



Perioperative Management and Strategies to Decrease Sternal Wound Infection

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Centers for Disease Control and classifications for Sternal Wound Infection (SWI)

- Superficial SWI
 - if only the skin and subcutaneous tissue are involved
- Deep SWI
 - when the infection reaches the sternum but does not involve it
- Osteomyelitis or Mediastinitis
 - when organ/space is involved





Centers for Disease Control and classifications for Mediastinitis

Diagnosis of Mediastinitis requires at least one of these Criterion:

- Organisms cultured from mediastinal tissue
- Evidence of mediastinitis seen during a surgical operation
- One of the following signs or symptoms : fever ($>38^{\circ}\text{C}$), chest pain or sternal instability and at least one of the following:
 - a. purulent discharge from mediastinal area
 - b. organisms from blood or discharge from mediastinum
 - c. mediastinal widening on x-ray.





Introduction

- Incidence of superficial SWIs after cardiac surgery is 0.5% to 8%
- Morbidity and mortality rate range from 0.5% to 9%





Introduction

- Incidence of mediastinitis after cardiac surgery is 1% to 5%.
- Mortality rate ranges from 10% to 47%



Gummett J . et al. Mediastinitis and cardiac surgery—an updated risk factor analysis in 10,373 consecutive adult patients. *Thorac Cardiovasc Surg.* 2002;50:87–91

El Oakley R.M., Wright J.E. *Postoperative mediastinitis: classification and management.* *Ann Thorac Surg* 1996;61:1030-1036.



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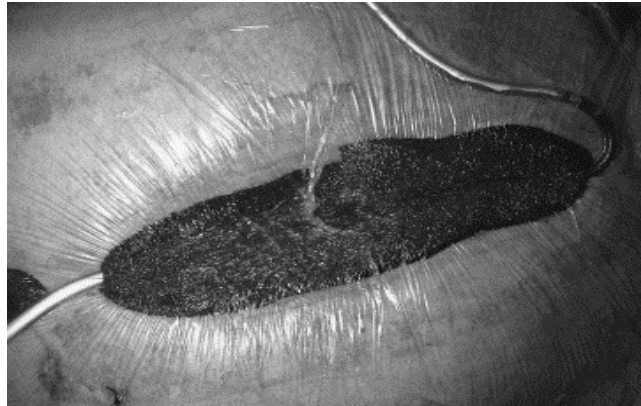
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Sternal Wound Infection

- Extends hospital stay
- Leads to additional surgical procedures, vacuum-assisted wound dressing and antibiotic therapy
- May triple health care costs in cardiac surgery





Risk Factors for SWI

- Reported consistently
 - Obesity
 - Prior cardiac surgery



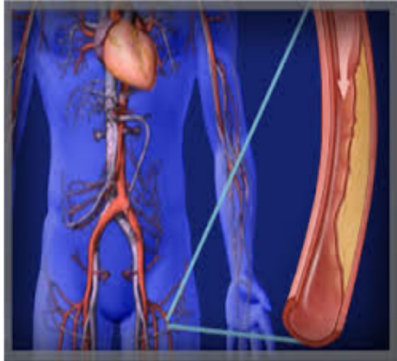
1. Mc Donald W.S., Brame M., Sharp C., Eggerstedt J. Risk factors of median sternotomy dehiscence in cardiac surgery. South Med J 1989;82:1361-1364

2. Bryan A.J., Lamarra M., Angelini G.D., West R.R., Breckenridge I.M. Median sternotomy wound dehiscence: a retrospective case control study of risk factors and outcome. J R Coll Surg Edinb 1993;37:305-308.





Risk Factors for SWI



Reported inconsistently

- Diabetes or perioperative hyperglycemia
- Peripheral artery disease
- COPD
- Tobacco use
- Use of bilateral internal mammary arteries
- Prolonged surgical procedure (> five hours)
- Return to the operating room within four days postoperatively
- Prolonged postoperative intensive care
- Large female breast size





Objective

- Analyze the frequency of sternal wound infection before and after changes in infection control policy.



