Deep Wound Infection in Cardiac Surgery. Prevention and Control Measures

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Disclosures

- **None for this presentation**

Introduction

General Data

Risk and Metrics

Prevention

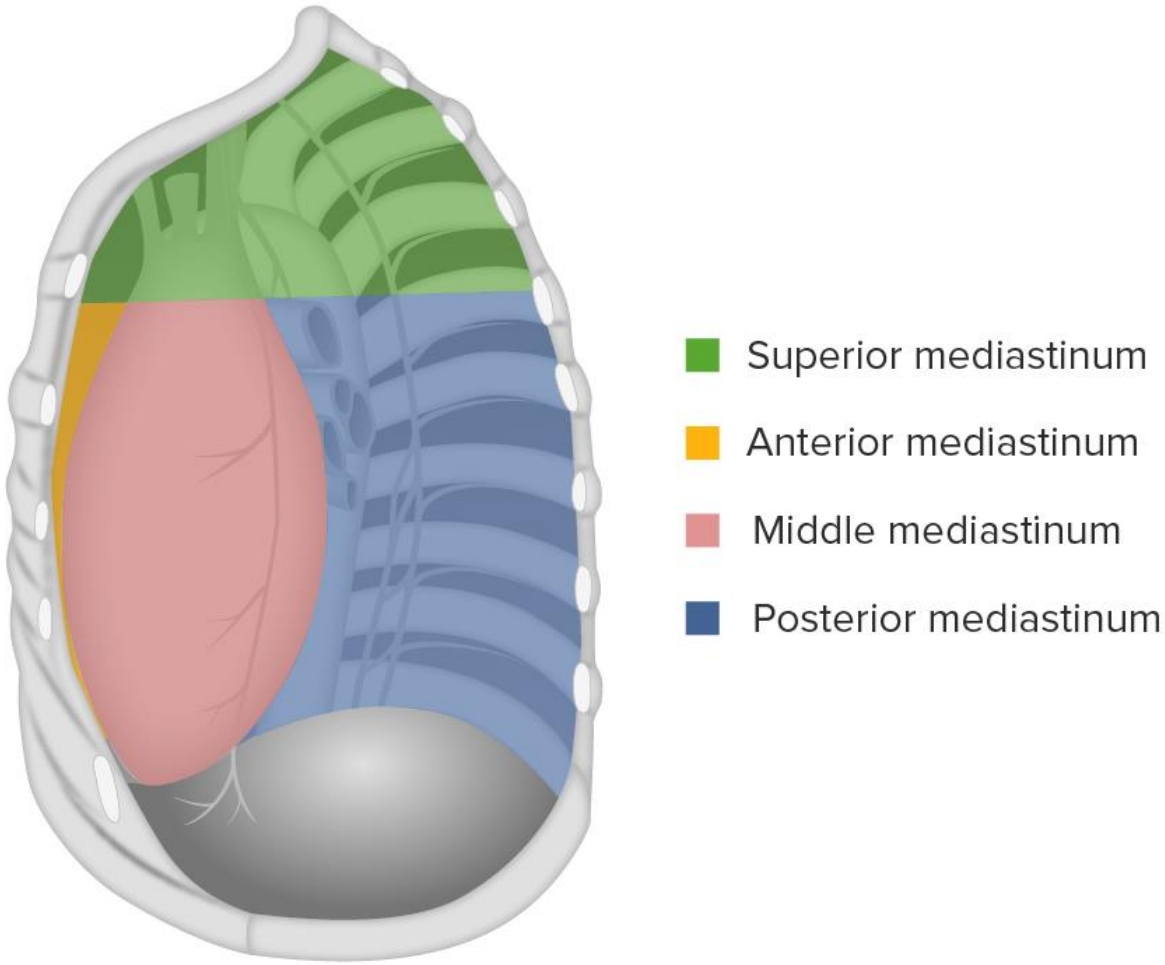
Patient

Non-ATB

ATB prophylaxis

General Data

Mediastinal space: area under the sternum and in front of the vertebral column, containing the heart and its large vessels, trachea, esophagus, thymus, lymph nodes, and other structures and tissues.



Definition:

Post-surgical mediastinitis (PSM) is a life threatening deep sternal wound infection

incidence rate: 0.2% to 8%

mortality rate: 8% to 45%

Singh *et al.* Sternal wound infection. Seminars in plastic surgery/volume 25, number 1.

