# Vasküler Greft ve İmplant ilişkili Enfeksiyonlar

## Tedavi Yaklaşımları

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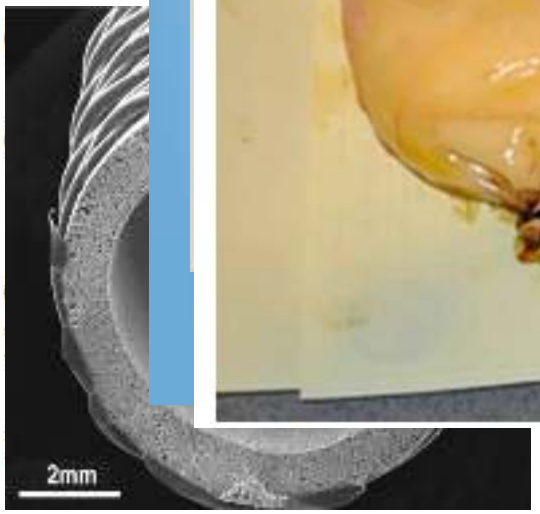
6. Türkiye EKMUD Kongresi
12 Mayıs Antalya

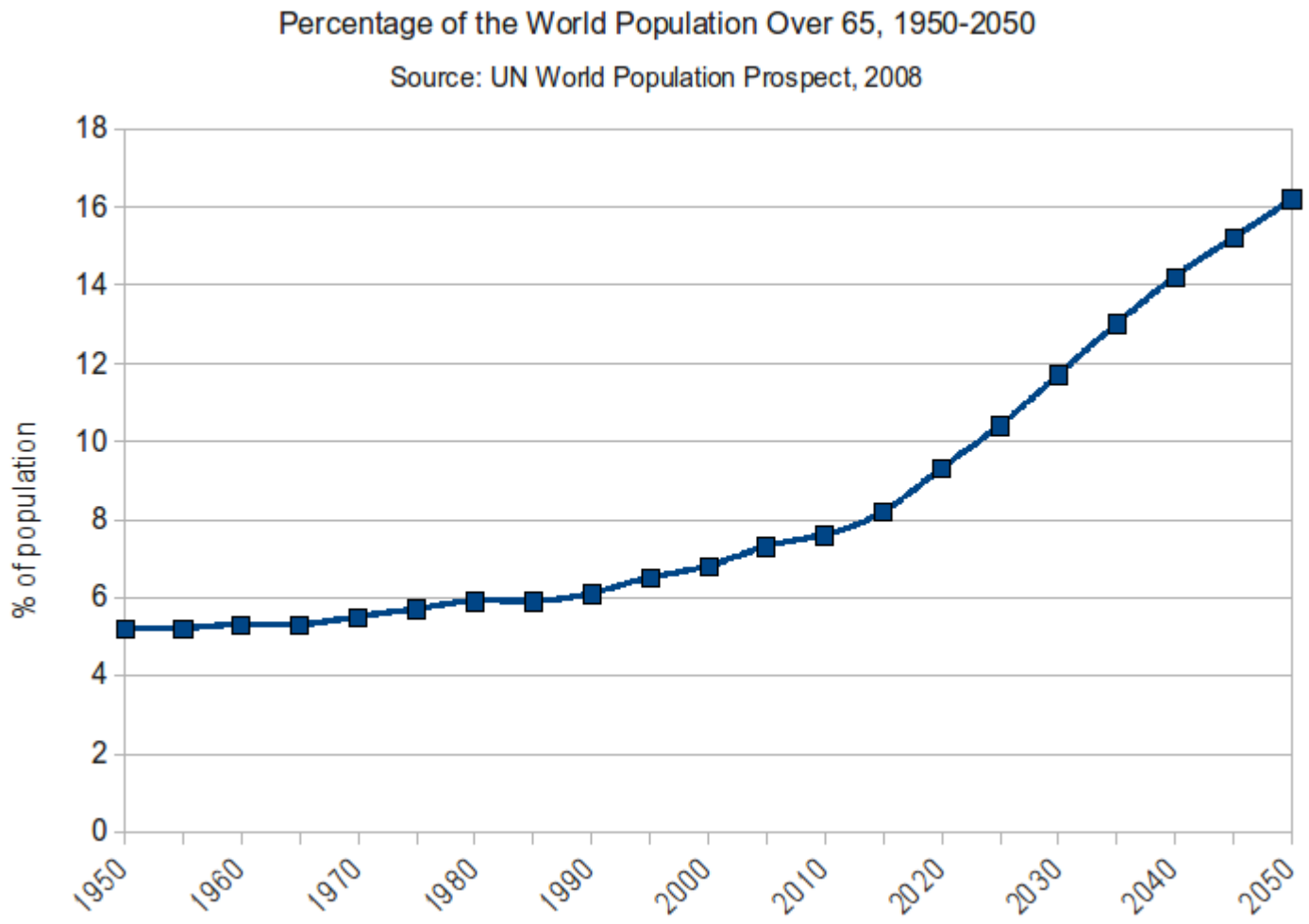
A programmable VP shunt

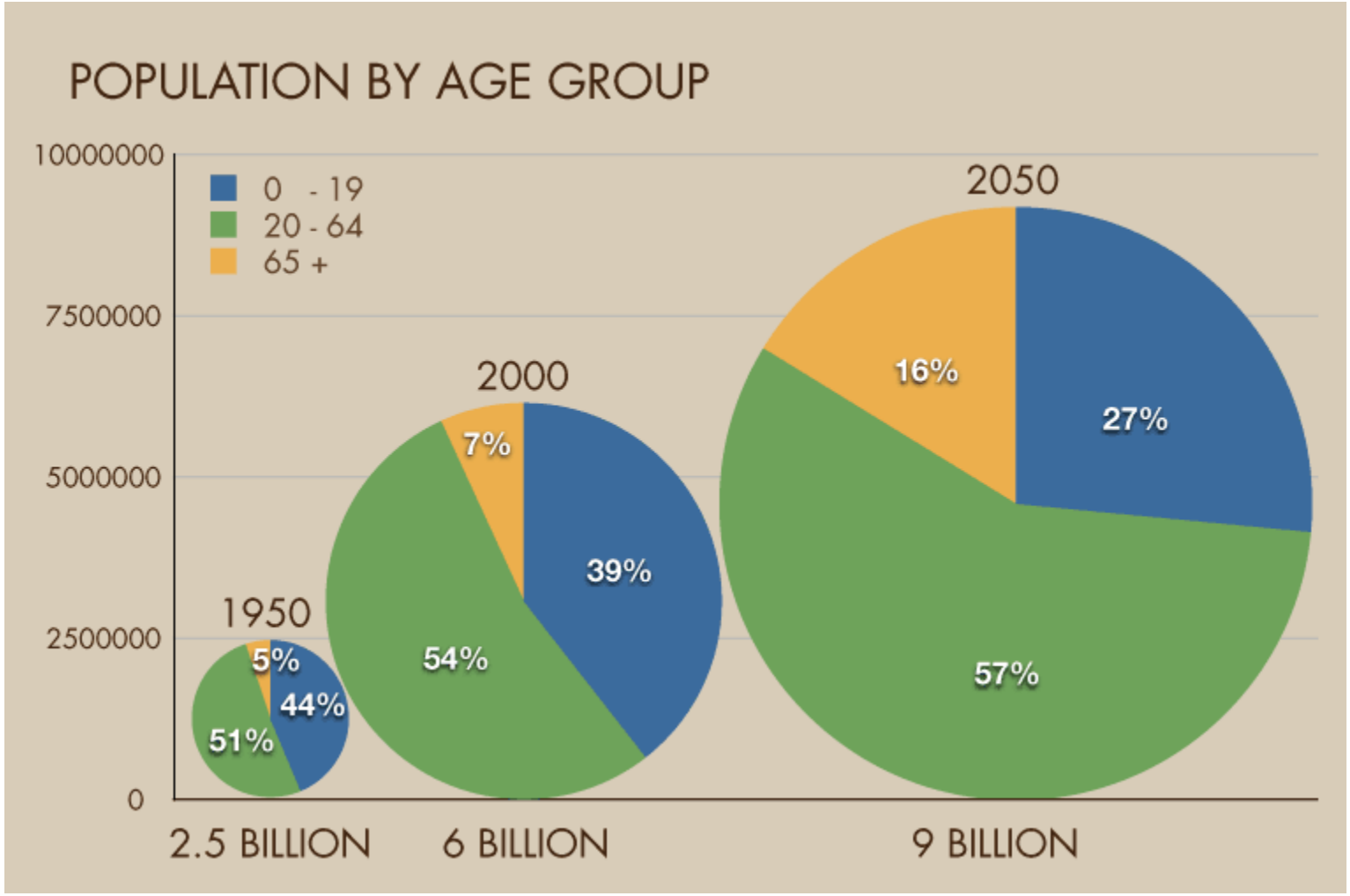
ostimulator

# Spain arrests woman with cocaine breast implants

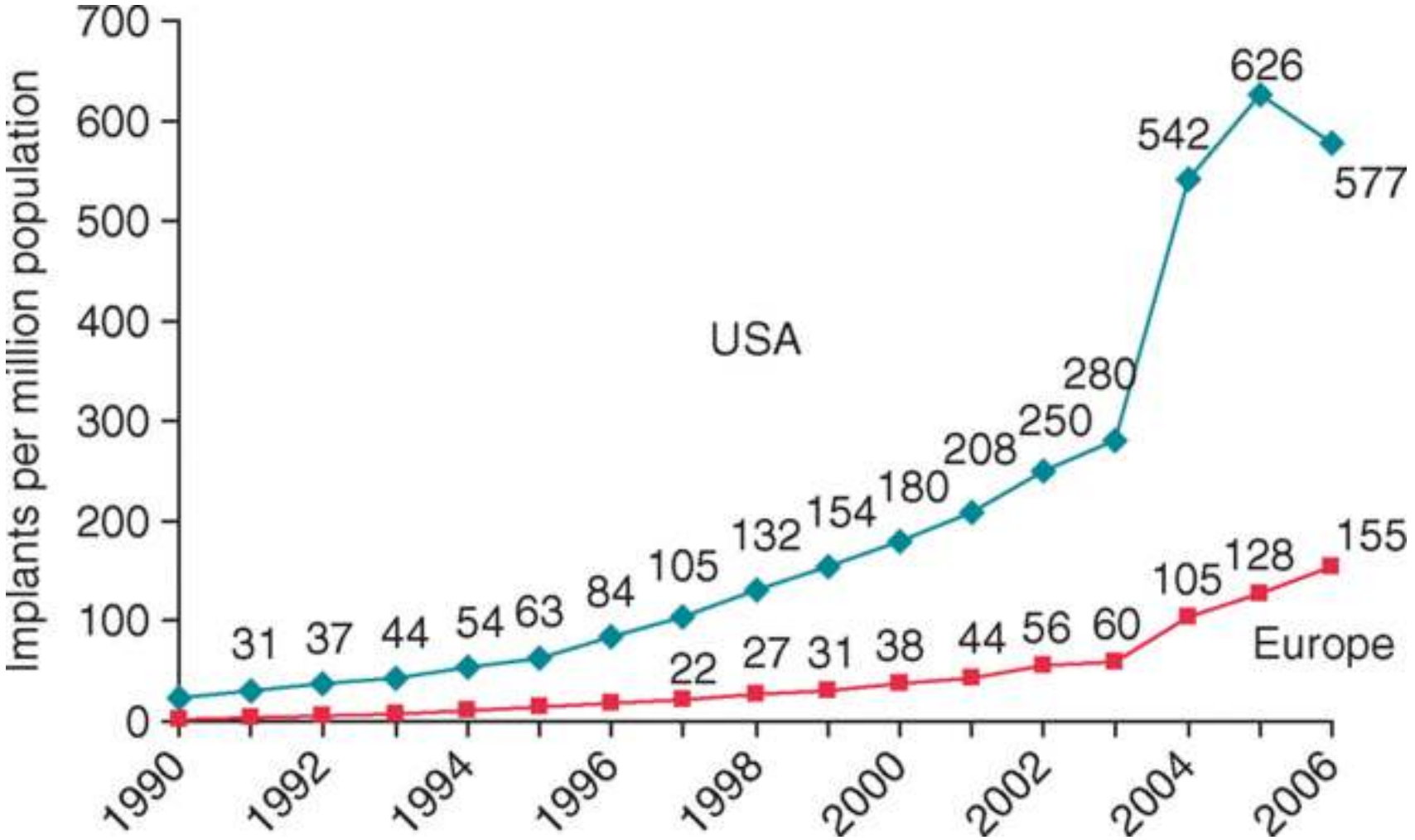
Panamanian woman detained after arriving at Barcelona airport with 1.4kg of cocaine concealed in breast implants