Method

- Retrospective cohort study
 - Control period 2008-2010 (1250 patients)
 - Postintervention period 2012 (439 patients)
- Infection control measures introduced between these periods
 - New hand disinfectants and strict disinfection technique
 - Sternal closure technique
 - Redon catheter discontinuation
 - Safe Surgery Saves Lives (SSSL)
 - Strict post-operative wound care guidelines
 - Post-operative support vests (Posthorax®)
- Sternal wound infections were classified according to the guidelines of the CDC





Hand disinfection technique

- Alcohol based Sterillium® (Bode Chemie GmbH, Hamburg, Germany)
- Chlorhexidine based Hibiscrub® (Mölnycke Health Care, Dietikon, Switzerland)
- Waterless scrub times of 2 minutes were recorded and scrubbing technique was standardized according the Guideline for Hand Hygiene in Health-Care Settings





Comparison of the bactericidal efficacy of five products for surgical hand disinfection with the reference alcohol (n-propanol)

- All achieved a reduction all organisms by 5 logs (RF=5) within 3 mins fulfilling the chemical disinfectants and antiseptics quantitative suspension test
- Sterillium® and Hibiscrub® were the only products that

reduced the bacteria counts similar or more than 60% n-propanol immediately and after 3 hrs



Table I Comparison of the bactericidal efficacy of five products for surgical hand disinfection with the reference alcohol (n-propanol, 60%) according to prEN 12791

Product	Immediate value	P-value	Requirement	3 h Value	P-value	Requirement
n-propanol (60%)	0.83 ± 0.52			0.50 ± 0.84		
Hibiscrub	0.82 ± 0.50 ^a	>0.1	Pass	0.53 ± 0.98	>0.01	Pass
Betadine	0.59 ± 0.47	<0.1	Fail	0.29 ± 0.84	<0.1	Fail
Derman Plus	-0.2 ± 0.30	<0.1	Fail	-0.01 ± 0.46	<0.1	Fail
Sterillium	1.45 ± 0.88 ^b	<0.01	Pass	0.84 ± 0.93 ^b	<0.01	Pass
Softa Man	1.06 ± 0.68	>0.01	Pass	0.38 ± 0.72	>0.1	Pass

Mean with standard deviation of 20 subjects.

^a The mean is below the reference treatment and assessed not to be significantly lower at P = 0.1.

^b The mean is above the reference treatment and assessed to be significantly higher at P = 0.01.

Mandhetti MG, Kampf G, Finzi G, Salvatorelli G. Evaluation of the bactericidal effect of five products for surgical hand disinfection according to prEN 12054 and prEN 12791. *Hosp Infect.* 2003; 54: 63-67



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Safe Surgery Saves Lives' (SSSL) checklist

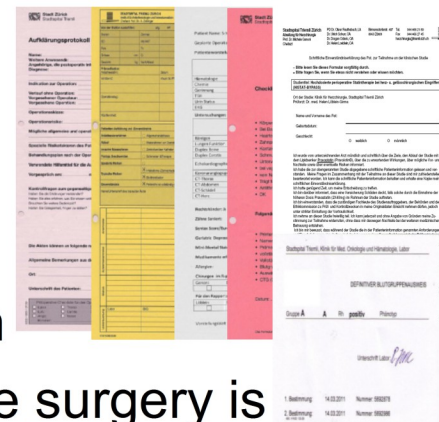


SURGICAL SAFETY CHECKLIST (FIRST EDITION)



Process Optimization

- Sign In: Identification
 - Time Out: Conformation
 - Sign Out: To report if the surgery is performed as originally planned, additional unplanned interventions and the occurrence of unexpected complications
- Has been shown to result in efficient operation time, a reduction in-hospital complications and mortality within the first 30 days after surgery



<input type="checkbox"/> NO	<input type="checkbox"/> YES
<input type="checkbox"/> YES, AND ADEQUATE INTRAVENOUS ACCESS AND FLUIDS PLANNED	<input type="checkbox"/> NOT APPLICABLE

THIS CHECKLIST IS NOT INTENDED TO BE COMPREHENSIVE. ADDITIONS AND MODIFICATIONS TO FIT LOCAL PRACTICE ARE ENCOURAGED.

