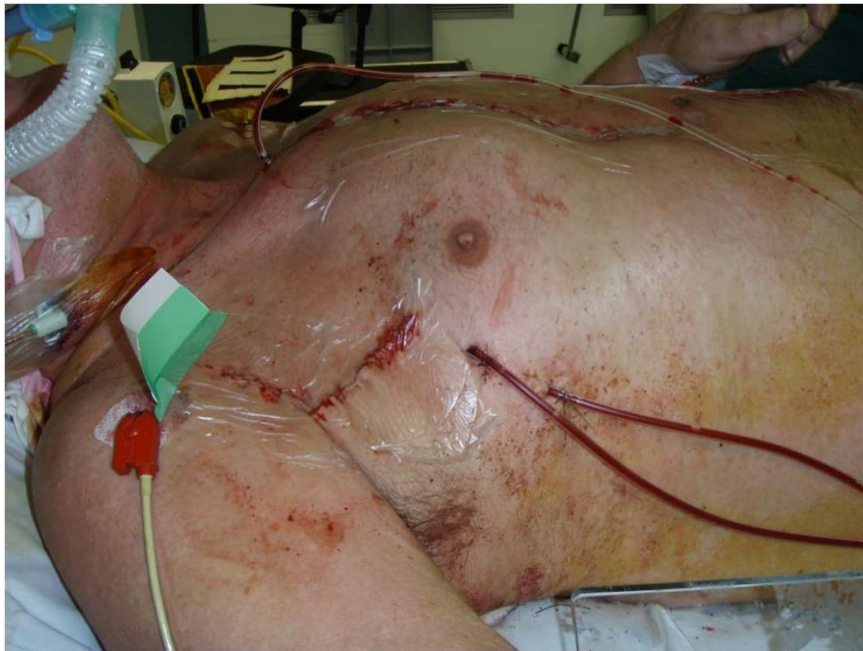
Sluitingsplastieken; pectoralis major



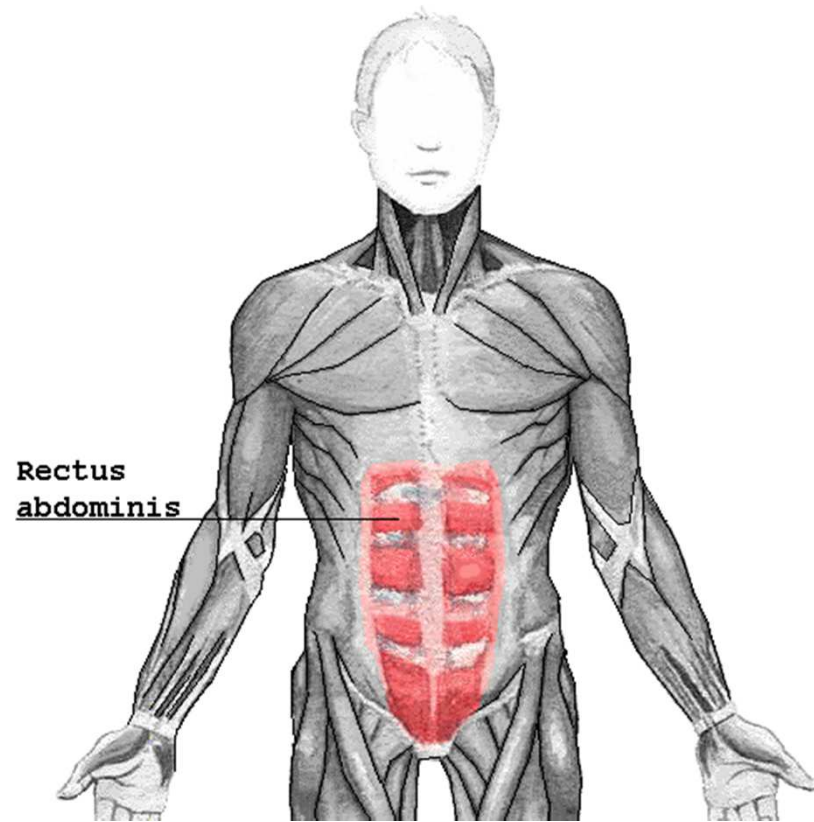
Sluitingsplastieken; pectoralis major