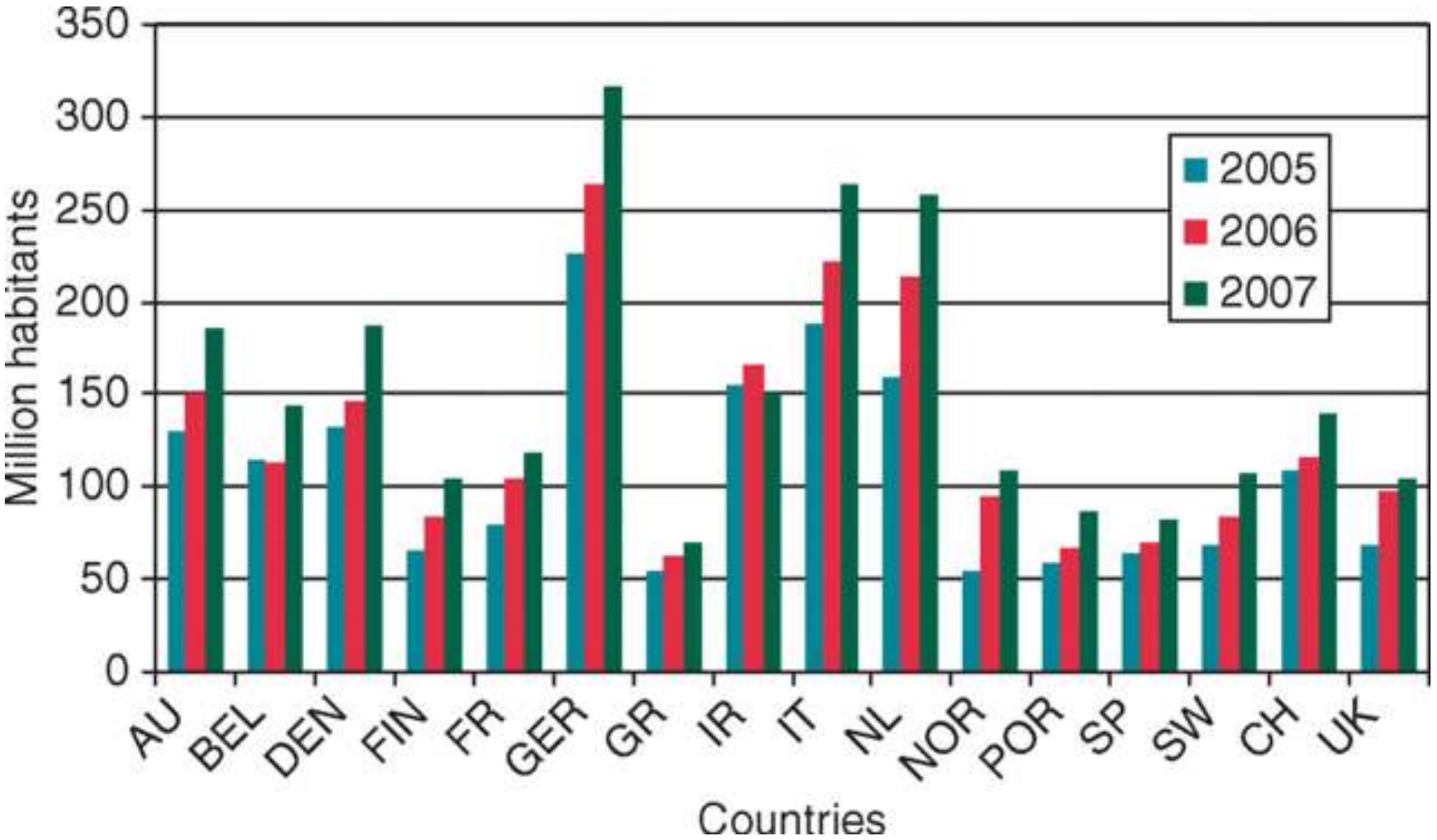


Percentage of the World Population Over 65, 1950-2050
Source: UN World Population Prospect, 2008
% of population
0
2
4
6
8
10
12
14
16
18
1950
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050

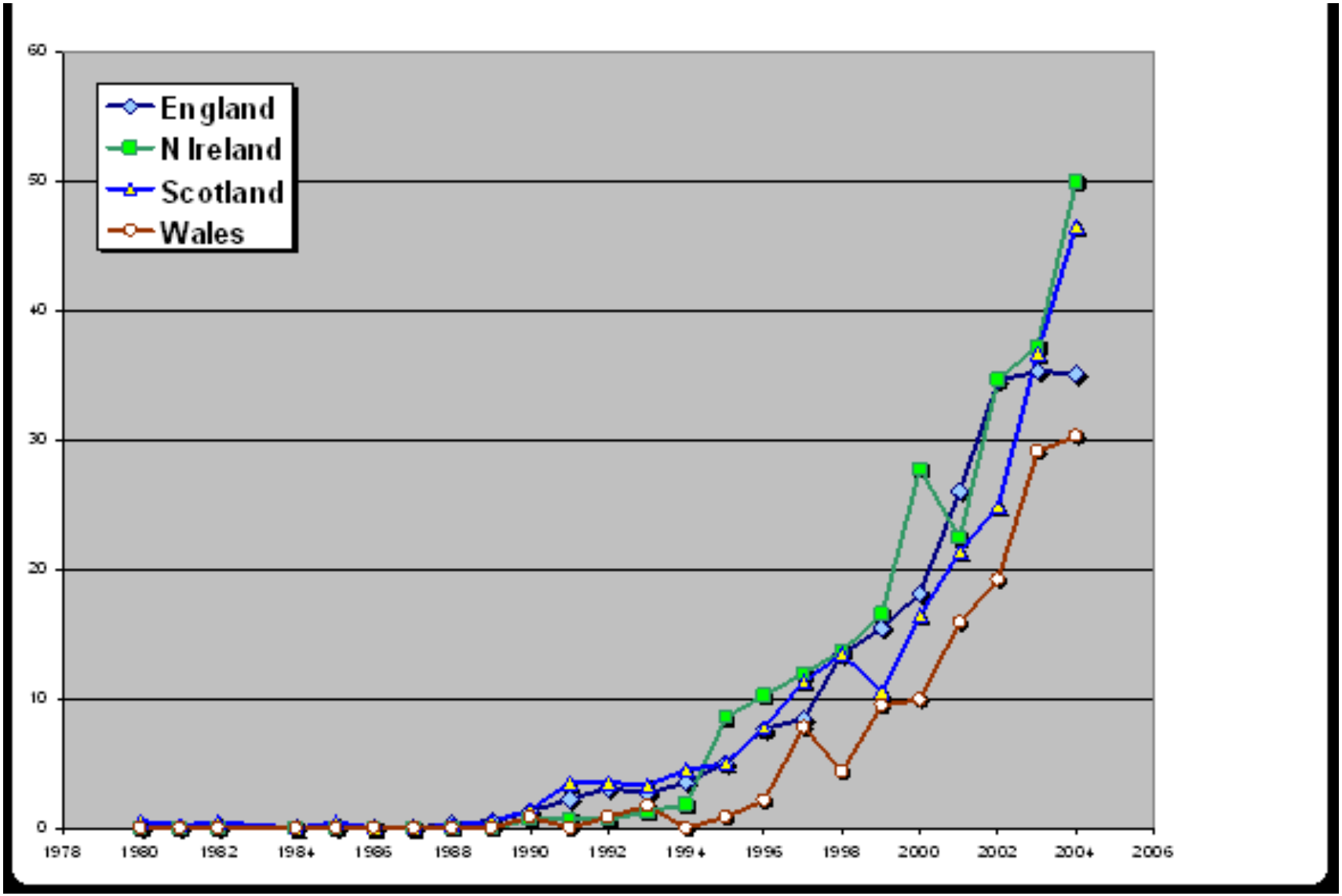

POPULATION BY AGE GROUP
10000000
7500000
5000000
2500000
0
0 - 19
20 - 64
65 +
1950
5%
44%
51%
2000
7%
39%
54%
2050
16%
27%
57%
2.5 BILLION
6 BILLION
9 BILLION

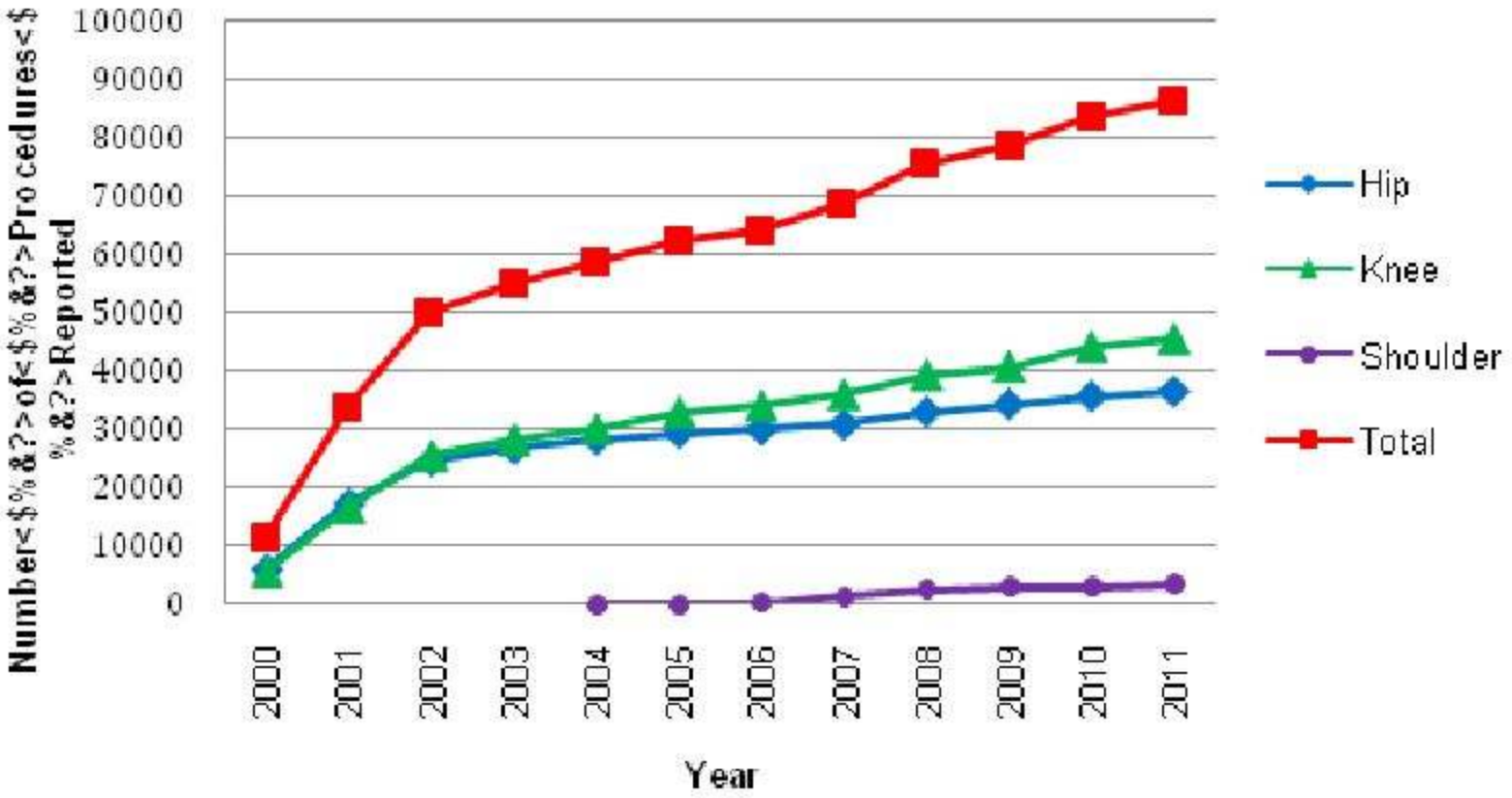
Implantable cardioverter defibrillator/CRT-D implantations per million of the population in Europe and the USA from 1990 to 2006.



