

Towards zero perioperative mortality

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Mortality after non-cardiac surgery varies considerably among different countries and different hospitals. Therefore, human and organizational factors that significantly contribute to these differences must be at play. The European Surgical Outcomes Study (1) observed the surgical outcome in 46,539 patients from 498 hospitals in 28 European countries. Overall crude mortality after non-cardiac surgery was 4% (1,855 patients) and varied from 1.2% (Iceland) to 21.5% (Latvia).

In our centre only one patient (0.3% 95% CI 0.1-1.9%) died among the 292 patients who underwent non-cardiac surgery during the 7-day study period. When comparing our findings with those of the overall Italian population enrolled in the same study (141/2,673 = 5.3%) and with those of the overall European population (1,855/46,247 = 4.0%), we noticed that this difference was probably not due to chance ($p < 0.001$ in both cases using the Fisher test), with comparable patients' severity and type of surgical procedures. A subsequent one-week observational study in 2013 focusing on patients undergoing general anesthesia (LAS-VEGAS trial NCT01601223) confirmed the low perioperative mortality in our hospital (0/156 patients). To the best of our knowledge, the only survey performed in the past in our centre was limited to coronary artery bypass grafting (CABG) surgery and evidenced a 0.5% (95% CI 0.03-0.9%) 30-day mortality, (again) significantly lower than the overall 2.6% Italian crude mortality (among 34,310 patients in 64 Italian centers) (2).

Large observational clinical studies greatly help in the understanding and improvement of perioperative care. Moreover, photographing the current situation, they provide relevant data that should trig-

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ger a change in the current approach to the patient undergoing surgery.

In the following, we therefore list various factors potentially associated with the low perioperative mortality in our centre, i.e. factors that might differ from routine in other hospitals: 1) NIV (non-invasive ventilation) in general wards. We routinely use NIV outside the intensive care unit at an early stage of acute respiratory failure, and often we apply it also as a prophylactic measure in patients at high-risk of post-operative respiratory complications (3). 2) MET (medical emergency team). There are no hierarchies in the activation of emergency team. Every member of the hospital staff is invited (and used) to call the anesthesiologists/intensivists whenever a patient is judged at risk of deterioration or is already unstable (3). 3) ERAS (Enhanced Recovery After Surgery), a multimodal perioperative care pathway designed to achieve early recovery for patients undergoing major surgery www.erassociety.org 4) Several international and national multicenter randomized controlled trials (mRCT) are ongoing in the perioperative setting

(NCT00364637; NCT01572337; NCT00994825; NCT00959569; NCT01249794; NCT01082874, ACTRN012605000557639)

or have recently been concluded (NCT00670345; NCT00821262; NCT00337766, NCT00621790).

As a consequence, staff is continuously, automatically updated on the best current practice and patients benefit from the Hawthorne effect (patients included in RCTs have better outcomes than usual even when they receive the placebo). 5) International consensus conferences were held on a yearly basis starting from 2010 focusing on mortality reduction in cardiac surgery (4), in the perioperative period of any surgery (5), in patients with or at risk for acute kidney injury (6) and in the overall critically ill patients population (ongoing at <http://www.hsrproceedings.org/> - Last accesses September 10th

2013), that involved more than 1,500 colleagues from over 70 countries. 6) Fourteen topics with at least one randomized evidence (either a RCT or a meta-analysis of RCT or both) of an effect on perioperative survival (5) are showed in *table 1* together with our management. 7) High volume Hospital. We perform approximately 30,000 interventions per year with highly specialized surgeons, with patients following standardized pathways and with the presence of all surgical, medical and diagnostic specialties (7). 8) Sepsis management. A dedicated team of physicians and nurses regularly meets and updates internal guidelines on the management of septic patients. 9) ICU (Intensive Care Unit) is readily available for patients with a complicated intraoperative course. The only patients that routinely go to the ICU are those undergoing thoracoabdominal aneurismectomy surgery, neurosurgery, cardiac surgery and pneumonectomy and those with an ASA \geq 4. As a consequence we have more beds promptly available for in-hospital (and out-of-hospital) emergencies. 10) ECMO (ExtraCorporeal Membrane Oxygenation). An ECMO team is always available for patients with cardiac arrest or cardiogenic shock refractory to advanced life support, for patients difficult to wean after cardiopulmonary bypass or for patients with severe ARDS. 11) Acute Pain Service (APS). There is a 24/7 anesthesiologist dedicated team following postoperative patients for the management of pain (eg through epidural catheters, regional or patient controlled analgesia, analgesic infusions...) in cooperation with the primary care team. 12) Teaching university hospital for medicine and nursing. The Hospital is affiliated to Vita-Salute University of Milan and is the training site to educate medical and nurses students, residents and fellows in all of the major medical and surgical specialties. 13) Safety operating room check-lists have been implemented several years ago and are rou-