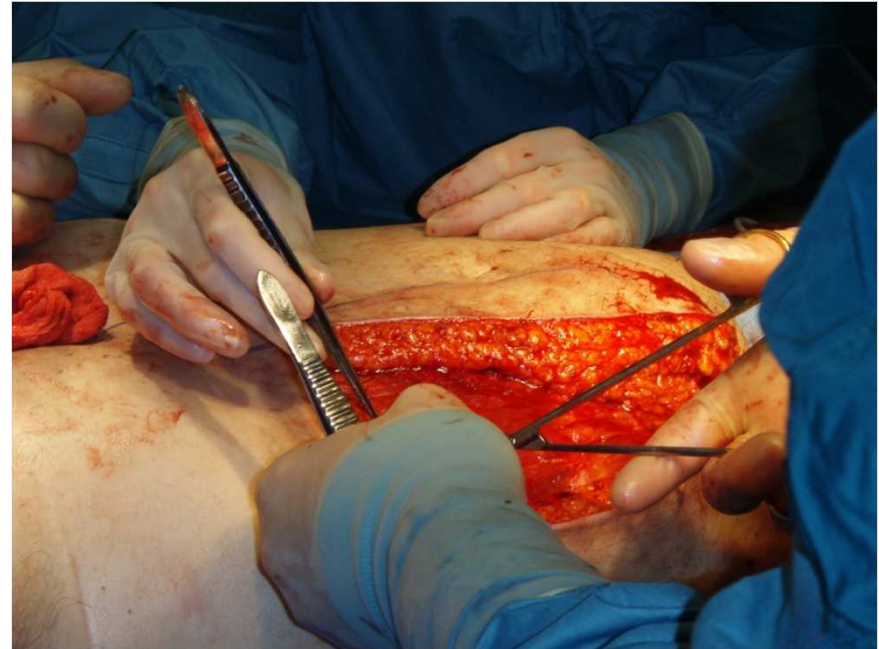
Sluitingsplastieken; pectoralis major



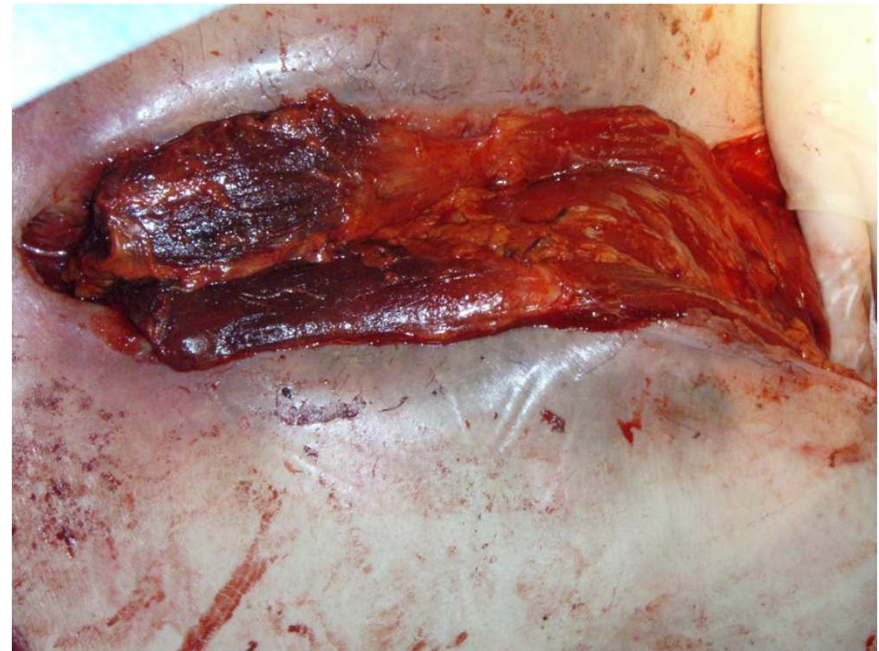
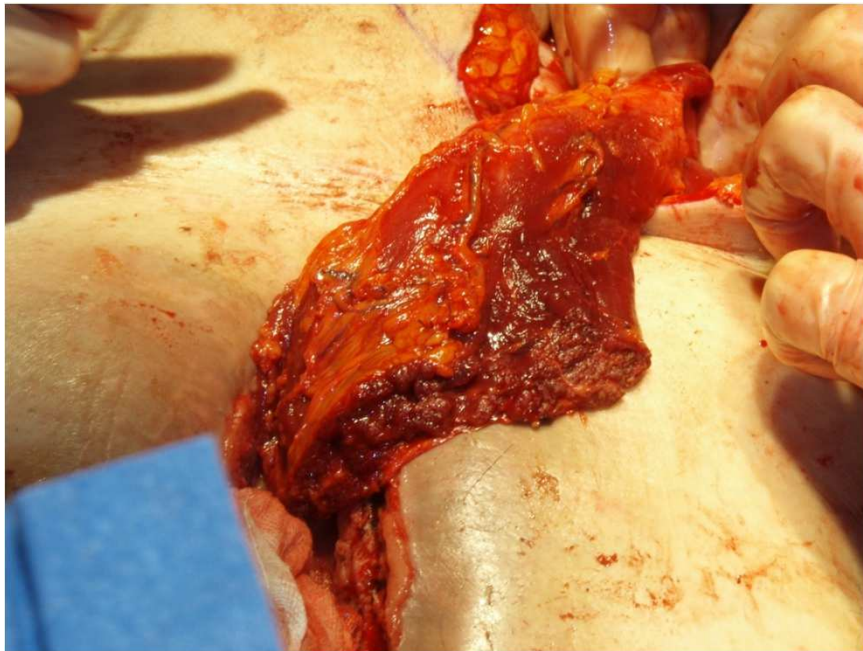
Sluitingsplastieken; rectus abdominis