Haynes A, Weiser T, Berry W, Lipsitz SR, Breizat A-HS, Patchen Dellinger E, et al. A surgical safety checklist to reduce morbidity and mortality in a global population. N Engl J Med 2009;360:491-9

Haynes AB, Weiser TG, Berry WR, Lipsitz SR, Breizat AH, Dellinger EP, et al. Safe Surgery Saves Lives Study Group. A surgical safety checklist to reduce morbidity and mortality in a global population. N Engl J Med. 2009;360:491-9.



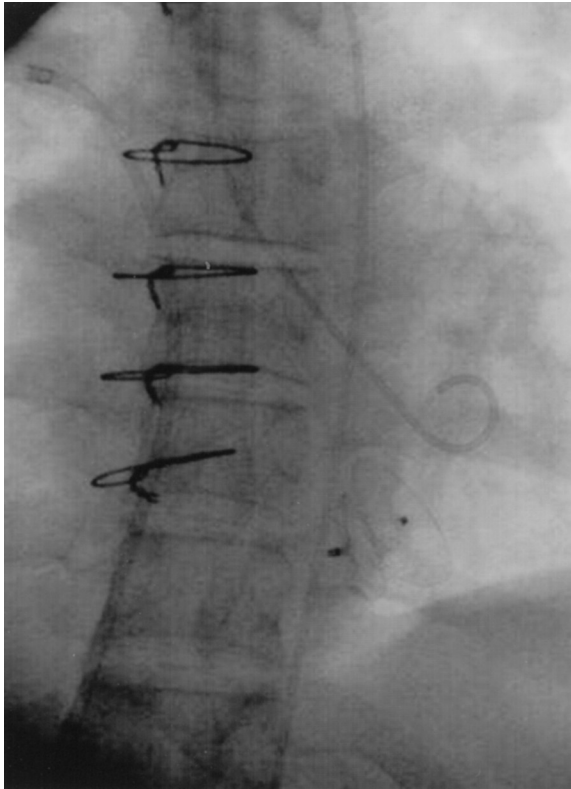
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Single loop technique Sternal closure



- Sternal closure in the post-intervention period is performed using surgical steel wires in single loop technique compare to the figure-of-eight technique used in the control period
 - easier to perform
 - less tissue damage
 - comparable mechanical support





Discontinuation of redon catheter

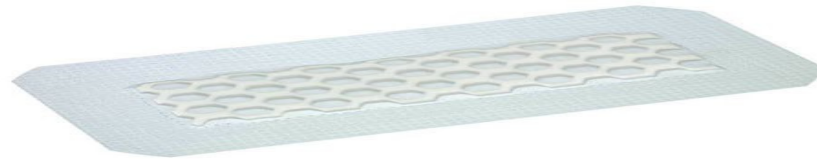
- Discontinuation of redon catheter
 - No benefit in reducing wound infection
 - May provide a route of entry for infective organisms





OPSITE Post-Op Visible (Smith & Nephew, Inc.)

- Replaced the normal gauze dressing during the post-intervention period.
 - Made of three layers: low adherent wound contact layer, lattice shaped absorbent pad and a waterproof top layer.
- Applied immediately and left in place for 5 days.
- Provides:
 - barrier to bacteria
 - reduced risk of maceration
 - maintains a dry wound through a highly absorbent pad and breathable film
 - allows uninterrupted monitoring of the wound





Discharge Instruction

- The patient is instructed to apply a waterproof dressing when showering and to keep the wound dry and clean until all wound crusts fall out to prevent maceration.
- Lotions, creams, oils, or powders on incision are strictly avoided until all crusts fall.