Implantable cardioverter defibrillator and CRT-D European implant rates per million inhabitants between 2005 and 2007 inclusive



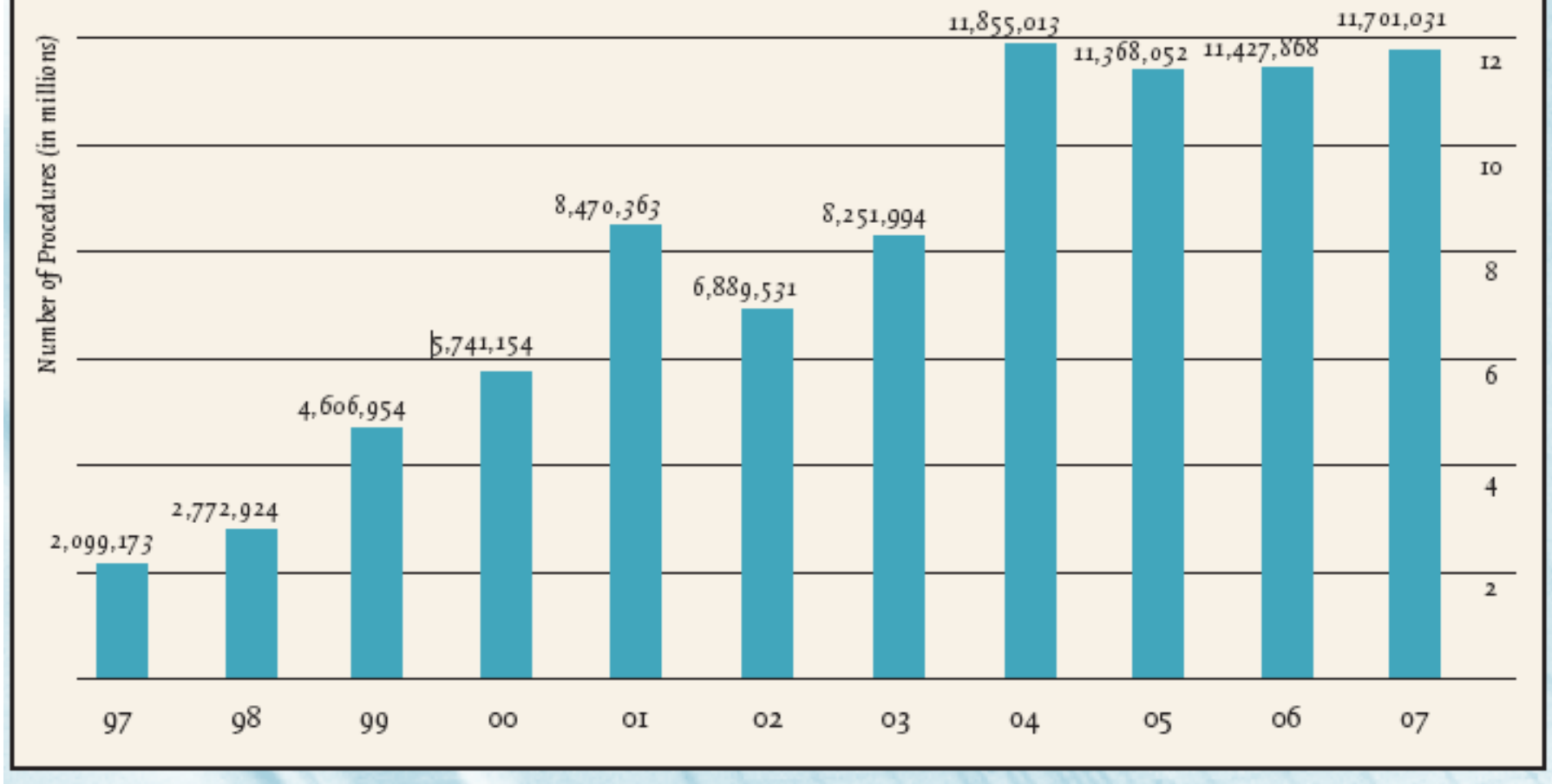

England
N Ireland
Scotland
Wales
60
50
40
30
20
10
0
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006



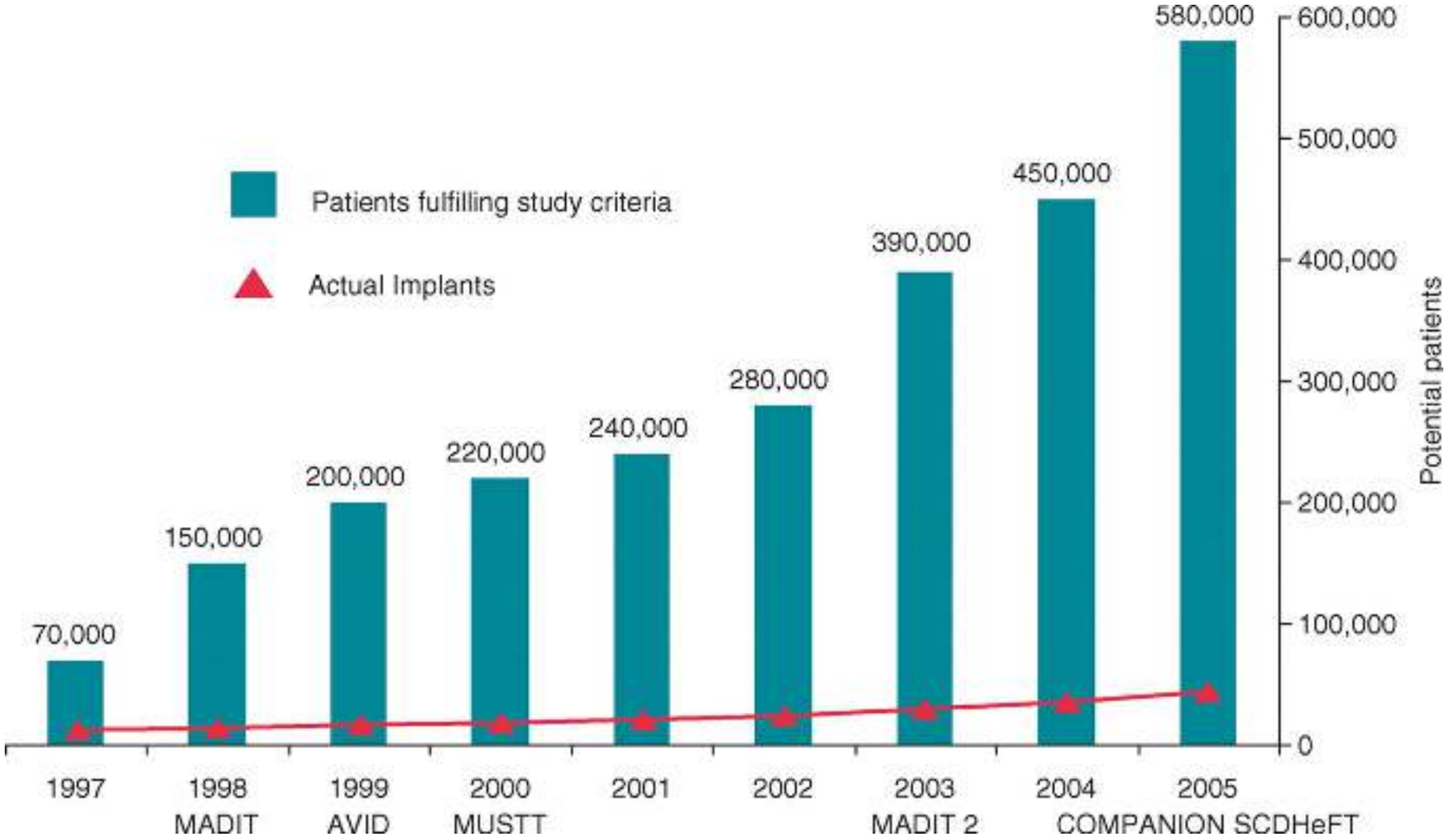

Prosthetic Joint Replacement Surgery in Australia (adapted from AOA National Joint Replacement Registry[1])

## Cosmetic Surgery

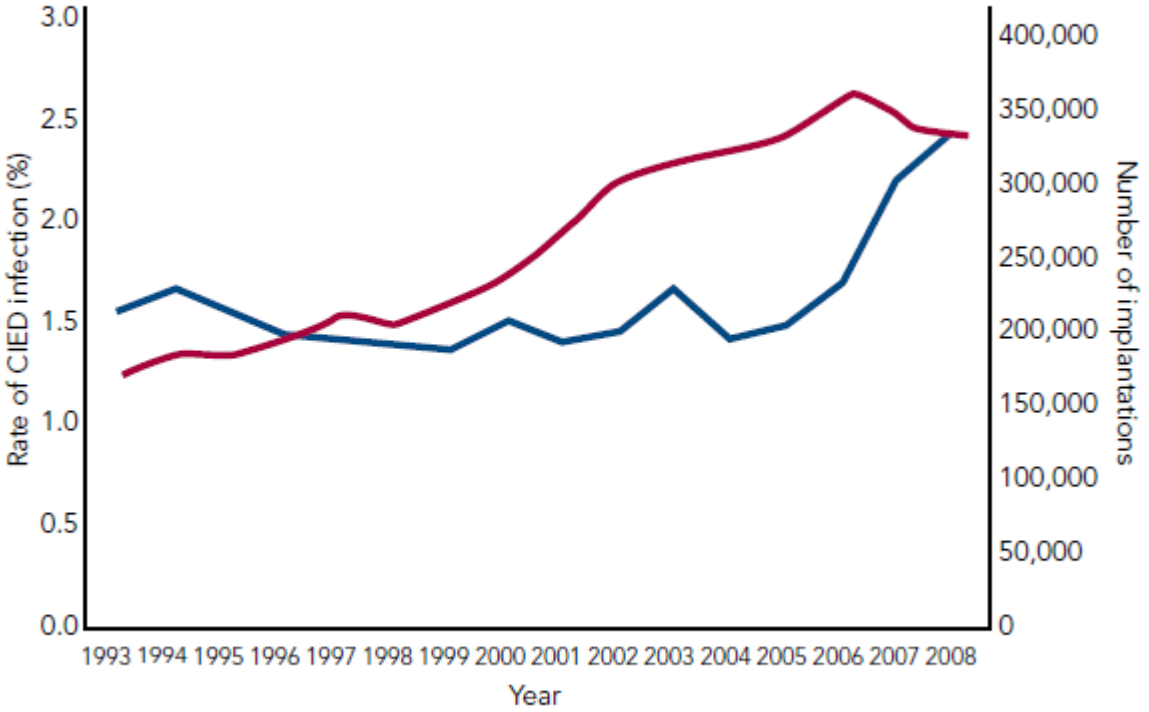
*(Surgical and Nonsurgical Cosmetic Procedures: Totals)*




Source: American Society for Aesthetic Plastic Surgery


Patients fulfilling study criteria
Actual Implants
70,000
150,000
200,000
220,000
240,000
280,000
390,000
450,000
580,000
600,000
500,000
400,000
300,000
200,000
100,000
0
Potential patients
1997
1998
MADIT
1999
AVID
2000
MUSTT
2001
2002
2003
MADIT 2
2004
2005
COMPANION SCDHeFT

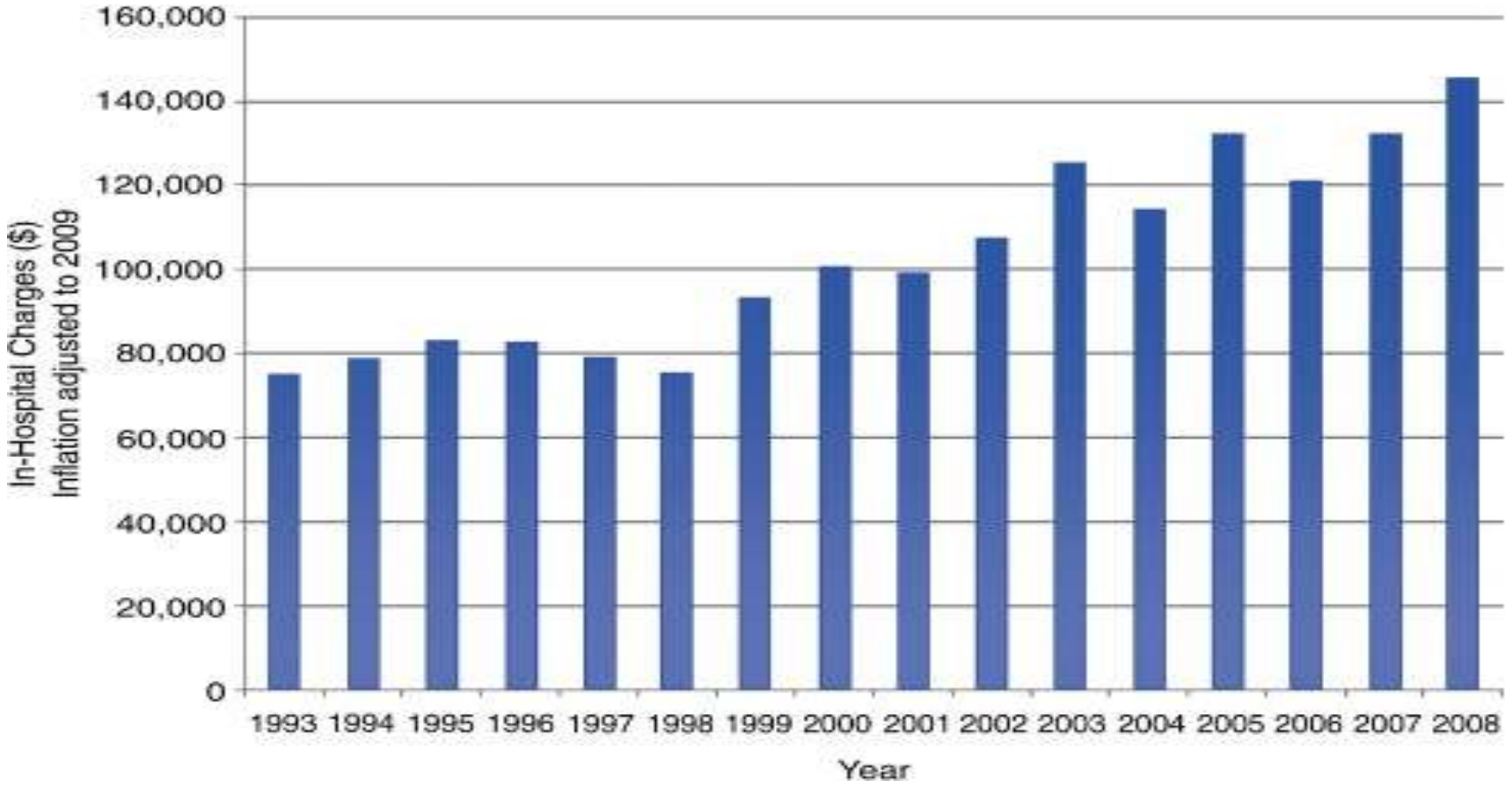
## Figure 1: Increasing Burden of CIED Infections with Time