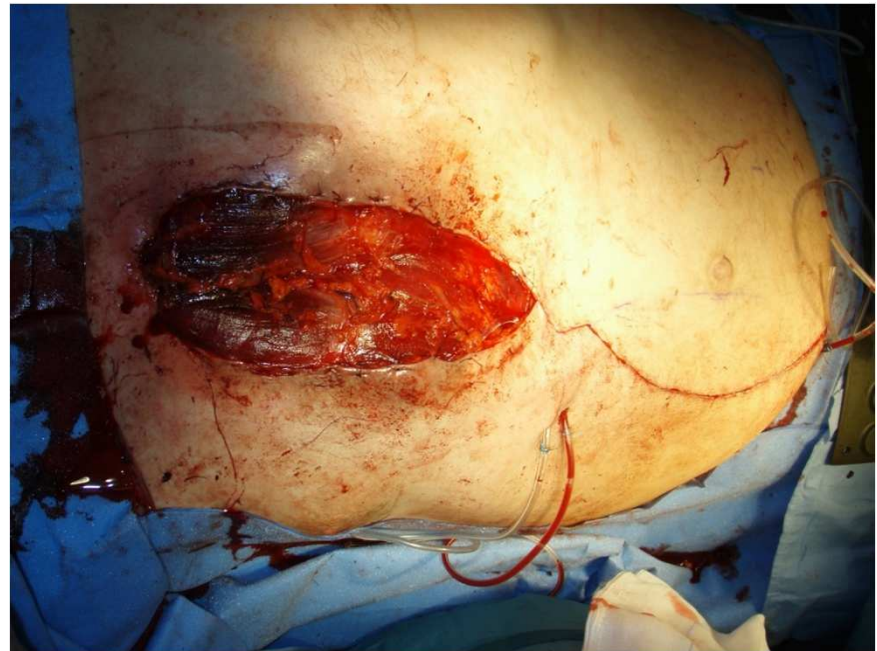
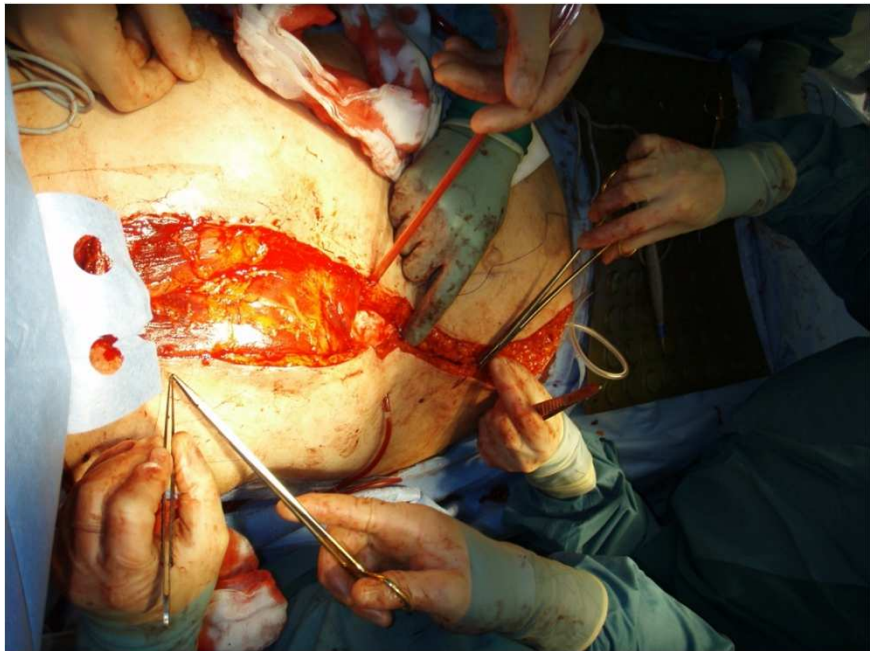
Sluitingsplastieken; rectus abdominis