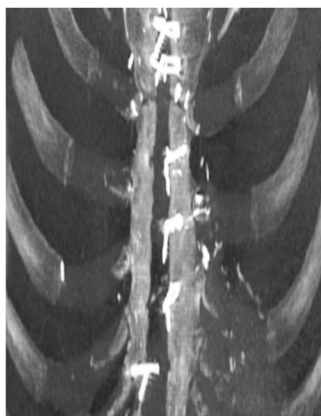
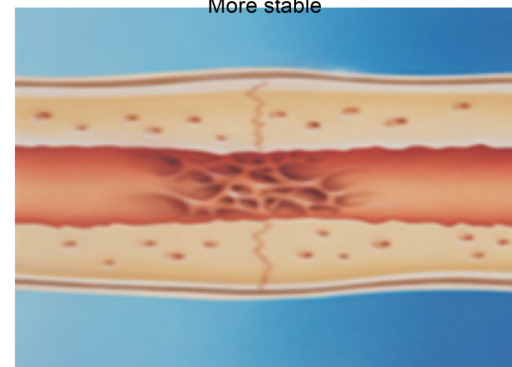
Posthorax® vest (Epple. Inc., Vienna, Austria)

- 2011 the Posthorax® vest was introduced to the clinic to be worn for 6 weeks after surgery
- ✧ Acts as shock absorber due to the cushions present on the front left and right side of the vest
- ✧ Acts as an anteroposterior sternal stabilizer and fixes the two halves of the sternum in place
- Consistent use of the Posthorax® vest has been shown to prevent deep sternal wound infections.



Hard Callus week 4-16

More stable



Gorlitzer M., et al. Prevention of sternal wound complications after sternotomy: results of a large prospective randomized multicentre trial. *Interact Cardiovasc Thorac Surg.* 2013;17:515-22.



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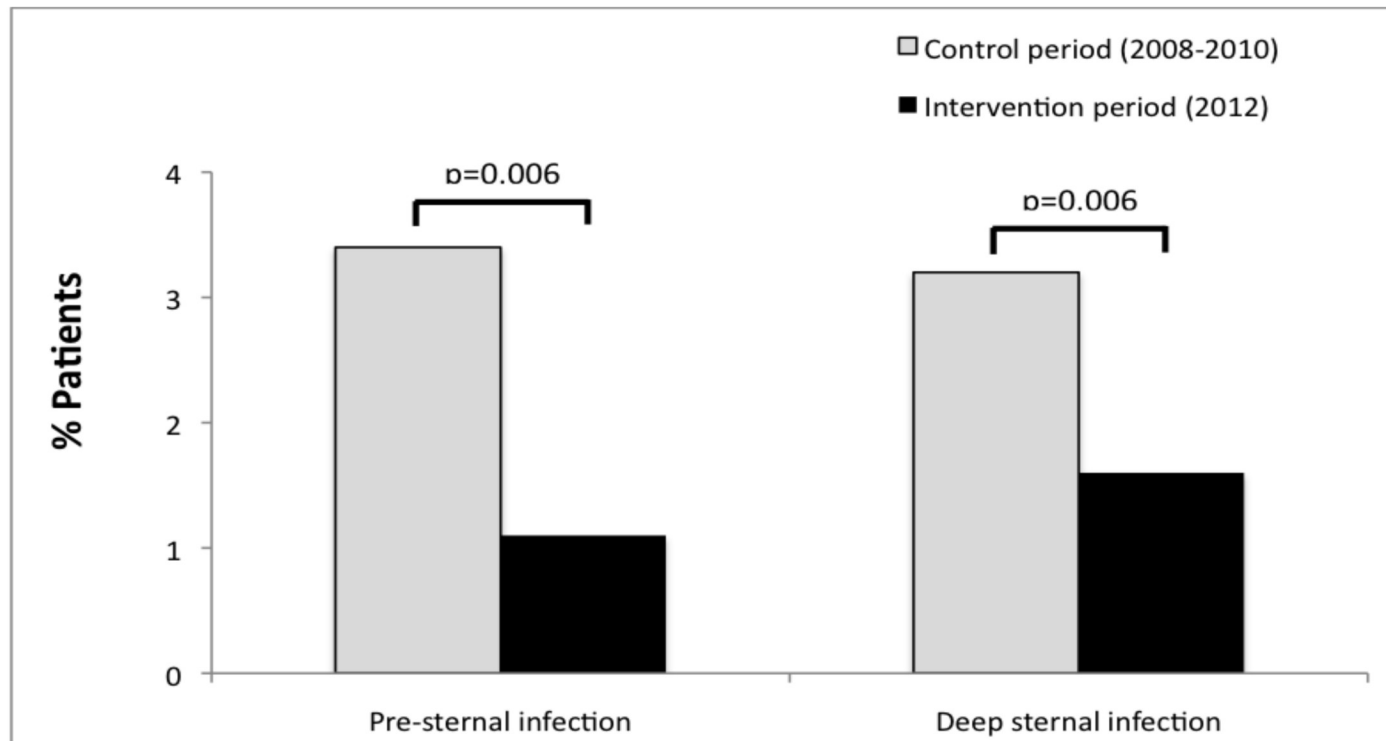
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Result