*Blue line = rate of CIED infection (%); Red line = number of implantations. Adapted from Greenspon et al, 2011.*[4]

Charles Kennergren. Management Of Cardiovascular Implantable Electronic Devices Infections In High-Risk Patients. Arrhythmia & Electrophysiology Review, 2015;4(1):53-7

# In-Hospital Charges Associated With CIED Infection (Inflation Adjusted to 2009)




Arnold J. Greenspon, Jasmine D. Patel, Edmund Lau, Jorge A. Ochoa, Daniel R. Frisch, Reginald T. Ho, Behzad B. Pavri, Steven M. Kurtz. 16-Year Trends in the Infection Burden for Pacemakers and Implantable Cardioverter-Defibrillators in the United States. 1993 to 2008 *J Am Coll Cardiol*. 2011;58(10):1001-1006

# Surveyans

- Gerçek insidans ???
- Gerçek metot ???
- Standart tanımlar ????

# Medical Implants - Market

(product Types, Application, Technology, End Users and Geography)

Global Share, Size, Industry Analysis, Trends, Opportunities,

Growth and Forecast,

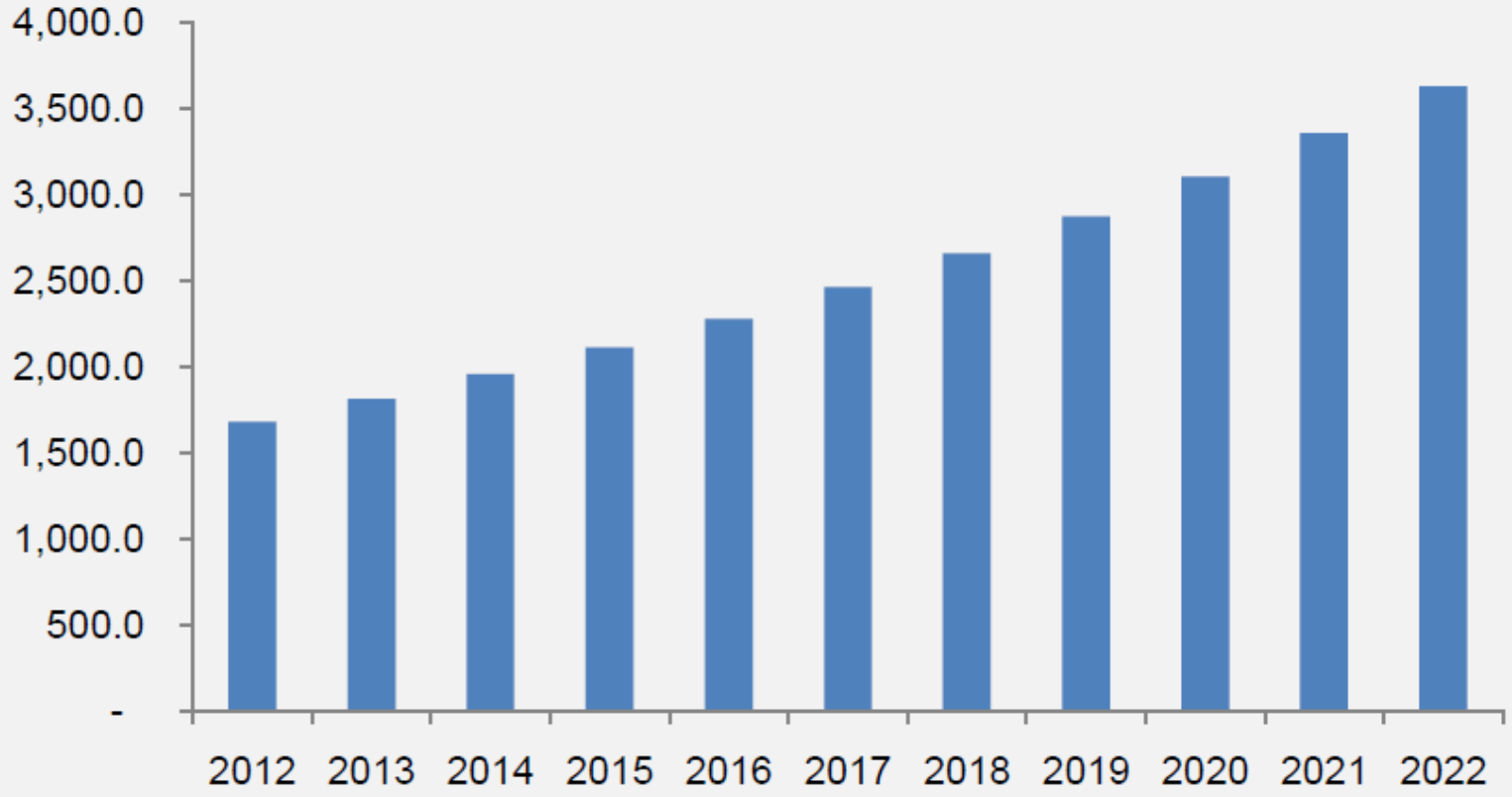
*2014 - 2020*

- The global revenue generated by medical device manufacturing companies is over $200 billion, and more than $85 billion is accounted to the U.S. Based medical device companies.
- The medical implants market is driven by an increase in health needs of old age people, and advancement in medical technologies.
- Increase in demand for reconstruction of joints, replacement of ophthalmic and dental market is expecting more growth in medical implant market.
- However, high cost of treatment and unavailability of expertise are decreasing the demand for medical implant market.

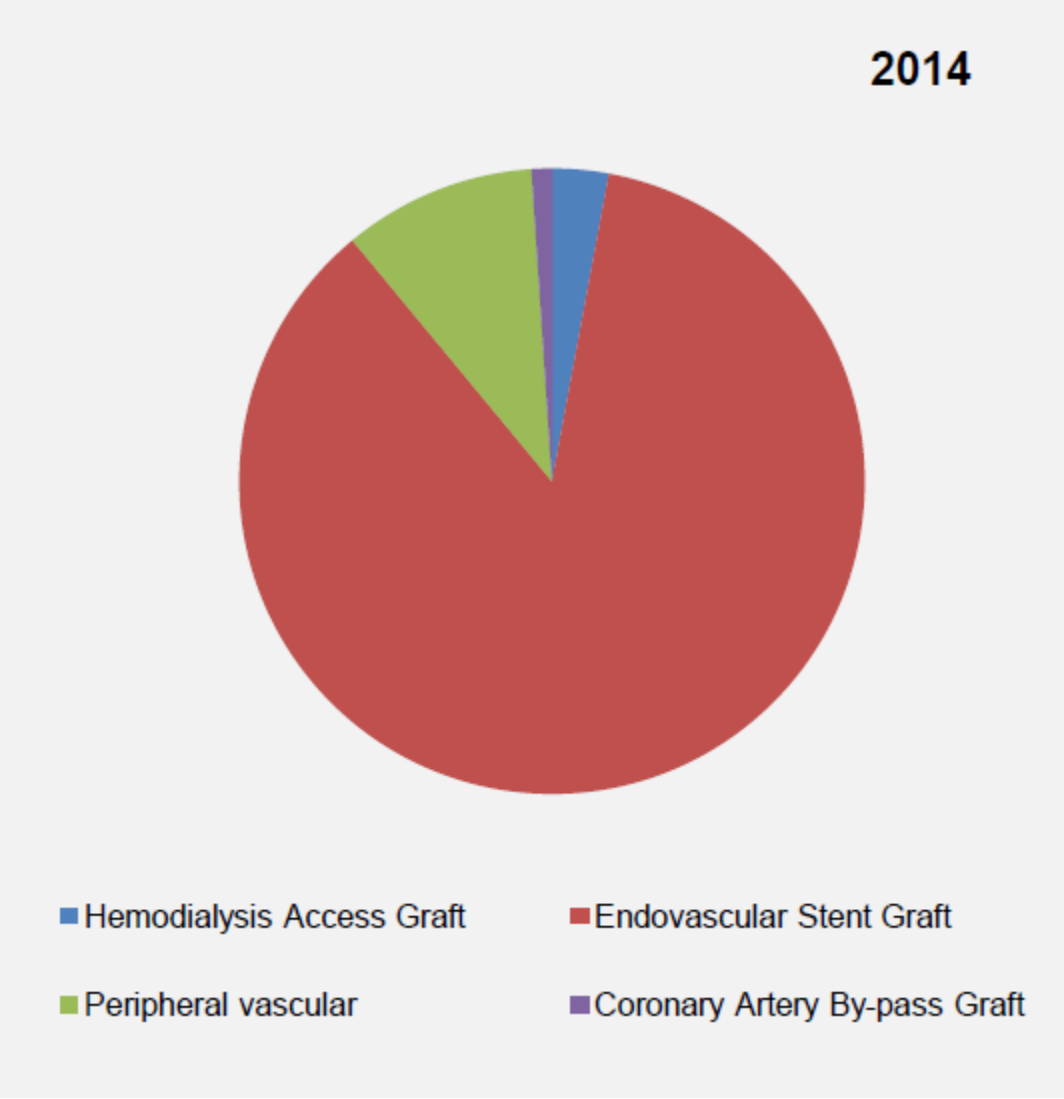
# Vascular Graft Market Analysis by Product (Hemodialysis Access Graft, Endovascular Stent Graft, Peripheral vascular, Coronary Artery By-pass Graft), by Application (Cardiovascular Diseases, Cardiac Aneurysm, Kidney Failure, Vascular Occlusion), by Raw Material (Polyester, Polytetrafluoroethylene, Polyurethane, Biological Materials) and Segment Forecasts To 2022

Grand View Research
Market Research & Consulting

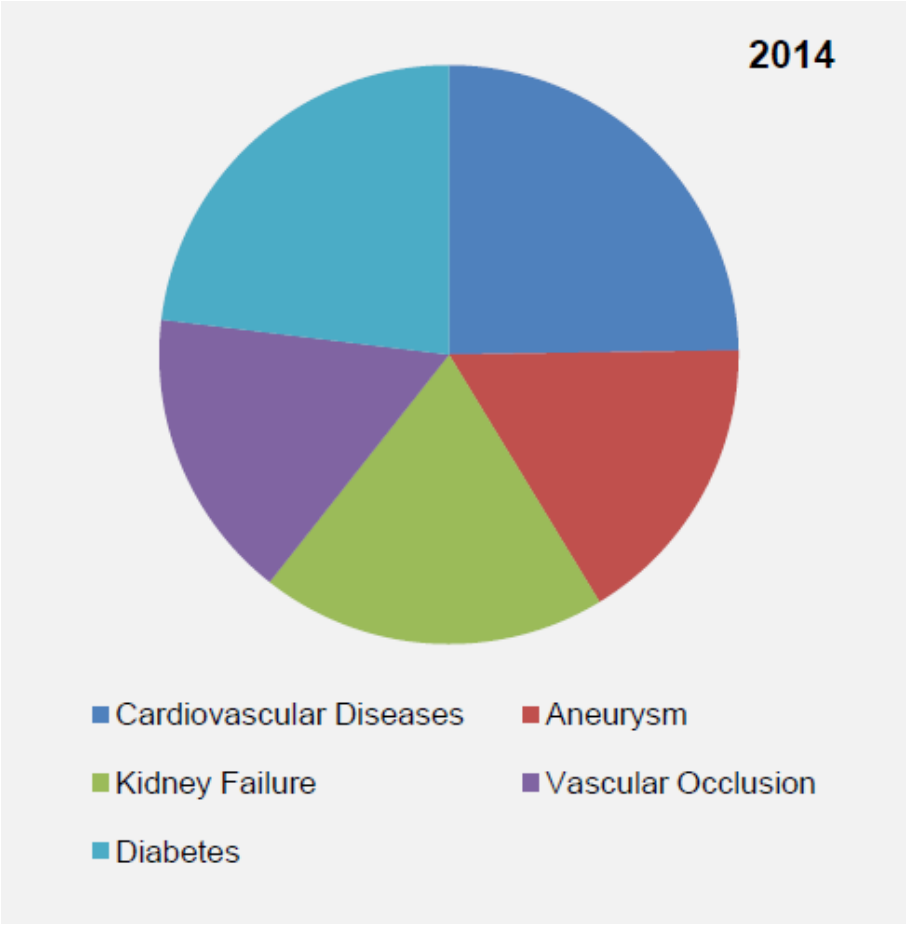
FIG. 2 Global vascular grafts market, 2012 – 2022 (USD Million)