Post-surgical mediastinitis (PSM) Criteria

1. Patient has organism(s) identified from mediastinal tissue or fluid by a culture or non-culture based microbiologic testing method which is performed for purposes of clinical diagnosis or treatment.

2. Patient has evidence of mediastinitis on gross anatomic or histopathologic exam.

3. Patient has at least one of the following signs or symptoms:
   - fever (>38.0°C), chest pain*, or sternal instability.
   - * And at least one of the following:
     - a. purulent drainage from mediastinal area
     - b. mediastinal widening on imaging test

https://www.cdc.gov/nhsn/pdfs/pscmanual/17pscnosinfdef_current.pdf January 2022

Risk & Metrics

1 HEALTHCARE ASSOCIATED INFECTIONS (HAI)

In the EU, an estimated

4,100,000

patients acquire a HAI every year[1].

WORLDWIDE,
SSI rank on

#2

of all HAI in resource-rich countries and on

#1

in income-poor settings[2]

2 INCIDENCE

0.5–10.1%

of all patients undergoing a surgery develop an SSI[3]. The real rate of SSI is probably underestimated[4]

800'000

SSI per year in Europe[5] ...

... result in more than **16'000** deaths annually[5]

3 IMPACT

SSIs increased

- patient morbidity[5]
- mortality[5]
- length of stay[6] and
- rates of admission[6]

Per year overall costs in Europe[7]

19 billion €

Additional total medical cost per SSI between

10'232 €

in Spain and

32'000 €

in Italy[5]

4 SOLUTION

"It has been proven to be effective to combine particular important measures into a bundle."[8]

60% of SSI can be avoided[9] !

The Society of Thoracic Surgeons 2021 Adult Cardiac Surgery Risk Models for Multiple Valve Operations

Jacobs J et al, Ann Thorac Surg 2022;113:511-8)

- Adult Cardiac Surgery Database (ACSD)~ 96% cardiac surgical operations performed in the United States
- Primary use is to assess the quality of adult cardiac surgery (STS Quality Measurement Task Force)
- July 2011 to June 2019
- AVR+MVRR (n= 31,968) and AVR+MVRR+CABG (n=12,650)

endpoints:

- Operative Mortality (all deaths, regardless of cause up to 30 d after discharge)
- Major morbidity (any 1 or more of the following: cardiac reoperation, deep sternal wound infection/mediastinitis, stroke, prolonged ventilation, and renal failure)
- Combined mortality and/or major morbidity

https://doi.org/10.1016/j.athoracsur.2021.03.089

The Society of Thoracic Surgeons 2018 Adult Cardiac Surgery Risk Models: Part 2—Statistical Methods and Results

Table 2. Percentage and Number of Endpoint Events by Model Population in Development Sample

Endpoint Events	All (n = 670,830)	CABG (n = 439,092)	Valve (n = 150,150)	Valve + CABG (n = 81,588)
Operative mortality	2.9% 16,792/569,998	2.4% 8,852/373,683	3.2% 4,004/126,204	5.6% 3,936/70,111
Stroke	1.5% 9,866/669,561	1.3% 5,621/438,385	1.5% 2,237/149,800	2.5% 2,008/81,376
Renal failure	2.7% 17,202/648,808	2.2% 9,381/424,888	2.7% 3,868/145,454	5.0% 3,953/78,466
Prolonged ventilation	10.9% 72,984/670,830	9.3% 40,974/439,092	11.1% 16,604/150,150	18.9% 15,406/81,588
Reoperation	3.1% 20,872/670,778	2.4% 10,327/439,060	4.2% 6,371/150,137	5.1% 4,174/81,581
Composite morbidity and mortality	17.4% 101,180/581,976	15.0% 56,984/380,491	18.4% 23,724/129,140	28.3% 20,472/72,345
Prolonged PLOS	6.6% 44,533/670,428	5.0% 22,091/438,867	8.0% 11,941/150,024	12.9% 10,501/81,537
Short PLOS	42.7% 286,362/670,428	48.3% 211,820/438,867	37.4% 56,130/150,024	22.6% 18,412/81,537
DSWI	0.3% 1,875/669,392	0.3% 1,346/438,270	0.2% 244/149,778	0.4% 285/81,344

CABG = coronary artery bypass grafting surgery; DSWI = mediastinitis/deep sternal wound infection; PLOS = postoperative length of stay.