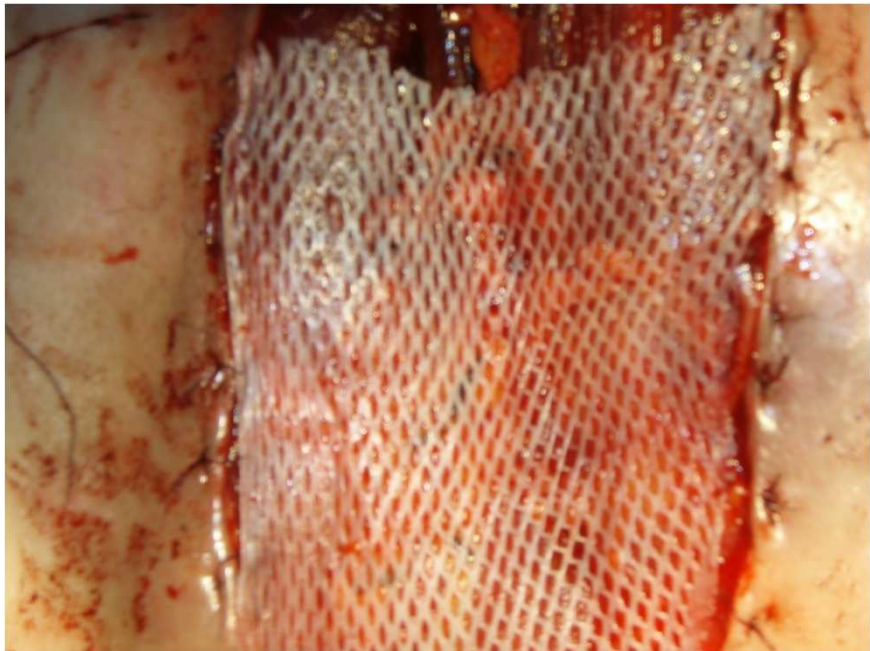
Sluitingsplastieken; rectus abdominis