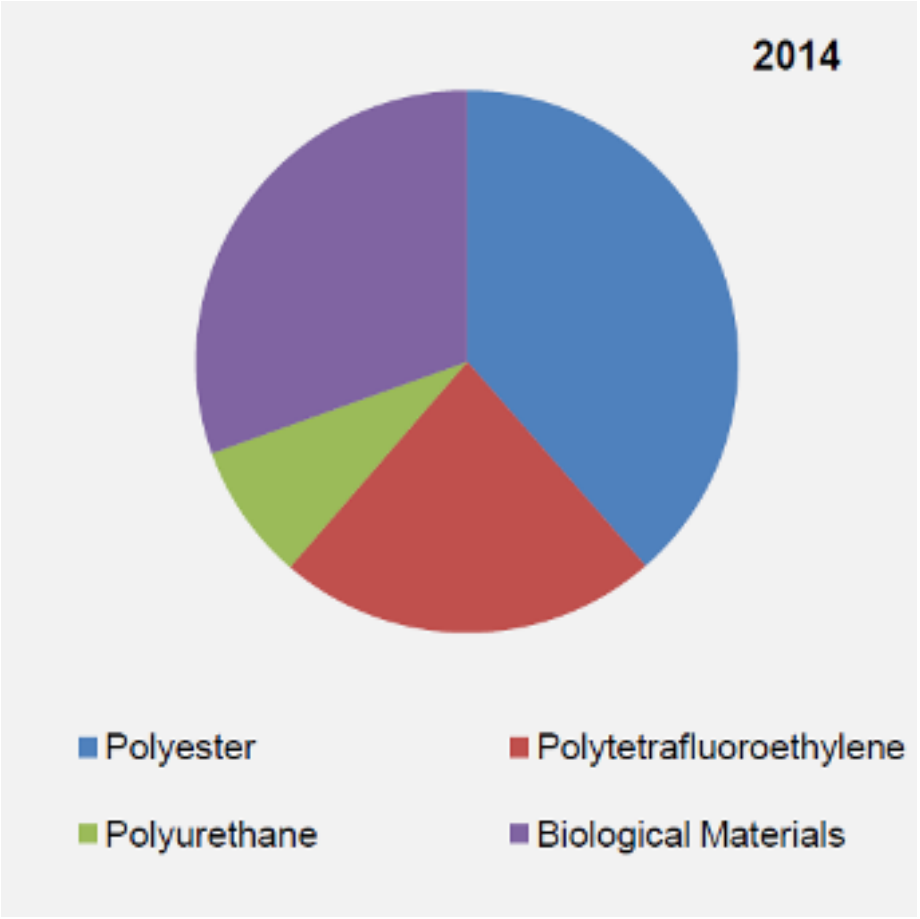


# Vascular grafts revenue share by product, 2014



## Vascular grafts revenue share by application, 2014 & 2022




## Vascular grafts revenue share by raw material, 2014

Prosthetic vascular graft infection has always been the diagnosis that no one wants to make.

- Sıklığı %0,8-6
  - İntraabdominal aortoaortic veya aortoiliak bypass greftleri < % 1
  - Torasik and torakoabdominal aort greftler %1-2
  - Kasık gölgesinde %2-4
  - Artereovenöz hemodiyaliz greftleri % 3,5
  - Femoropopliteal, axillofemoral, veya axillopopliteal yerleşim %7-9

| Infection | Incidence (%) |
|---|---|
| **GRAFT IMPLANT SITE** | |
| Descending thoracic aorta/thoracoabdominal | 0.5-1.9 |
| Aortoiliac | 0.2-1.3 |
| Aortofemoral | 0.5-3 |
| Femorofemoral | 1.3-3.6 |
| Axillofemoral | 5-8 |
| Femoropopliteal | 0.9-4.6 |
| Femorotibial | 2-3.4 |
| Carotid patch | 0.25-0.5 |
| Carotid-subclavian | 0.5-1.2 |
| Axilloaxillary | 1-4 |
| **ENDOVASCULAR DEVICE** | |
| Aortic stent-graft | 0.1-1.2 |
| Peripheral stent | <0.1 |

# Risk faktörleri

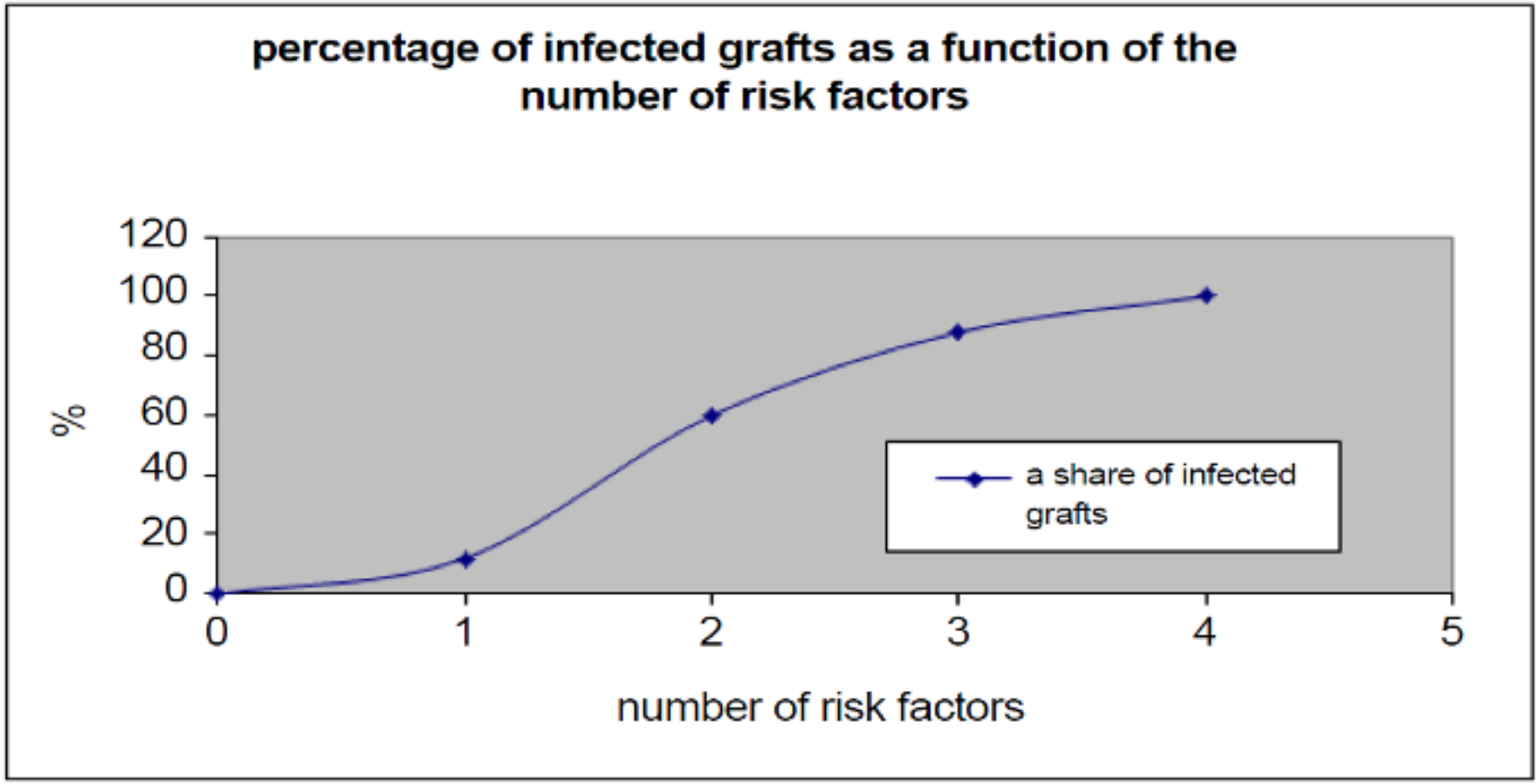
- Hasta ile ilişkili faktörler
  - Yaş
  - Cinsiyet
  - Obesite
  - Diyabet
  - Kötü glukoz kontrolü,
  - Malnütrisyon,
  - Açık cilt yaraları
  - İmmünosüpresyon
  - Malignite

# Risk faktörleri

- Prosedür ile ilişkili faktörler
  - Revaskülarizasyon
  - Re-operasyon,
  - Operasyonun süresi
  - Operasyon bölgesi

# Risk faktörleri

- Postoperatif faktörler
  - Sepsis
  - Hipoksemi
  - Hipervolemi,
  - Hematom varlığı
  - Yara enfeksiyonu
  - Başka bir bölgede enfeksiyon varlığı




Kysela and Silhart, Vasc Med Surg 2015, S1

# Sınıflama

## Zamana göre

- Erken (<4 ay)
- Geç (>4 ay)

## Postoperatif yara enfeksiyonu varlığına göre

- Grade I : Cilt enfeksiyonu
- Grade II : subkutan doku enfeksiyonu
- Grade III: vasküler protezi de içine alan enfeksiyon

## Tutulum miktarı (bunt's sınıflaması)

- Periferal graft enfeksiyonu
- Graft-enterik erozyon
- Graft-enterik fistül
- İnfekte aortik grefti sonrasında aort güdük, ve sepsis varlığı

Samson Sınıflaması;

- Grade 1: Yüzeyel cilt ve/veya ciltaltı dokularda enfeksiyon
- Grade 2: Fasia ve kasları da içeren derin doku tutulumu ve apse varlığı
- Grade 3: İnfeksiyon var ama çevre dokulara yayılım yok
- Grade 4: İnfeksyion ile birlikte çevre dokulara yayılım var ama anastomoz yok
- Grade 5: İnfeksiyon ile birlikte anastomoz varlığı

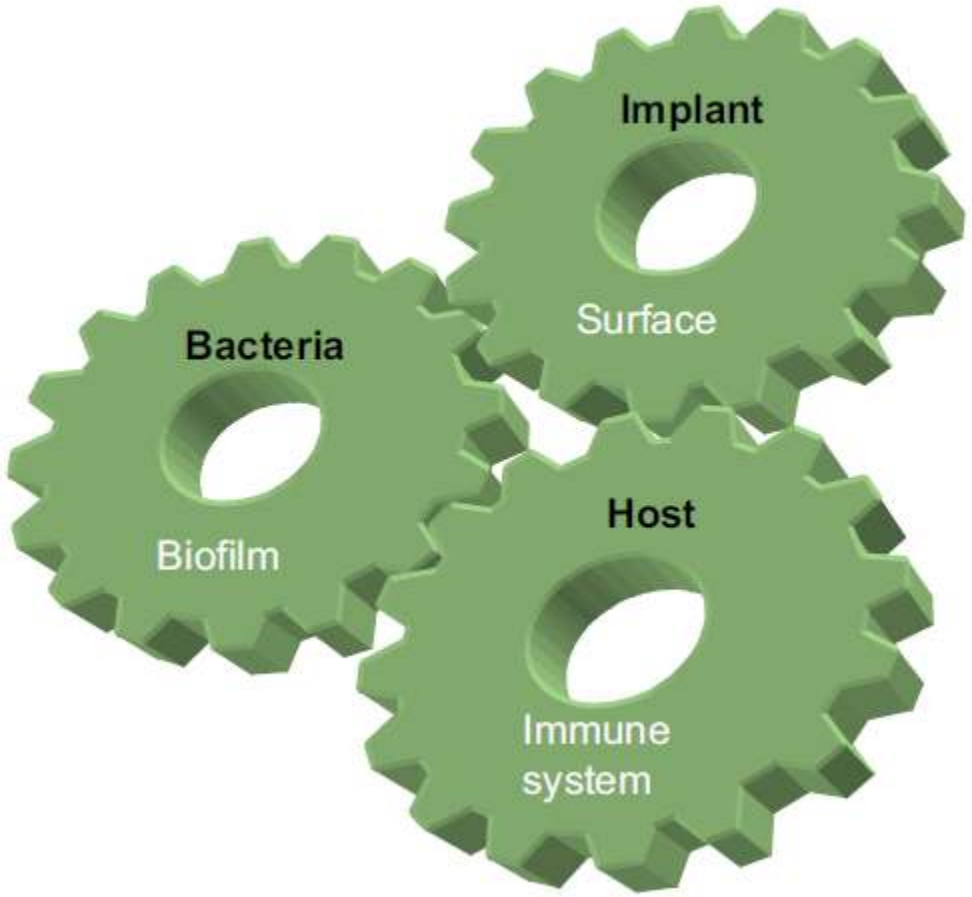
## Prosthetic Graft Infection Classification Systems

| Szilagyi et al.[91] | | Koenig and vonDongen[92] | | Samson et al.[93] | |
|---|---|---|---|---|---|
| Group 1 | Infection involves only the dermis | Group 1 | Infection extends no deeper than the dermis | Group 1 | Infections extend no deeper than the dermis |
| Group 2 | Infection extends into the subcutaneous tissue but does not invade the arterial implant | Group 2 | Infection is in the subcutaneous tissue but does not involve the graft | Group 2 | Infections involve subcutaneous tissues but do not come into grossly observable direct contact with the graft |
| Group 3 | The arterial implant proper is involved in the infection | Group 3 | Infection involves the body of the graft | Group 3 | Infections involve the body of the graft but not at an anastomosis |
| | | Stage 1 | The body of the graft is infected without the secondary complications of bleeding, thrombosis, and systemic sepsis | Group 4 | Infections surround an exposed anastomosis, but bacteremia or anastomotic bleeding has not occurred |
| | | Stage 2 | A trickle of bleeding occurs from anastomosis with no thrombosis of graft or systemic sepsis | Group 5 | Infections involve a graft-to-artery anastomosis and are associated with septicemia, bleeding, or both at the time of presentation |
| | | Stage 3 | Infection is complicated by massive bleeding, systemic sepsis, or bleeding | | |