Ann Thorac Surg 2018;105:1419–28

Cirugía cardiovascular en España en el año 2019. Registro de intervenciones de la Sociedad Española de Cirugía Cardiovascular y Endovascular

Registro anónimo y voluntario. 57 Hospitales

33.660 cirugías.

Tabla 19

Otros procedimientos sin circulación extracorpórea (CEC) realizados durante el año 2019, no codificados en apartados previos

Otros procedimientos sin CEC no codificados en apartados previos	Casos	Mortalidad
Ventana pericárdica/pericardiocentesis	414	1,45%
Reintervenciones por sangrado	701	4,71%
Reintervenciones por mediastinitis	98	6,12%
Reintervenciones por dehiscencia esternal	183	1,64%
Asistencia ventricular sin CEC	50	30,0%
Implante de ECMO	453	26,27%
Total de otros no codificados	1.899	

ECMO: dispositivos de oxigenación por membrana extracorpórea.

DOI: 10.1016/j.circv.2021.01.004

- Despite the clinical and economic consequences of sternal wound infections, to date there are no specific guidelines for the prevention, diagnosis and management of PSM based on a multidisciplinary consensus.

Journal of
Clinical Medicine

Prevention, Diagnosis and Management of Post-Surgical Mediastinitis in Adults Consensus Guidelines of the Spanish Society of Cardiovascular Infections (*SEICAV*), the Spanish Society of Thoracic and Cardiovascular Surgery (*SECTCV*) and the Biomedical Research Centre Network for Respiratory Diseases (*CIBERES*)

J. Clin. Med. **2021**, *10*, 5566. https://doi.org/10.3390/jcm10235566

Emilio Bouza [1], Arístides de Alarcón [2], María Carmen Fariñas [3], Juan Gálvez [4], Miguel Ángel Goenaga [5], Francisco Gutiérrez-Díez [6], Javier Hortal [7], José Lasso [8], Carlos A. Mestres [9], José M. Miró [10], Enrique Navas [11], Mercedes Nieto [12], Antonio Parra [13], Enrique Pérez de la Sota [14], Hugo Rodríguez-Abella [15], Marta Rodríguez-Créixems [1], Jorge Rodríguez-Roda [16], Gemma Sánchez Espín [17], Dolores Sousa [18], Carlos Velasco García de Sierra [19], Patricia Muñoz [1] and Martha Kestler [1,*]

Prevention

Patient

Non-ATB measures

ATB prophylaxis

Patient

- Glycemia
- Weight
- Tobacco

Glycemia

Ref.	Design	Population	Results	Summary	Comments	Evidence
Halkos et al. J Thorac Cardiovasc Surg 2008	Prospective Cohort	3089 CABG - HbA1C < 7% 2275 - HbA1C > 7% 814	Mediastinitis - 0,4% - 2,3% P < 0,001	Lower incidence of mediastinitis HbA1C < 7%	Independent predictor of mortality and morbidity. No comparison of pre-op optimisation	2++
Subramaniam Anesth Analg 2014	Prospective Cohort	1461 CABG - HbA1C < 6.5% 1093	Mediastinitis - 0,5%	Lower incidence of mediastinitis	Blood glucose PO variability predicts	2++
Faritous Z Ann Thorac Cardiovasc Surg 2014	Prospective Cohort	216 CABG - HbA1C < 7% 165 - HbA1C > 7% 51	SWI - 2,4% - 15,6% P = 0,001	Lower incidence of SWI HbA1C < 7%	Both hyperglycaemia and elevated HbA1C levels increase morbidity and mortality	2++

Recommendation	Grade of Evidence/Strength of Recommendation
We recommend optimising preoperative glycaemic control in diabetic patients with high HbA1c levels (>6.5–7%) to reduce the risk of mediastinitis.	*Evidence level 2++. Strong recommendation, moderate quality of evidence.*

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Weight

STS

2002-2003
Infection after CABG
12 variables:

N=300.000
700.000

0,67-0,68

Friedman

Cohort Pros
2003-2005
BMI>29-35

N=4.987

0,64

Magedanz

Obs 10y
COPD
Obesity (OR 2.4)
Reintervention

N= 2.800

0,72

MEDSCORE

Prospective
ICU (2005-11)
Age>70, COPD,
Obesity (OR 2),

N= 7200
4625/2615

0.80

Obese or overweight patients should be encouraged to lose weight before surgery; we also recommend adjusting prophylactic antimicrobials doses, reinforce the preparation of the surgical field and ensure a very stable wound closure to avoid dehiscence, besides systematic closure with a NPWT device.