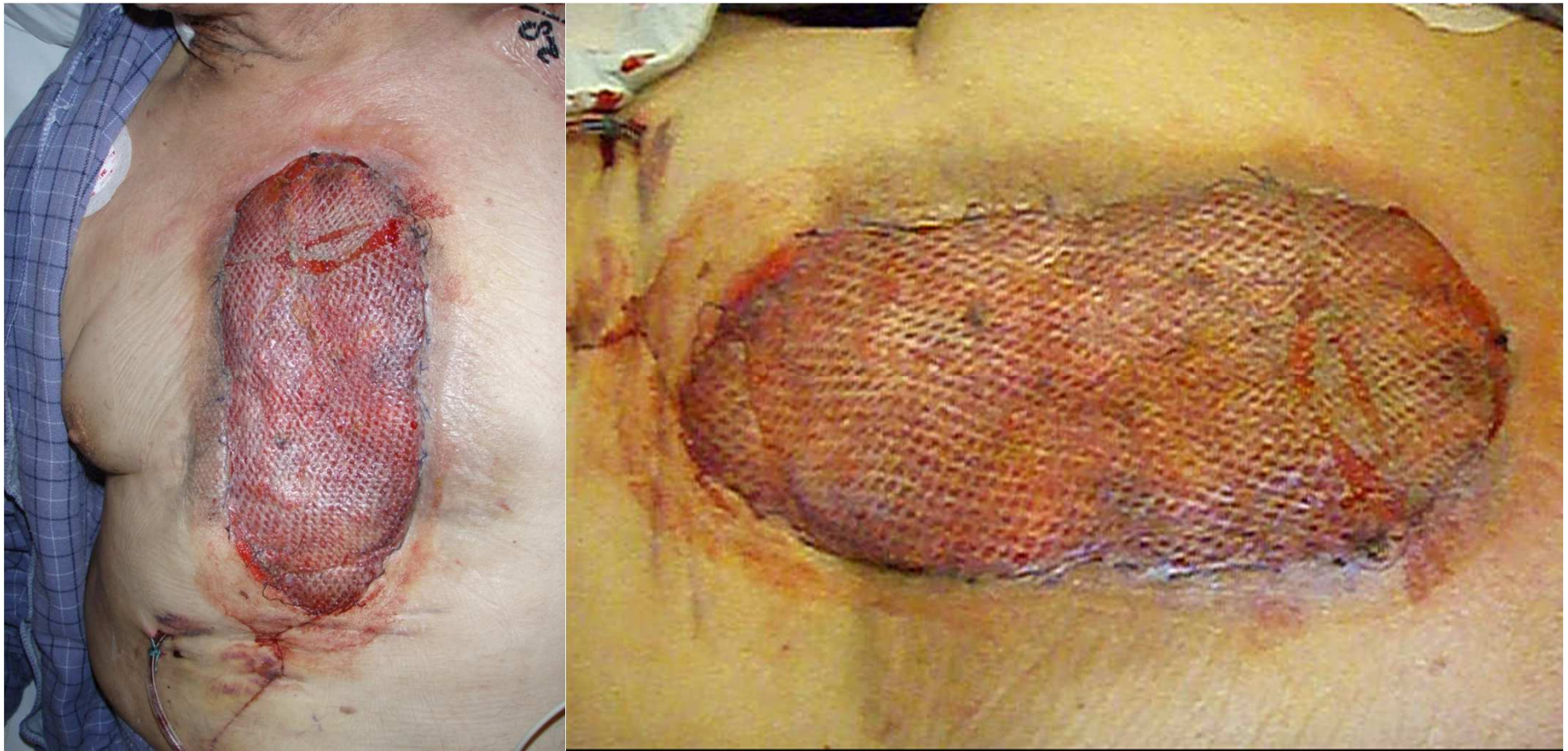
Sluitingsplastieken; rectus abdominis



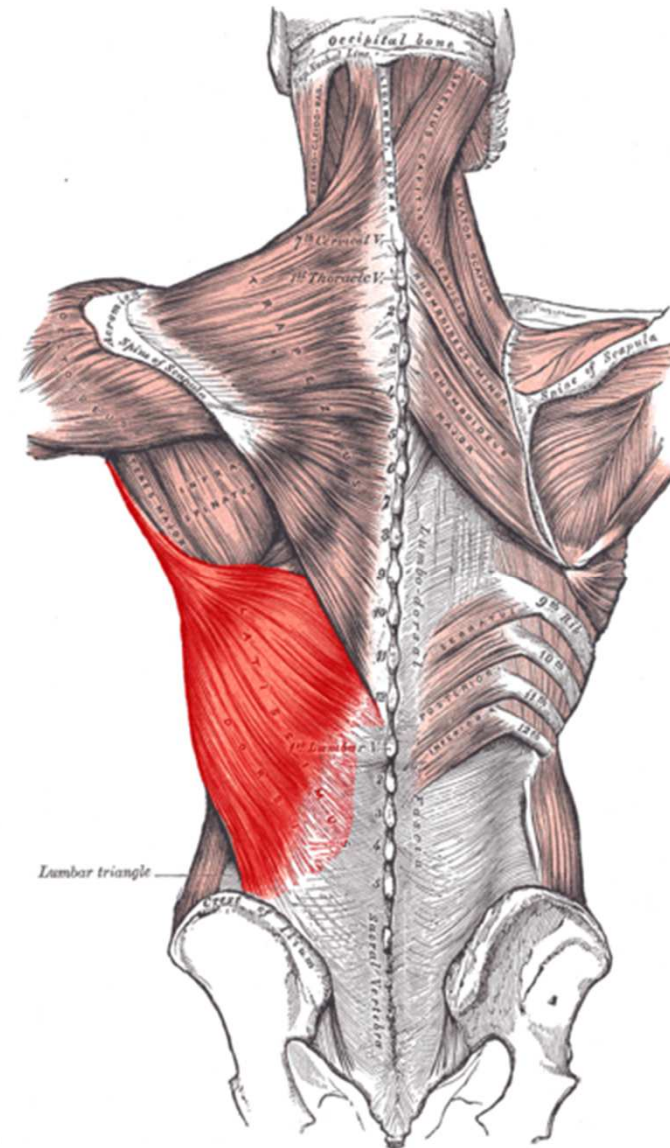