Table 1 - Panel A - Topics (drugs and/or non surgical techniques or strategies) with randomized published evidence of reduction in perioperative mortality (modified from reference E) and their use in our Hospital.

Topic	Setting	Implementation
Chlorhexidine oral rinse	Any major surgery and all ICU patients	Routine
Clonidine	Any surgery and ICU patients	If needed
Insulin for glycemic control	Cardiac ICU	In all patients with a target of 12-150 in order to avoid hypoglycemia
Intra aortic balloon pump	Cardiac surgery	Routine in high risk patients
Leucocyte depletion of transfused blood	Any surgery	Selected patients
Levosimendan	Cardiac ICU	Selected high risk patients
Neuraxial anesthesia	All major non-cardiac surgery	Routine (often associated to general anesthesia)
Non invasive respiratory support	Any surgical patient	Outside and inside the ICU in post-operative patients with early acute respiratory failure
Perioperative hemodynamic optimization	Any surgery	Routinely performed but not standardized
Perioperative supplemental oxygen	Any surgery	Routine in the recovery room
Selective decontamination of the digestive tract	Any surgery	Never implemented
Volatile anesthetics	Any surgery	Routine

ICU = Intensive Care Unit

Table 1 - Panel B - Topics (drugs and/or non surgical techniques or strategies) with randomized published evidence of increase in perioperative mortality and their use in our Hospital.

Topic	Setting	Implementation
Aprotinin	Cardiac surgery	Never implemented
Extended-release metoprolol	Non-cardiac surgery	Intraoperative B Blockade was never implemented.

tinely applied (8). 14) Simulation and refresher courses are continuously performed on most of the above topics either in Italian, for Hospital personnel or in English, for visitors <http://www.hsr.it/>.

Further topics, that are probably common among teaching hospitals are:

A) Ability to recognize early and manage complications. B) Patients at risk are monitored by telemetric devices in general wards. C) Staff adequate in number and competency. D) Debriefing: all aspects of the difficult surgical procedures or complicated courses or “nearly miss” are routinely collegially discussed and analyzed. This allows a “per-

formance feedback” and individual, team, and organizational learning. E) Specialized anesthesiologists. The hospital provides a full range of ultra-specialized anesthesia services including general, loco-regional, neuro, cardiac, obstetrical and specialized ambulatory surgery. F) Modern and technologically advanced operating rooms. G) Anesthesiologist as perioperative leader. H) Presence of dedicated anesthesia nurse. I) Patients follow perioperative standardized clinical pathways, developed by each surgical team after reviewing up-to-date medical literature in order to identify the best practice. These pathways include all hospi-

tal services including nutrition, anesthesia, nursing, physical therapy, follow-up therapy etc.

Two limitations to this approach might be highlighted: some perioperative death might be a necessary evil following the offer of advanced surgical therapy to otherwise very sick patients; while avoiding death is always good, you still need to avoid poor functional status in those surviving (saving patients from death but leaving them crippled might not necessarily be a smart result).

Nonetheless, aiming to near-zero perioperative mortality is a realistic target; actually, it is an imperative. However, the age when a single man (a surgeon, more commonly) could significantly lower perioperative mortality thanks to his/her technical prowess is definitively past. Nowadays, only a joint effort by all healthcare personnel, researchers, hospital managers, and - last but not least - politicians can achieve a clinically significant, economically sustainable and long-lasting result. We, as clinicians and researchers, must keep on looking for all the factors that can improve or worsen perioperative survival. We have

also the duty to promote the awareness of the citizens on the topic, as citizens have the right to have the best perioperative care, for example by choosing the hospitals that achieves the best survival rates. It is no more time for sentences like “we did all that was possible” or “it was an unavoidable accident”. It is time for ranking, and the benchmark is: zero perioperative mortality.

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