- A total of 1689 patients were included
 - 1250 patients (2008-2010)
 - 439 patients (2012)





Preoperative Data

	Control period 2008-2010 (n=1250)	Post-intervention period 2012 (n=439)	p
Age (years)	66.42	65.8	ns
BMI (kg/m ²)	28.6	27.6	ns
WBC (10 ⁹ /l)	8.13	7.98	ns
C reactive protein (mg/ml)	12.32	11.95	<0.001
Creatinine (μmol/l)	84.8	87.74	0.043
Albumin (g/L)	40.55	41.65	ns
Ejection fraction (%)	53.4	54.6	0.018
Gender (% Female)	27.4	26.9	ns
Hypertension (%)	79.5	68.0	<0.001
Diabetes (%)	22.8	22.2	ns
COPD (%)	7.6	8.1	ns
Euroscore	6.25	5.97	ns



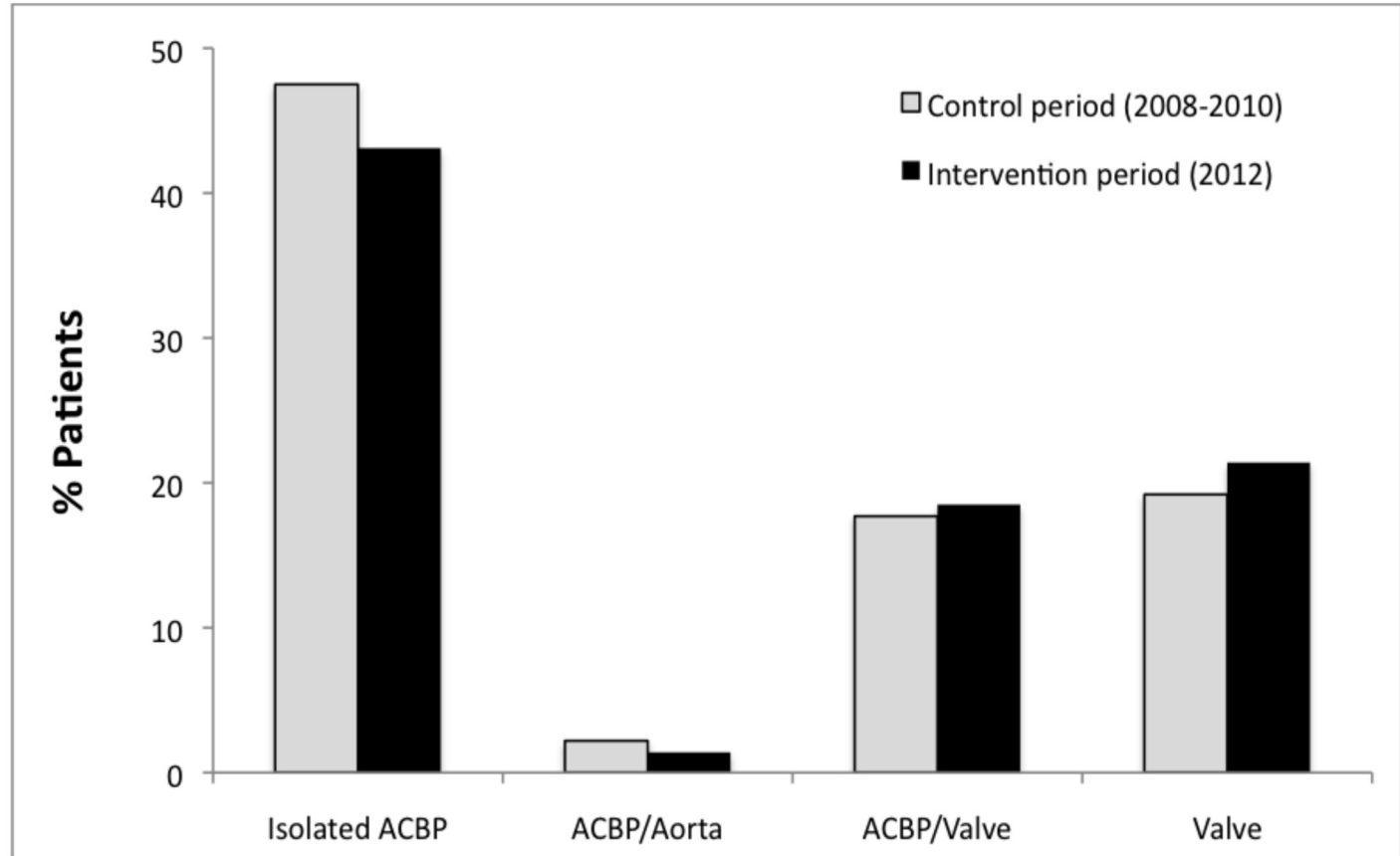
Correlation between preoperative data and infection

	No infection (n=1595)	Pre-sternal infection	Deep sternal infection (n=47)	p
Age	66	65.8	65.4	ns
BMI kg/m ²	28.38	27.6	27.9	ns
WBC 10 ⁹ /l	8.09	7.98	8.43	ns
CRP mg/ml	12.2	11.95	15.65	ns
Creatinine µmol/l	78	87.74	88.5	ns
Albumin (g/L)	41.2	41.65	40.94	ns
EF%	53.4	54.6	50.2	ns
Gender (% Female)	27	27.7	36.2	ns
Hypertension (%)	76.5	78.8	76.6	ns
Diabetes (%)	22.2	36.2	25.2	ns
COPD (%)	7.5	8.5	7.7	ns
Euro score	6.25	5.97	6.87	ns