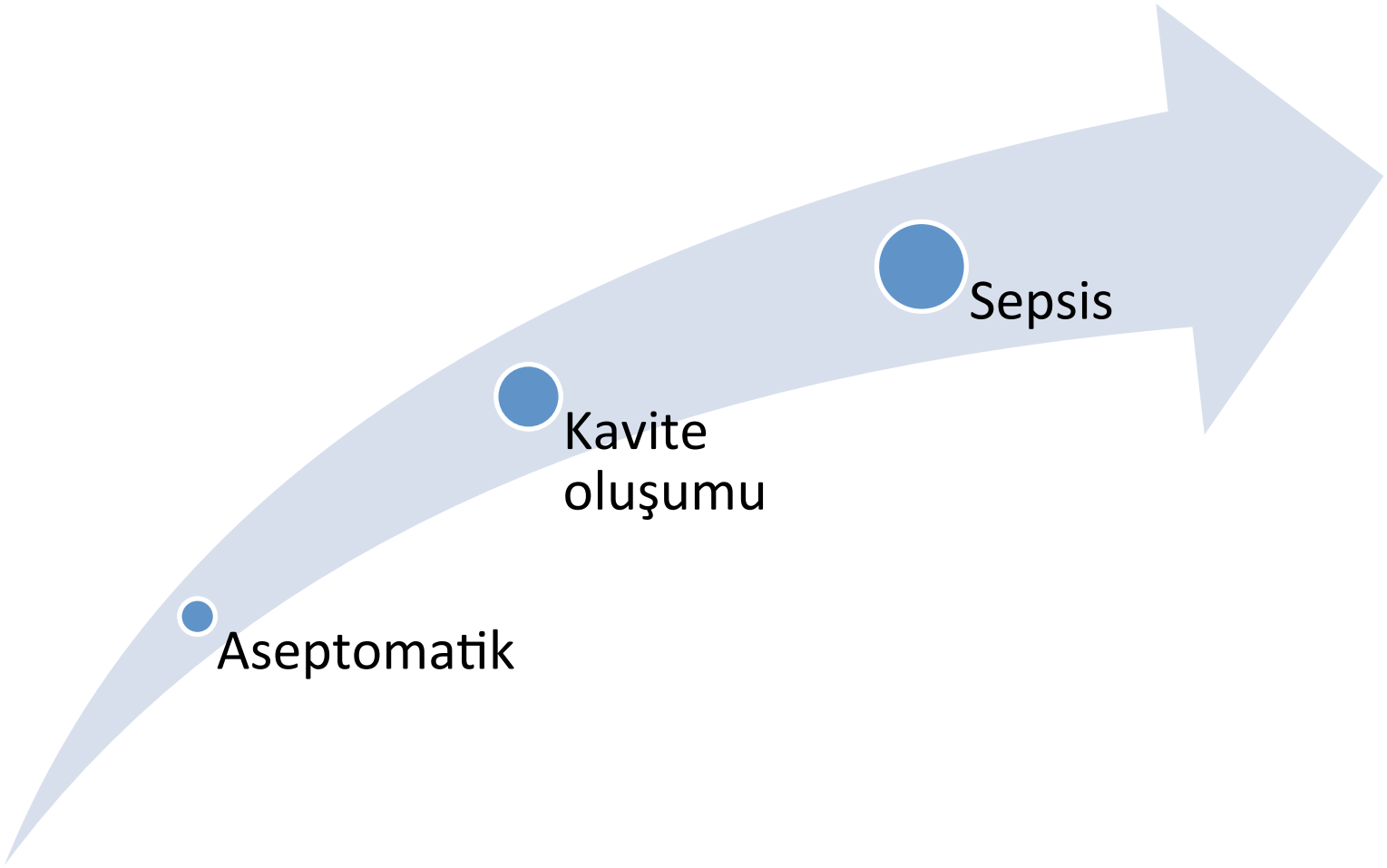
# Mikrobiyal kontaminasyon

- Üretim ve paketleme sırasında
- İmplantasyon öncesinde
- İmplantasyon sırasında
- Cerrahi alan enfeksiyonuna sekonder olarak
- Hematojen yayılım ile

# Patogenez



# Klinik görünüm



# Klinik görünüm

- İmplantasyon ile infeksiyon arası süre
- Mikroorganizmanın tipi
- Anatomik lokalizasyon

Erken enfeksiyonlar

- 4 ay içinde gelişen eneksiyonlardır
- Ateş, bakteremi, ağrı eritem, şişlik, ısı artışı,
- Lokal kanamalar,
- Ülser oluşumu,
- Pulsatil kitleler

Geç enfeksiyonlar

- Ameliyattan 4 ay sonra gelişen enfeksiyonlardır
- Semptomlar siliktir
- Sırt, karın ağrısı fistül oluşumu, greft oklüzyonu,
- Asemptomatik pseudöanevrizma oluşumu
- Sistemik  bulgular genellikle yoktur
- Kan kültürü genellikle negatiftir

| Finding | Number of patients | % in the group of infected |
|---|---|---|
| Wet wound | 16 | 57,0 |
| Fever | 9 | 32,0 |
| Local resistance | 7 | 25,0 |
| Elevated FW | 7 | 25,0 |
| Elevated leucocytes | 6 | 21,0 |
| Elevated CRP | 4 | 14,0 |
| Bleeding | 4 | 14,0 |
| Pseudoaneurysm – pulsating resistance | 3 | 11,0 |
| Reconstruction closure | 3 | 11,0 |
| Local overall | 25 | 89,0 |

Kysela and Silhart, Vasc Med Surg 2015

# Etken

**Table 42-2** Bacteriology of Prosthetic Vascular Graft Infections from Collected Series

| Microorganism | Incidence (%) | | | | |
|---|---|---|---|---|---|
| | Thoracic Aorta | Graft-Enteric Erosion/ Graft-Enteric Fistula | Aortofemoral | Femoral-Popliteal-Tibial | Carotid |
| *Staphylococcus aureus* | 32 | 4 | 27 | 28 | 50 |
| *Staphylococcus epidermidis* | 20 | 2 | 26 | 11 | 15 |
| *Streptococcus* spp. | 2 | 9 | 10 | 11 | 3 |
| *Pseudomonas* spp. | 10 | 3 | 6 | 16 | 6 |
| Coliforms/gram-negative organisms* | 14 | 49 | 28 | 29 | 9 |
| Other species/*Candida* | 10 | 15 | 1 | 3 | 5 |
| No growth/no culture | 12 | 18 | 2 | 2 | 12 |

**Escherichia coli; Enterococcus, Bacteroides, Klebsiella, Enterobacter, Serratia, Proteus* species.

# Tanı

- Gereksiz cerrahiyi önlemek
- Uygun antibiyotik tedavisi

# Tanı

- Klinik
- Laboratuvar
- Görüntüleme yöntemleri
- Cerrahi

# Görüntüleme yöntemleri

Bilgisayarlı tomografi

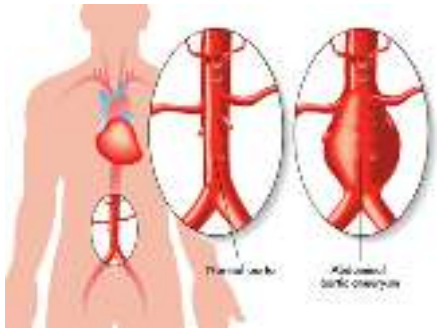
- İlk tercih edilecek yöntem
- Iv ve oral kontrast made kullanılmalı

# Görüntüleme yöntemleri

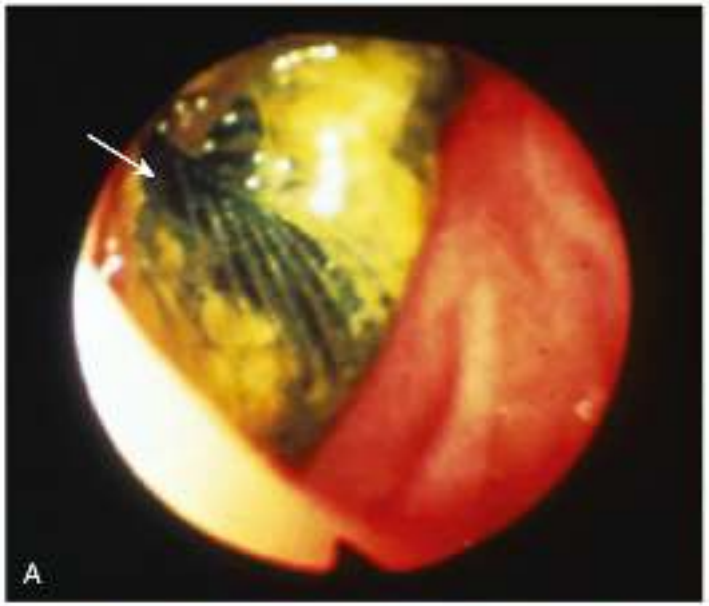
Ultrasonografi

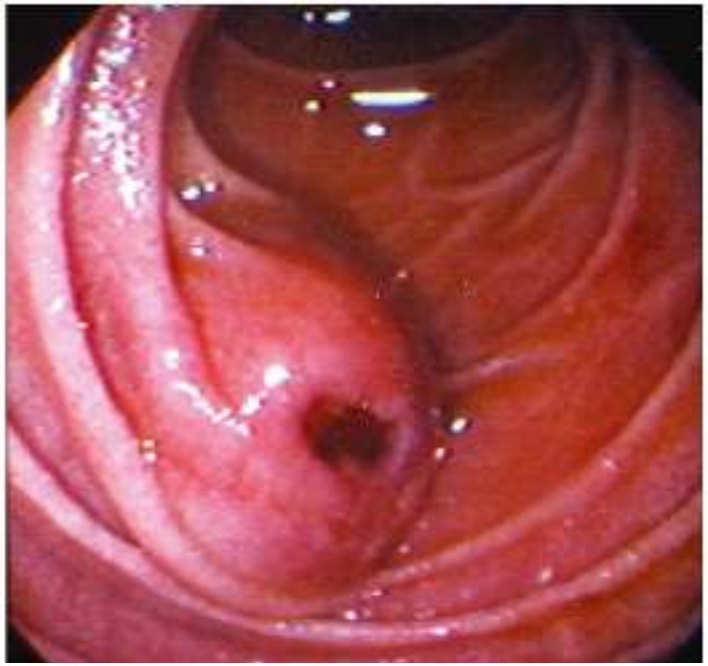
- Yatak başı yapılabilir
- Tanısal değeri kişinin tecrübesine bağlı