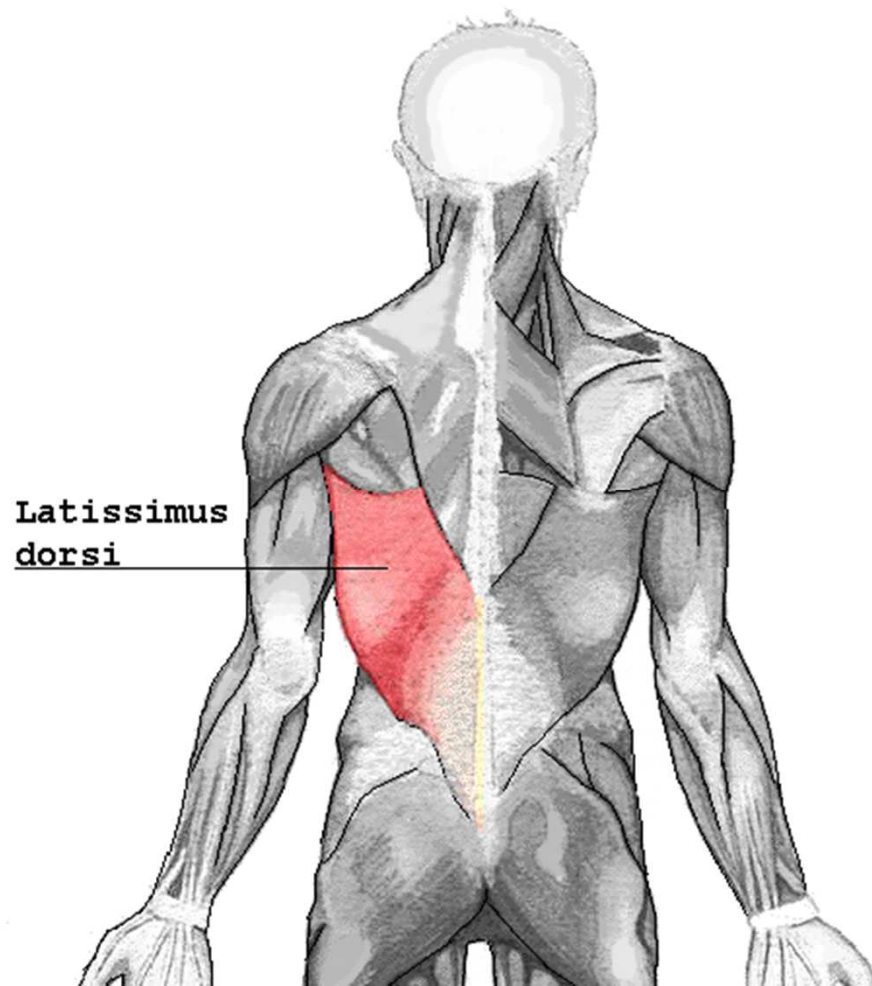
Sluitingsplastieken; rectus abdominis