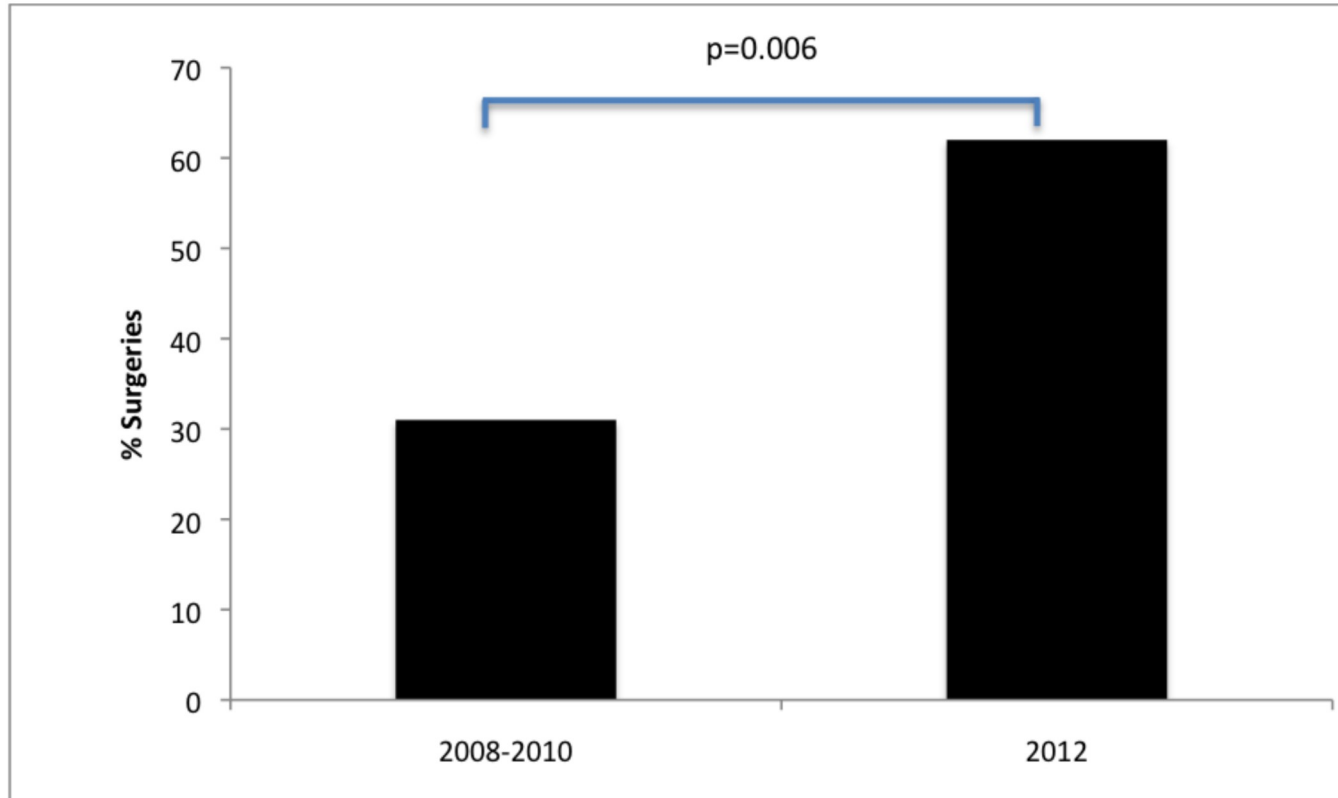


Types of surgery performed





Use of BIMA





Intra- and post- operative data





Correlation between intra- and post- operative parameters with sternal infection

	No Infection (n=1595)	Pre-sternal infection	Deep sternal infection (n=47)	p
Surgical time (min)	278	329	327	0.017
Intubation time (h)	27.1	20.87	48.53	0.001
CKMB peak ($\mu\text{g/L}$)	56.85	53.7	56.7	ns
Creatinine peak ($\mu\text{mol/L}$)	85	119	124	ns
PRBC	3.22	3.79	7.98	0.04
Noradrenalin ($\mu\text{g/min}$)	9.77	7.53	12.5	0.016
Re-thoracotomy	6.4	10.9	13.3	ns
BIMA (%)	24.7	43.9	25.9	0.021





Conclusion



Despite the higher BIMA and noradrenaline use in 2012 multidisciplinary strategies resulted in fewer sternal infections:

- New hand disinfectants and strict disinfection technique
- Sternal closure technique
- Redon catheter discontinuation
- Safe Surgery Saves Lives (SSSL)
- Strict post-operative wound care guidelines
- Post-operative support vests (Posthorax®)





Conclusion



- Responsibility to educate new rotating resident surgeons on the changes implemented to reduce sternal infections
- Institutional guidelines to help in maintaining standards





Conclusion



Process Optimization



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