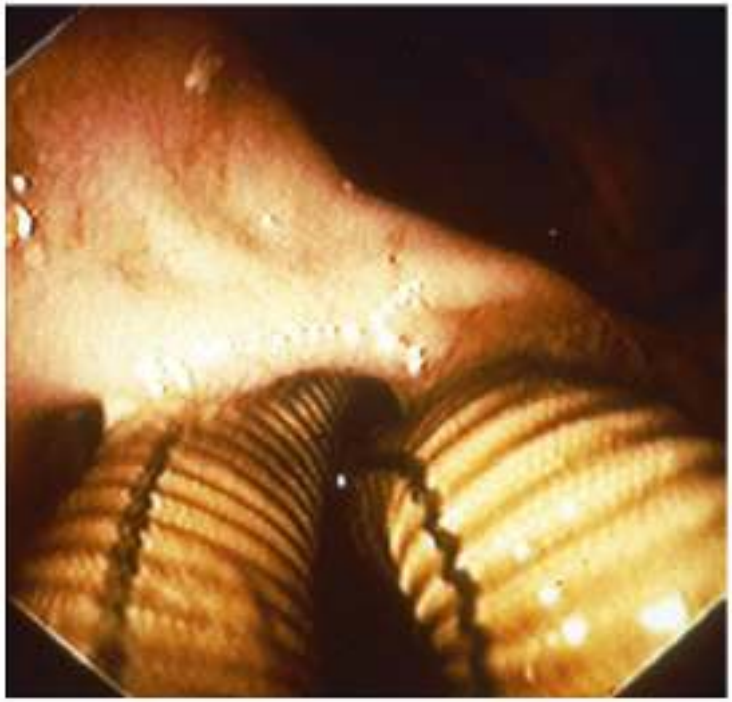
- MR görüntüleme
- Sintigrafi
- Endoskopi
- Kolonoskopi
- Arteriografi
- Mikrobiyolojik tanı



# Endoskopi



# Accuracy of Imaging Modalities in Vascular Graft Infection*

| | (%) | | | |
|---|---|---|---|---|
| | Sensitivity | Specificity | Positive Predictive Value | Negative Predictive Value |
| CT scan[98] | 64 | 86 | 70 | 83 |
| MRI[100] | 68 | 97 | 95 | 80 |
| Tc-labeled WBC[104] | 100 | 92 | | |
| FDG-PET scan[98,111] | 91 | 64 | 56 | 93 |
| PET/CT[107] | 93 | 91 | 88 | 96 |
| In-labeled WBC[100] | 73 | 87 | 80 | 82 |

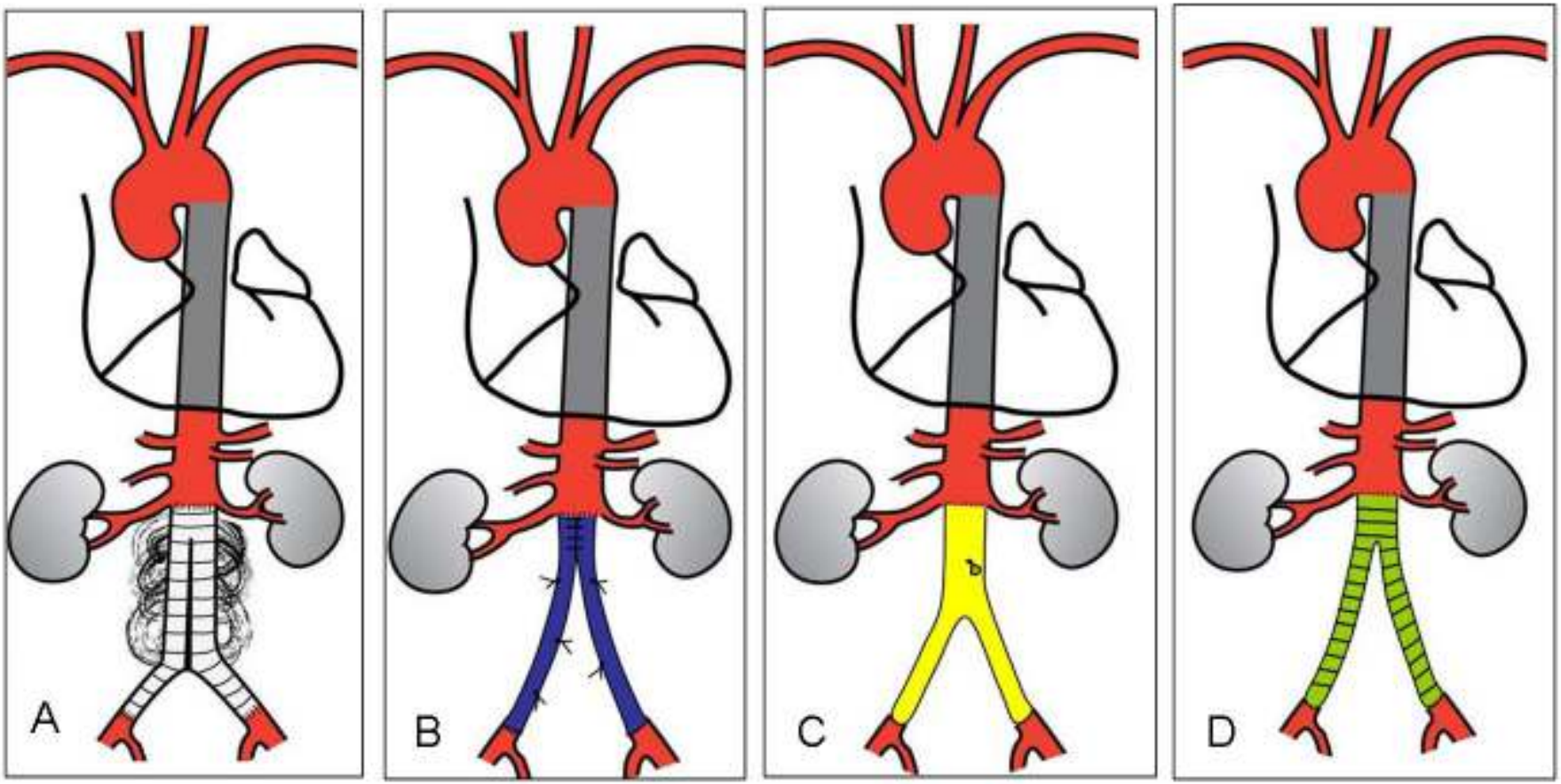
# Mikrobiyolojik tanı

- Sürüntü kültürü→ greft yüzeyi veya perigreft sıvıdan
- Greft kültürü → zenginleştirici besi yeri ile

# Tedavi

treatment of infected vascular grafts falls into one of five major approaches:

1. Extraanatomical bypass through noninfected tissue fields, followed (either immediately or after an interval of 2 to 5 days) by removal on the infected prosthesis and debridement of the infected tissue
2. Removal of the infected prosthetic conduit, followed immediately by in situ reconstruction with another prosthetic graft, without antimicrobial impregnation
3. Removal of the infected prosthetic conduit, followed immediately by in situ reconstruction using arterial allograft
4. Removal of the infected prosthetic conduit, followed immediately by in situ reconstruction using venous autograft or allograft
5. Surgical debridement, tissue coverage, and partial or complete preservation of the infected prosthesis


A
B
C
D

# Tedavi

- Standardized yaklaşım ??
- Kanıta dayalı ??
- Multidisipliner yaklaşım*

# Tedavi

Amaç:

- Enfeksiyonu tedavi etmek
- Rekürrensi önlemek
- Fonksiyonel sonuçlar
  - Amputasyona engel olmak
  - Yaşam kalitesini korumak

# Tedavi-Genel İlke

- Grefte ve hastaya göre kişiselleştirilmeli
- Cerrahi tedavi + uzun süreli antimikrobiyal tedavi

- Sistemik enfeksiyon bulguları var veya anastomoz bölgesini etkileyen enfeksiyonlarda greft çıkarılmalıdır
- Sistemik bulgular yok, greft sağlam, anastomoz gölgesi temiz ise greft kalabilir

# Antimikrobiyal tedavi

- Tanıdan süphelenildiği anda
- Geniş spektrumlu
- Parenteral
- Uzun süreli (2-4-6 h, …)

Review

# Medical treatment of prosthetic vascular graft infections: Review of the literature and proposals of a Working Group

M. Revest[a,b], F. Camou[c], E. Senneville[d], J. Caillon[e], F. Laurent[f], B. Calvet[g], P. Feugier[h], M. Batt[i], C. Chidiac[j,*], Groupe de Réflexion sur les Infections de Prothèses vasculaires (GRIP)[1]

Empirical antibiotic therapy for prosthetic vascular graft infections (PVGIs) depending on the clinical situation (C-III).

| Clinical situation | In the absence of allergy to β-lactams | In the case of allergy to penicillin |
|---|---|---|
| PVGI with sepsis without signs of severity or known colonisation, no history of MDR bacterial infection | Piperacillin/tazobactam + vancomycin or daptomycin[a] ± gentamicin | Cefotaxime or ceftriaxone or cefepime or aztreonam + metronidazole + vancomycin or daptomycin[a] ± gentamicin |
| PVGI with sepsis, signs of severe sepsis and/or known colonisation or previous infection with ESBL-GNB[b] | Imipenem or meropenem or doripenem + vancomycin or daptomycin[a] ± gentamicin | Fosfomycin + metronidazole + vancomycin or daptomycin[a] ± gentamicin |

Antibiotic therapy for prosthetic vascular graft infections caused by meticillin-sensitive *Staphylococcus* sp.

| | | In the absence of allergy to β-lactams | In the case of allergy to penicillin | In the case of contraindication to β-lactams |
|---|---|---|---|---|
| Pre-operative treatment | | Cloxacillin or oxacillin (B-III)<br>+<br>gentamicin[a] 3 days (B-III) | Cefazolin or vancomycin or daptomycin (B-III)<br>+<br>gentamicin[a] 3 days (B-III) | Vancomycin or daptomycin (B-III)<br>+<br>gentamicin[a] 3 days (B-III) |
| Post-operative treatment | Optimal | Cloxacillin or oxacillin (B-III)<br>+<br>gentamicin[a] 3 days (C-III)<br><br>and then addition of rifampicin[b] in place of gentamicin (B-III)<br><br>relay with oral rifampicin + fluoroquinolone at Day 15 post-operatively[c] (C-III)<br><br>Duration of treatment, 6 weeks post-operatively (C-III) | Cefazolin or vancomycin or daptomycin (B-III)<br>+<br>gentamicin[a] 3 days (C-III)<br><br>and then addition of rifampicin[b] in place of gentamicin (B-III)<br><br>relay with oral rifampicin + fluoroquinolone at Day 15 post-operatively[c] (C-III)<br><br>Duration of treatment, 6 weeks post-operatively (C-III) | Vancomycin or daptomycin (B-III)<br>+<br>gentamicin[a] 3 days (C-III)<br><br>and then addition of rifampicin[b] in place of gentamicin (B-III)<br><br>relay with oral rifampicin + fluoroquinolone at Day 15 post-operatively[c] (C-III)<br><br>Duration of treatment, 6 weeks post-operatively (C-III) |
| | Suboptimal | Cloxacillin or oxacillin (B-III)<br>+<br>gentamicin 3 days (C-III)<br><br>and then addition of rifampicin[b] in place of gentamicin (B-III) for 6 weeks post-operatively (C-III)<br><br>and then suppressive treatment[d] (C-III) | Cefazolin or vancomycin or daptomycin (B-III)<br>+<br>gentamicin 3 days (C-III)<br><br>and then addition of rifampicin[b] in place of gentamicin (B-III) for 6 weeks post-operatively (C-III)<br><br>and then suppressive treatment[d] (C-III) | Vancomycin or daptomycin<br>+<br>gentamicin 3 days<br><br>and then addition of rifampicin[b] in place of gentamicin (B-III) for 6 weeks post-operatively (C-III)<br><br>and then suppressive treatment[d] (C-III) |

