

Risk factors for infections
due to carbapenem-resistant
Klebsiella pneumoniae after
cardiac surgery

Background

- The number of hospital outbreaks caused by carbapenem-resistant *Klebsiella pneumoniae* (CR-Kp) has rapidly increased in recent years, and CR-Kp is now considered endemic in several countries, including Italy
- Mortality associated with CR-Kp infections has been reported to be as high as 40-60%
- Patients undergoing major surgery are at increased risk of developing CR-Kp infections in comparison with other patient populations. In this regard, identifying risk factors for CR-Kp infection might be crucial to prevent the disease and reduce morbidity and mortality in the postoperative period.
- Aim of the present study was to assess risk factors for CR-Kp infections after cardiac surgery

- The study was conducted at the IRCCS AOU San Martino-IST teaching Hospital, University of Genoa, Genoa, Italy.
- All 553 patients who underwent open heart surgery from January 2014 to December 2014, were included in the study.

Methods 1

- Single-center retrospective study
- The primary study endpoint was postoperative CR-Kp infection.
- CR-Kp infection was defined and classified according to the Centers for Disease Control and Prevention (CDC) criteria. Only the first CR-Kp infection episode after cardiac surgery was considered for the analysis. Identification of CR-Kp from rectal swab in absence of signs and symptoms of infection was defined as CR-Kp colonization.
- For all patients, routine surveillance rectal swabbing was performed at standard points in time: (i) before surgery; (ii) the first day after surgery and every seven days thereafter until discharge. According to the time of the first positive culture, isolation of CR-Kp from rectal swab was categorized as pre-surgery (i) or post-surgery (ii) CR-Kp colonization.
- Potential predictors of CR-Kp infection were compared between patients who developed CR-Kp infection and those who did not, by means of the χ^2 test, the Fisher exact test, or the Mann-Whitney U test, as appropriate.

Methods 2

- To assess the independent role of variables, a multivariate Cox regression was carried out using a stepwise backward procedure, after having verified proportional hazards. All variables associated with CR- Kp infection in the univariate analysis ($p < 0.10$) were included in the model.
- For the purpose of the analysis, CR-Kp colonization was included in the model as a time-dependent covariate, according to the time of the first positive rectal swab.
- A secondary endpoint was the occurrence of postoperative mortality within six-months after surgery through non-adjusted survival estimates calculated with the Kaplan-Meier product-limit method. Then, to reduce the possible confounding effect of patients' characteristics, survival curves were adjusted for age, sex, comorbidities

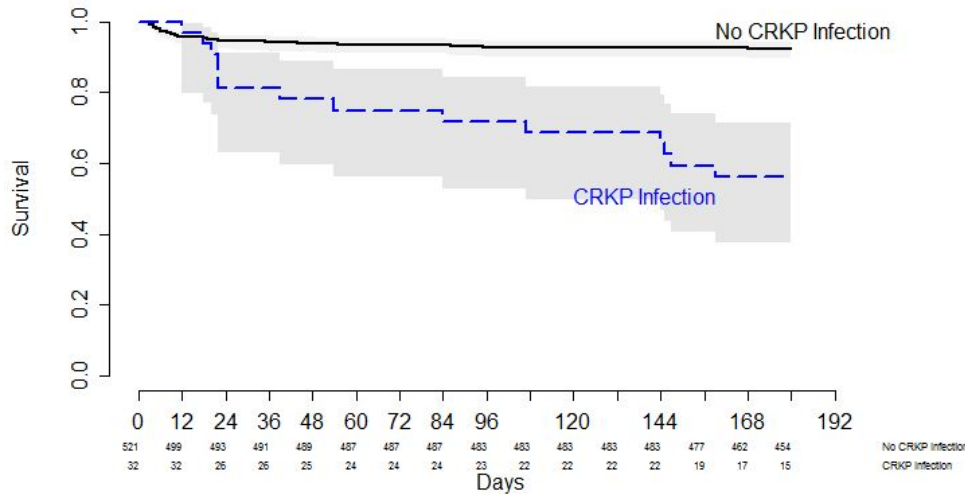
Results 1

- Among 553 patients undergoing open heart surgery at our hospital, 32 developed CR-Kp infections (6%).
- In the final multivariate model, CR-Kp colonization, chronic obstructive pulmonary disease, postoperative stroke, postoperative mechanical ventilation >48, cardiopulmonary bypass time >120 min, and female sex were significantly associated with the risk of developing CR-Kp infection.

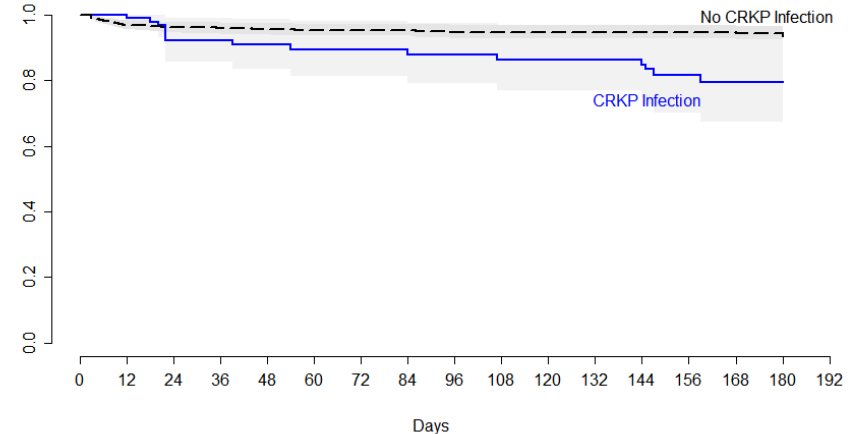
Variable	Hazard Ratio (95% CI)	p
CR-Kp colonization (time-dep covariate)	577.6 (71.9-4638.6)	<0.001
COPD	11.3 (3.9-32.4)	<0.001
Postoperative stroke	7.0 (2.3-21.7)	<0.001
Postoperative MV > 48 h	6.5 (2.4-17.2)	<0.001
CPB time > 120 min	2.6 (1.1-6.0)	0.023
Female sex	2.3 (1.1-5.0)	0.034

Results 2

- A reduced survival was observed in patients who developed CR-Kp infections in comparison with those who did not (log-rank test, $p < 0.001$).



Non-adjusted survival curve (KM method)



Survival curve adjusted for age, sex, comorbidities (on the basis of Cox's proportional hazards regression)

Conclusion

- In our cohort CR-Kp colonization was the strongest predictor of CR-Kp infection after cardiac surgery, with most colonization and infections occurring in the early postoperative period.
- CR-Kp infection after cardiac surgery significantly affected survival.
- Because of the dramatic shortage of dependable therapeutic options, maximized preventive efforts might be the most effective strategy to reduce the unfavorable impact of CR-Kp on postoperative morbidity and mortality, and to control dissemination.