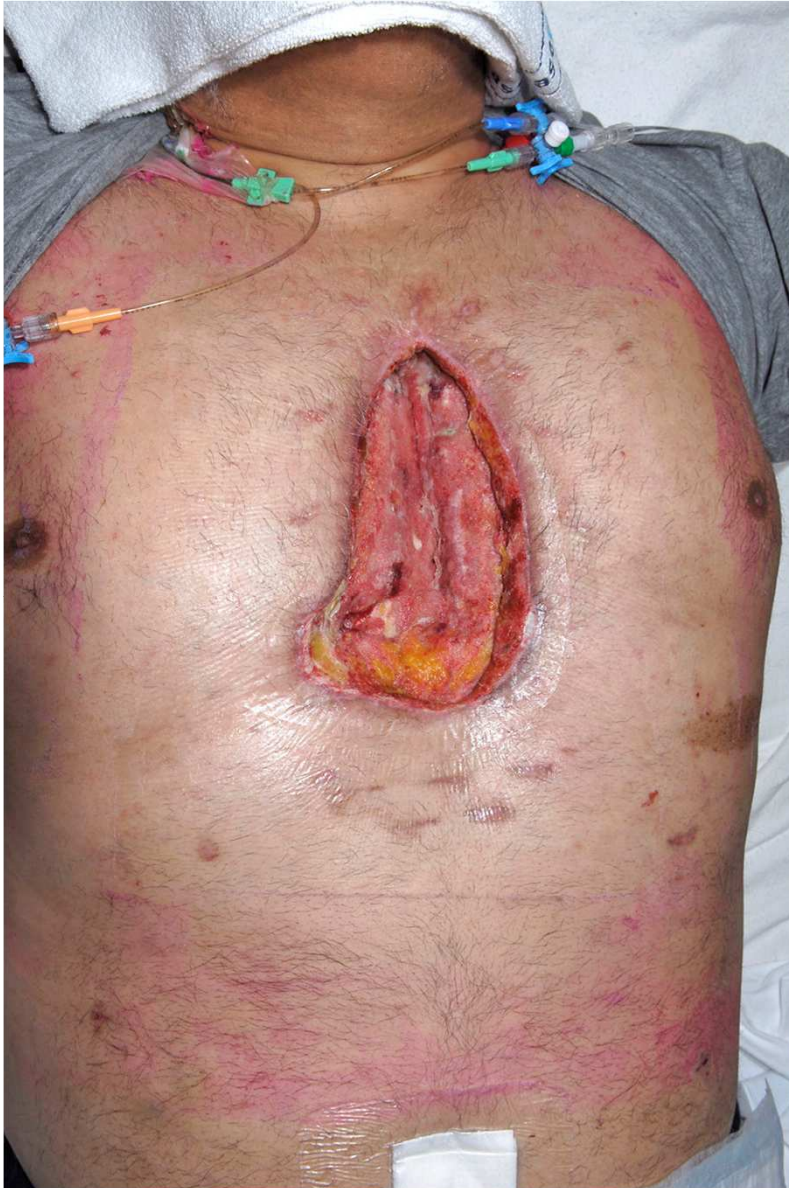
Sluitingsplastieken; rectus abdominis



Sluitingsplastieken; latissimus dorsi



Sluitingsplastieken; latissimus dorsi



Sluitingsplastieken; latissimus dorsi

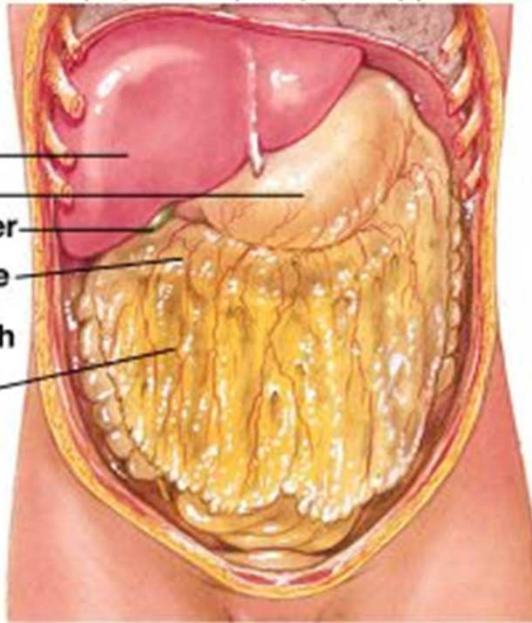


Sluitingsplastieken; Omentum

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Greater Omentum

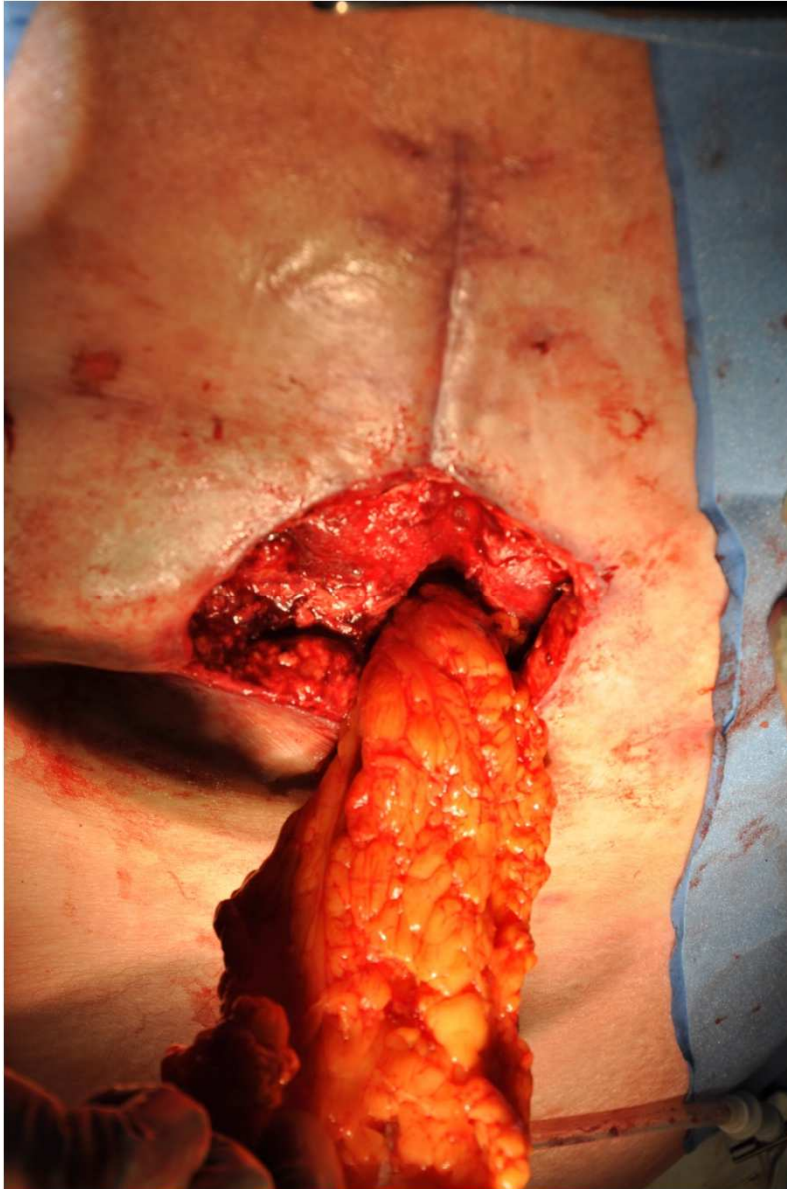
- Liver
- Stomach
- Gallbladder
- Transverse colon underneath
- Greater omentum



Sluitingsplastieken; Omentum



Sluitingsplastieken; Omentum



Sluitingsplastieken; Omentum



En wat te kiezen bij een diabeet?

- Steeds meer neiging omentum te kiezen
 - Minder revisies
 - Minder recidief infecties
 - Minder bloedingen
- Potentiele nadelen
 - Uitbreiding infectie naar buik-compartiment
 - Creëren van hernia's

CONCLUSIONS

We have found that poor wound healing and impaired infection clearance translates into poor outcomes after sternal reconstruction in our diabetic patients. By altering our treatment approach to include omental transposition as the initial surgical therapy, we were able to demonstrate a trend toward decreased need for flap revision. When used selectively, the omental flap can be an extremely safe and highly effective treatment for sternal wound breakdown.

Stump et al

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Omentum flap

The greater omentum (*Figure 4*) is perfused with blood by the gastro-epiploic vessels along the greater curvature of the stomach. It contains many immunologically active cells and shows anti-infective activity (4, 11, 26, 27). The greater omentum has a wide range; the mediastinum can be filled in satisfactorily. The flap can be pedicled

Management of sterno-mediastinitis

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Take home messages

- Wondstoornissen met name op micro-niveau
- Diabeten leven korter met meer problemen na chirurgie
- Stricte glucose-regulatie is nog steeds het doel
- Als er een infectie is, overweeg dan omentum.



Vragen?