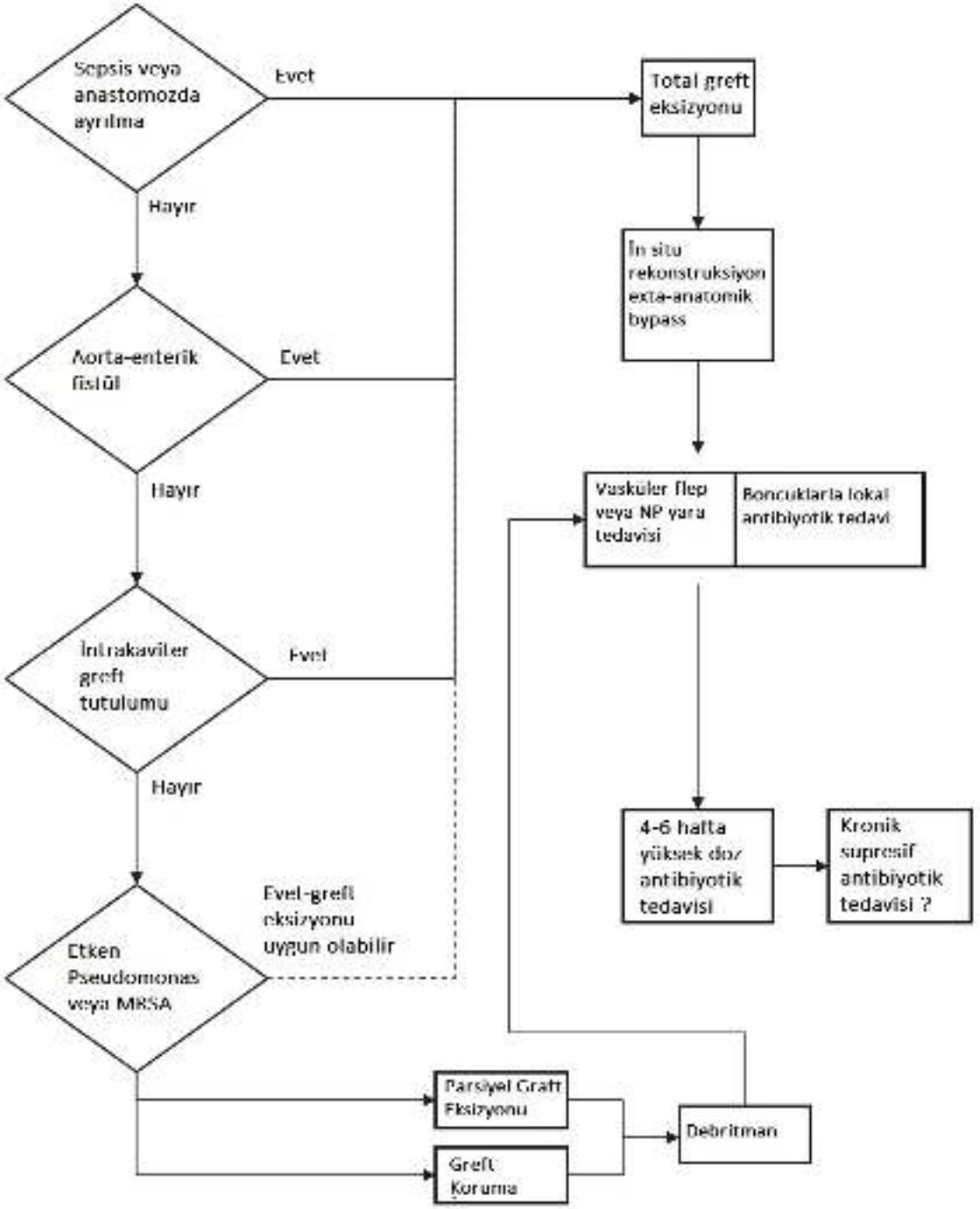
Antibiotic therapy for prosthetic vascular graft infections caused by meticillin-resistant *Staphylococcus* sp.

| | | Vancomycin MIC < 1.5 mg/L | Vancomycin MIC ≥ 1.5 mg/L |
|---|---|---|---|
| Pre-operative treatment | | Vancomycin[a] (B-III) or daptomycin (C-III)<br>+<br>gentamicin 3 days (B-III) | Daptomycin (B-III)<br>+<br>gentamicin 3 days (C-III) |
| Post-operative treatment | Optimal | Vancomycin[a] (B-III) or daptomycin (C-III)<br>+<br>gentamicin 3 days (C-III) | Daptomycin (B-III)<br>+<br>gentamicin 3 days (C-III) |
| | | and then addition of rifampicin[b] in place of gentamicin (B-III) | and then addition of rifampicin[b] in place of gentamicin (B-III) |
| | | relay with oral rifampicin + fluoroquinolone at Day 15 post-operatively[c] (C-III) | relay with oral rifampicin + fluoroquinolone at Day 15 post-operatively[c] (C-III) |
| | Suboptimal | Duration of treatment, 6 weeks post-operatively (C-III)<br>Vancomycin (B-III) or daptomycin (C-III)<br>+<br>gentamicin 3 days (C-III) | Duration of treatment, 6 weeks post-operatively (C-III)<br>Daptomycin (B-III)<br>+<br>gentamicin 3 days (C-III) |
| | | and then addition of rifampicin in place of gentamicin (B-III) for 6 weeks post-operatively (C-III) | and then addition of rifampicin in place of gentamicin (B-III) for 6 weeks post-operatively (C-III) |
| | | and then suppressive treatment[d] (C-III) | and then suppressive treatment[d] (C-III) |

Antibiotic treatment of prosthetic vascular graft infections caused by Enterobacteriaceae.

| | | In the absence of allergy to β-lactams | In the case of allergy to penicillin |
|---|---|---|---|
| Pre-operative treatment | | Ceftriaxone or cefotaxime[a] (B-III)<br>+<br>gentamicin 3 days[b] (C-III) | Aztreonam (C-III)<br>+<br>gentamicin 3 days (C-III) |
| Post-operative treatment | Optimal | Ceftriaxone or cefotaxime[a] (B-III) | Aztreonam (C-III) |
| | | and then relay with fluoroquinolones[c] (C-III) | and then relay with fluoroquinolones[c] (C-III) |
| | | Duration of treatment, 6 weeks post-operatively (C-III) | Duration of treatment, 6 weeks post-operatively (C-III) |
| | Suboptimal | Ceftriaxone or cefotaxime[a] (B-III) | Aztreonam (C-III) |
| | | and then relay with fluoroquinolones[c] (C-III) for 6 weeks post-operatively (C-III) | and then relay with fluoroquinolones[c] for 6 weeks post-operatively (C-III) |
| | | and then suppressive treatment[d] (C-III) | and then suppressive treatment[d] |

# Aort greft enfeksiyonlarının tedavisi

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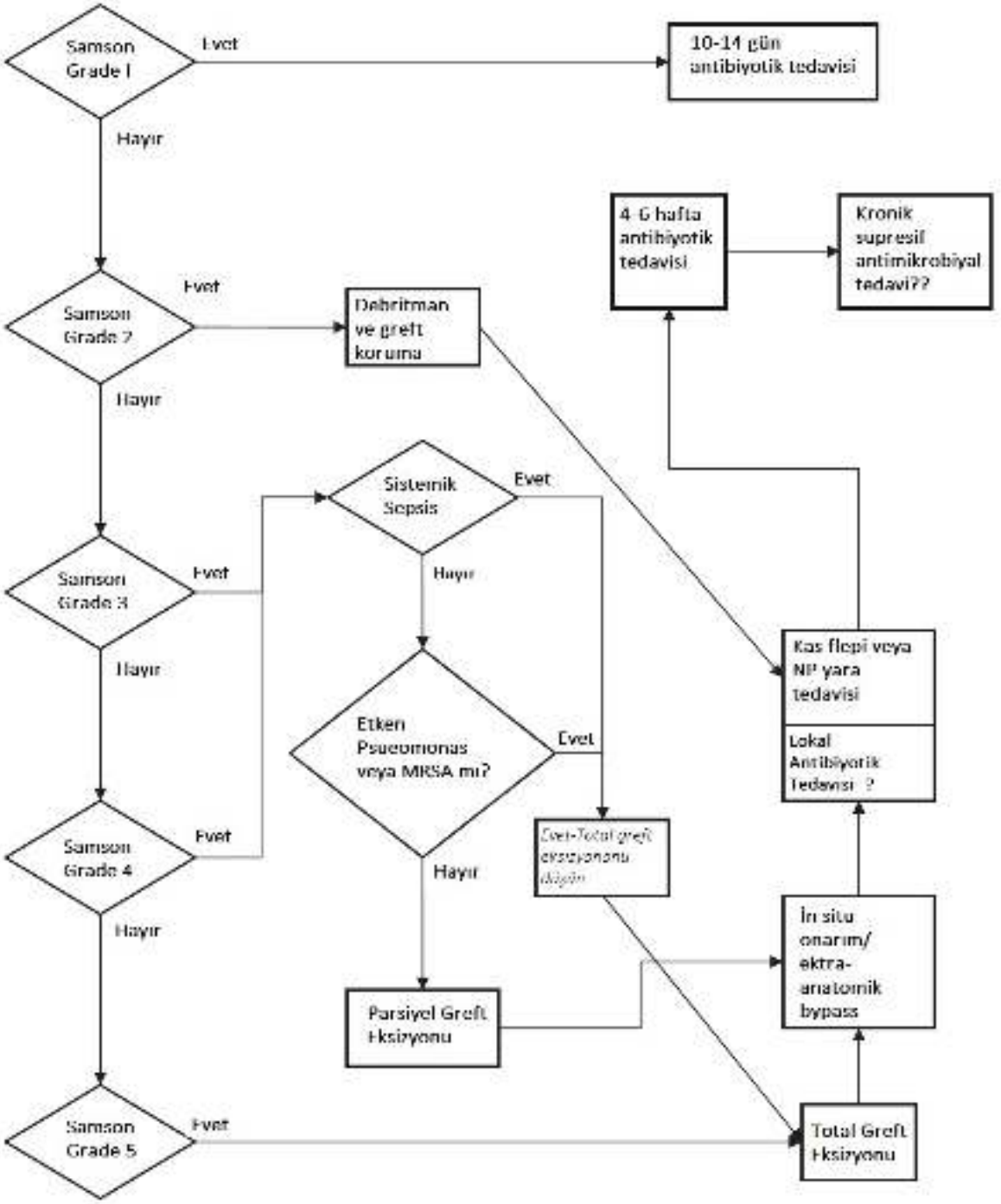
# Periferik greft enfeksiyonları tedavisi

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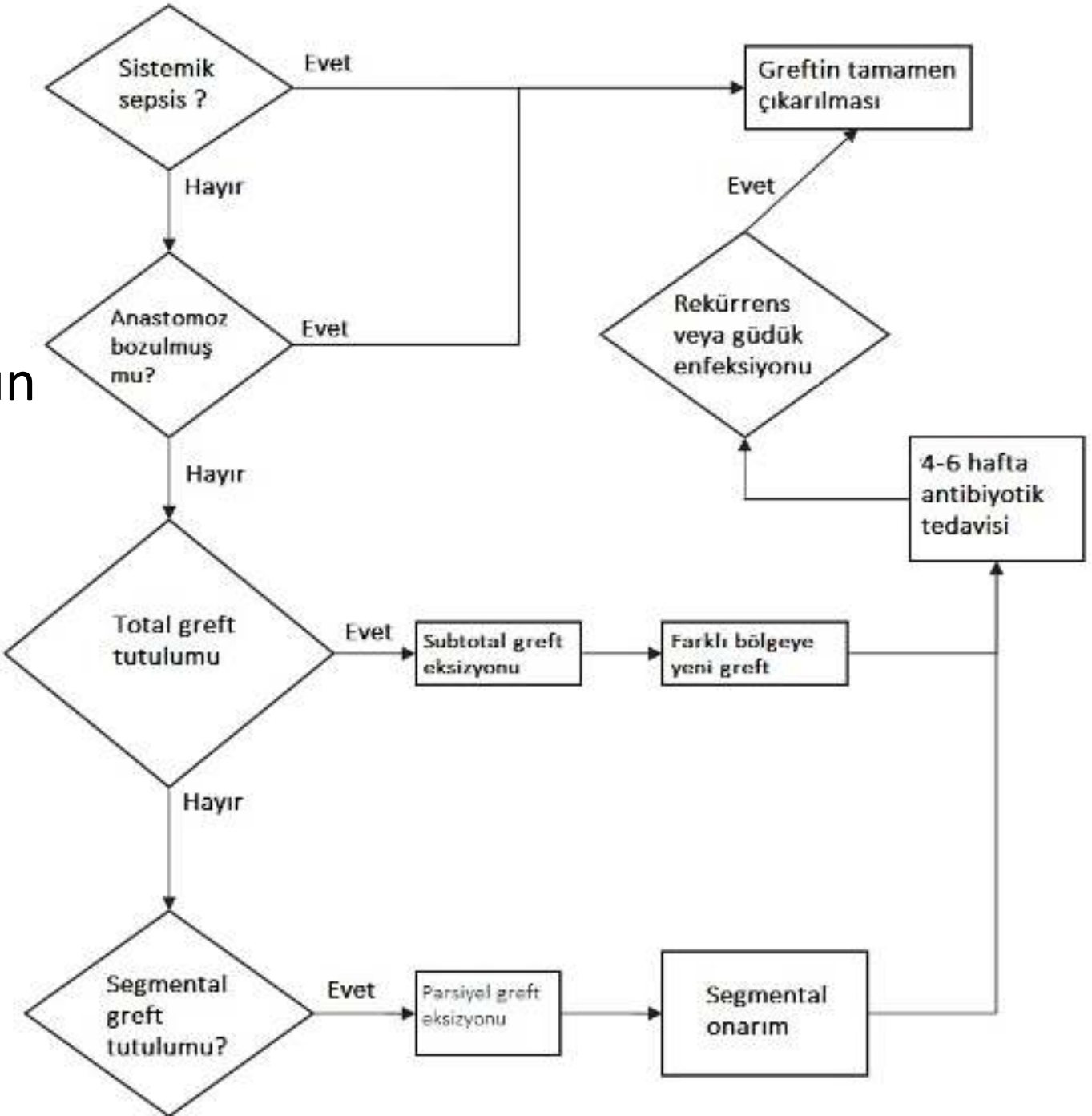
# Hemodiyaliz greft enfeksiyonlarının tedavisi

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MRSA herzaman hedeflenmeli

Vankomisin
Daptomisin

+

Piperasilin/Tazobactam
Sefepim
Levofloksasin

Rifampisin

Koruma tedaviden daha iyidir

Teşekkürler