Evidence level 2++. Strong recommendation, moderate quality of evidence

Fowler, *Circulation 2005*; Shahian, *Ann Thorac Surg 2009*; Friedman. *Infect Control Hosp Epidemiol. 2007*; Magedanz, *Rev Bras Cir Cardiovasc 2010*;Eagle J Am Coll Cardiol 1999;, *Nieto M Intensive Care Medicine experimental 2015l*

Ref.	Design	Population	Endpoint	Results	Summary	Comments	Evidence
Sorensen LT Arch Surg2012	Meta-analysis	140 cohort (480000) 4 RCT (900)	Quit smoking (4RCT)	1,8(1,6-2,0)	Reduce SWI	Los 4 RCT no en CC. smoking was a risk predictor	1++
Benedetto U J Thor Card Surg 2014	Prospective Cohort	6113 CABG	Quit smoking	SWI (P = 0,9)	Reduce pulmonary complications	smoking cessation 4 weeks before CABG reduces risk of major	2+
Al-Sarraf et al Ann Thorac Surg 2008	Prospective Cohort	2587 CABG - smokers - Ex smokers (>4sem) - Non-smokers		Infection - 9,5% - 8,9% - 7,6% P = 0,46	Reduce pulmonary complications	Smoking is associated with pulmonary complications after CABG. The only complication that decreased was the pulmonary	2+
Jones et al Interac Cardiovasc Thorac Surg 2011	Prospective Cohort	1108 pctes CC - Smokers - Non-smokers		Infection - Fum 32% - No fum 22%	Reduce infection	Decreased pulm and infection complications AND mortality in > 70y	2+

We recommend that patients should be encouraged to stop smoking at least 30 days prior to heart surgery. *Evidence level 2+. Strong recommendation, moderate quality of evidence*

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Non-ATB measures

Hair Removal

Nasal Carriage

Skin prep

Hair removal

- Shaving with sharp material: small cuts and trauma facilitate bacterial proliferation and overgrowth[1]: microscopy: trimmers less damage than razors; depilatories cause no damage to the skin surface

- Meta-analysis COCHRANE 2011[2]: 14 Trials

When hair removal is considered necessary, we recommend the use of a depilatory cream or an electric razor, never a blade.	*Evidence level 1 +. Strong recommendation, high quality of evidence*

  - 3 Trials s (n=1340). **Shaving vs Clipping**

  More infections with shaving (RR 2,09; IC 95%: 1,15-3,80)

  - 7 Trials (n= 1213). **Shaving vs cream**.

  No significant differences (RR 1,53; IC 95%: 0,73 a 3.21). Low power

  - 1 Trials : **Shaving or Clipping day of surgery OR day before**

  No significant differences in SSI risk. Low power

  - No cream vs. trimming trials, no best time to apply cream, no best place to apply cream

1. Cruse PJ. Surg Clin North Am. 1980. 2. Tanner J, Woodings D, Moncaster K. Preoperative hair removal to reduce surgical site infection. Cochrane Database Syst Rev.2011

S.aureus nasal carriage

Ref.	Study	Population	Interventions	Endpoints	Results	Comm	Evidence
Bode LGM. N.E.J.Med. 2010; 362: 9-17	Clinical trial, multicentre	6771 (> 4 d) 1270 positives	Nasal carrier detection followed by Mupi and	Deep Wound Infection	HAI S.aureus Infections: 3,4% vs 7,7%	Reduction in Cardiac Surgery	1++
Bod Ann 201 511-							

We recommend knowing the state of *S. aureus* nasal carriage and proceeding with its eradication if possible or time allowable in positive patients before cardiac surgery.	*Evidence level 1−. Strong recommendation, moderate quality of evidence.*
We recommend PCR-based screening techniques for *S. aureus* carriage when a rapid method is necessary due to their high negative predictive value.	*Evidence level 1++. Strong recommendation, moderate quality of evidence*
We recommend topical mupirocin for nasal decontamination in combination with chlorhexidine for skin decontamination.	*Evidence level 1+. Strong recommendation, high quality of evidence.*
We suggest systematic decontamination in patients in whom nasal carrier status cannot be assessed in a timely manner.	*Evidence level 3. Strong recommendation, low quality of evidence*

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Skin Preparation

Ref	Study	Population	Intervention	Endpoints	Results	Comments	Evidence
Dumville JC	SR Cochrane	2623 p / 13 studies (11 comparisons)	CH vs. PI en 5 estudios		- En DAC no hay comparación CH vs. PY - 2%/4% CH en 70% alcohol vs. PY 10%: no diferencia en cirugía hombro, rodilla y pie	En DAC no hay comparación CH vs. PY En metaanálisis CH alcohólica parece ser lo más efectivo	1+
Berry AR	Ramdomized	866 p: 546 "clean surgery" (abdominal vs no abdominal)	CH 0.5% alcohólica vs. PI	Surgical wound infection	En cirugía limpia no abdominal menos infección con CH: 6.3% vs. 13% PY (RR 0.47)	Incluye varios tipos tipos de cirugía (hernia, genital, venosa y otras no abdominales)	1+
Darouiche R	Ramdomized, Multicentre	849 p (409+440)	CH vs. PI	Primary: Surgical wound infection 30 d Secundary: Any infection.	- Globalmente menos infección CH: 9.5% vs. 16.1% PY (p=0.004) - Menor infección superficial CH: 4.2% vs. 8.6% PY (p=0.008). - Menor inf. profunda CH: 1% vs. 3% PY (p=0.05).	Incluye varios tipos tipos de cirugía (digestiva mayor, hernia, genital, venosa y torácica) No especifica si es CCV o torácica	1+
	(Registrer)			Supervivencia 30 d Estancia Hosp.	secundarios	ambos productos (sesgo)	
Segal C	Ramdomized 3 arms	209 p CABG (4 strategies for skin preparation)	PI acuosa vs. Iodóforo en alcohol: - PI 7.5% lavado + PI 10% pintado / PY 10% pintado. - PI 7.5% lavado + PI 10% pintado / iodóforo pintado. - PO 10% pintado / iodóforo pintado.	Infección de herida quirúrgica según criterios CDC	- No diferencias entre los 4 grupos. - Menos infecciones con preparados acuosos frente a insolubles.	Grupos muy pequeños Diversas estrategias quirúrgicas No compara CH con PY sino PY acuosa con iodóforos en alcohol	1+
Falk-Brynhildsen K	Ramdomized Control	140 p CABG or Valve	Plástico adhesivo vs. pintado de piel solo (CH 5% alcohólica)	Crecimiento bacteriano en herida y tiempo de recolonización	El uso de plástico no reduce colonización de la herida. CHG alcohólica reduce colonización de piel por Estafilococo coagulasa -.	Muy pocos pacientes Ambos grupos recibían pintado con CH 5% No compara CH vs PY No mide riesgo de mediastinitis	1+

We recommend chlorhexidine over povidone-based products for skin preparation in cardiac surgery. *Evidence level 2+. Strong recommendation, moderate quality of evidence*

ATB prophylaxis

- Perioperative antibiotic prophylaxis (PAP) is one of the most effective measures in the prevention of surgical wound infection, but it is often performed inadequately
  - Is not started at the right time
  - It is continued for a prolonged period of time.
- Inappropriate use of antibiotic prophylaxis
  - increase the risk of infection
  - toxicity
  - antimicrobial resistance.
- Consider the microorganisms at each site.

Country/ Region	Recommendation				Reference
	Indication	1st ATB	Alternative	Duration	
Europe	multidisciplinary AM team	N/A	N/A	60 min before incision Continuing antibiotic prophylaxis after the end of surgery is not recommended	ECDC technical report 2013 doi 10.2900/85936
U.S.A	Valve Replacement/ Coronary artery bypass/ Transplant and TAVI	Cefazolin	Vancomicin +/- Gentamicin	2 gr 60min pre-incision 1gr every 3-4hrs <48hrs	Ann Thorac Surg 2007;83:1569–76
Spain	Valve Replacement/ Coronary artery bypass/PCM	Cefazolin or cefuroxime	Vancomicin	2gr/1.5gr 5´before anesthesia Every 4-6 hrs < 24hrs	SEIMC/GEIH 2001 https://seimc.org/documentos/geih_dyc2_2001.pdf
HGUGM	Valve Replacement/ Coronary artery bypass/ Transplant and TAVI	Cefazolin	Vancomicin	Single dose pre-surgery 2gr every 3hrs during procedure (GF>50) Stop after closure	Internal Document 2022


THANK YOU FOR YOUR ATTENTION!