Leveraging Research in Chest Drain Management to Enhance Recovery After Cardiothoracic Surgery (ERACS)

Summary of a symposium held on 11 September 2024 in Zurich, hosted by Prof. Dr. Omer Dzemali, chaired by PD Dr. David Niederseer, MHBA, Prof. Dr. Bettina Pfannmüller and PD Dr. Hector Rodriguez.

Advances in Enhanced Recovery After Surgery (ERAS) cardiac surgery protocols have improved clinical effectiveness. A recent symposium in Zurich, Switzerland, was an exciting step forward in bringing together current research and clinical practice. The in-depth discussions highlighted the importance of optimising prehabilitation, surgical approaches, chest drain management, pain relief and rehabilitation to further improve clinical outcomes and reduce complication rates in cardiac surgery.

Postoperative Management in the ERAS Model: What to Consider?

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Prof. Nestoras Papadopoulos Zurich/CH

Posterior Pericardiotomy in Cardiac Surgery: An Alternative to Conventional Drain Management?

Stak Dushaj, MD, Zurich/CH

Postoperative Management in the ERAS Model: What to Consider?

Sonia Matter-Ensner, MD

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Key Message

Non-pharmacological and pharmacological delirium screening reduces the risks of postoperative complications.

Compliance with ERACS protocols from the first referral to rehabilitation improves patient outcomes, reducing the length of hospital stay and complications[1]. Dr. Sonia Matter-Ensner, a specialist in anaesthesia for cardiac surgery (Zurich), discussed key elements included in clinical trials for enhanced recovery after cardiac surgery but are currently not graded in ERACS (Enhanced Recovery After Cardiac Surgery)[2].

When combined with early mobilisation, physiotherapy, nutritional support, and early drain removal, early extubation (<6h) is beneficial. Even extubation in the operating room is feasible and can significantly reduce the stay in the intensive care unit (ICU) and length of hospital stay (LOS)[3]. However, such 'fast-track' protocols are resource-intensive, requiring specialised postoperative care units. For patients fitting specific criteria, early mobilisation within 4 hours of extubation, combined with respiratory and physiotherapy exercises, improves their respiratory and functional capacity and reduces the length of hospital stay[4]. Opioid-sparing multimodal analgesics, particularly ultrasound-guided chest wall nerve blocks, reduce postoperative complications[5].

Assessing levels of frailty in perioperative ERACS protocols is crucial to improving postoperative outcomes for high-risk patients[6]. Early mobilisation and supportive therapies mentioned above improve outcomes for this population. Delirium and poorer long-term outcomes are also interrelated. While ERACS protocols recommend daily delirium screening, delirium prevention strategies, both non-pharmacological and pharmacological, reduce these risks[7].

Quote

"There is a tendency to fast-track patients where possible, but the priority is to concentrate on the outcomes for seriously ill patients".

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ERAS Approach: Applicable to All Cardiac Surgery Patients?

David Niederseer MD, PhD

Hochgebirgsklinkik, Davos, Switzerland

Key Message

Individualised, preoperative and postoperative rehabilitation from a multidisciplinary team is central to recovery.

David Niederseer, a sports cardiologist (Davos), explained how prehabilitation and rehabilitation complement Enhanced Recovery After Surgery (ERAS) care, but their importance is often underestimated in cardiac surgery. Optimising a patient's physical fitness and mental health before cardiac surgery improves outcomes. Prehabilitation includes exercise programmes, nutritional support, and lifestyle education. Exercise programmes increase aerobic functional capacity, strengthen physiological reserve and support recovery[1]. Moderate physical activity for 30 minutes daily, resistance and muscle strength training improve quality of life, activities of daily living (ADL), 6-minute walk test, and frailty scores after surgery[2]. Evidence also shows that preoperative acute exercise improves graft quality in coronary artery bypass graft (CABG) surgery, with fewer complications.

The cardiac rehabilitation centre at Medicine Campus Davos in Switzerland receives around 1200 patients annually during the acute phase postoperatively. The centre's RECOVER project aims to characterise the cardiac rehabilitation cohort. Patients are followed up at three months post-cardiac surgery and then annually. Retrospective data published by this group revealed that postoperative supervised exercise-based rehabilitation following open heart or minimally invasive cardiac surgery improved fitness and overall quality of life in both groups (n=408)[3]. Rehabilitation should focus on gradually increasing physical activity with aerobic and strength training. The intensity depends on the patient's physical state before surgery, any complications, or the type of surgery. Rehabilitation also includes advice on coping with postoperative pain, sleep disturbances, digestion, and other complications.

Cardiac rehabilitation is also an ideal time to manage comorbidities, blood pressure, diabetes, weight management, and psychosocial support for long-term success. The overall care package must be a holistic and individualised approach for each patient that includes specialised nursing care, family, and patient support to enhance recovery.

It was noted that rehabilitation programmes are not available in all countries. Economic studies will help justify the cost-benefit of perioperative programmes and show how much the investment in prehabilitation will reduce the need for rehabilitation.

Quote

"The duration of rehabilitation depends on the indication, but even one session improves outcomes after coronary artery bypass surgery."

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3. Hubisz MM, van der Stouwe JG, Ziob M, et al. A comparative analysis of open heart surgery and minimally invasive cardiac surgery in exercise-based cardiac rehabilitation. *J Cardiothorac Surg*. Jun 27 2024;19(1):390. doi:10.1186/s13019-024-02871-z

Retained Blood Syndrome (RBS): What is It?

Jurij M. Kalisnik, MD, PhD

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Key Message

Approximately 30% of acute morbidity and mortality following cardiac surgery is associated with insufficient chest drainage.

The rate of postoperative complications for all types of cardiac surgery is linked to chest drain management and inflammation. Professor Jurij M. Kalisnik (Austria) presented evidence to highlight where the knowledge gaps remain and how to prevent complications before they occur. Retained blood syndrome (RBS) encompasses the most common complication following cardiac surgery (30-50%) and is associated with higher in-hospital mortality, higher incidence of renal replacement therapy, and longer ICU and hospital length of stay[1].

A study on postoperative blood loss kinetics reveals that the rate of bleeding in the early postoperative period can predict major bleeding at 12 hours[2]. Early reexploration (0-4 hours) for postoperative bleeding reduces the risk of morbidity and mortality[3]. Equally, the rate of bleeding can advise us on the source of the bleeding and whether reexploration is needed[4].

Data are available from various established cardiac centres reporting their typical total blood drainage volume levels, corresponding to insignificant or mild bleeding, according to the universal definitions of bleeding[5]. While classified as insignificant or mild, these bleedings are associated with remarkable rates of retained blood-associated complications, causing significant morbidity and even mortality. Up to 40% of chest drains block, leading to retained blood in the pericardial space[6]. RBS and pericardial effusion lead to pericardial tamponade, hemolysis, activation of the inflammatory response, and postoperative atrial fibrillation in susceptible patients. Thus, strategies to reduce the exposure of the pericardium to the prooxidative and proinflammatory environment by posterior pericardiotomy[7] and improved chest drainage will further mitigate complications[8]. The advancement in digital chest drain technology allows blood loss to be constantly measured. Around one-third of reexploration surgeries for bleeding, without the presence of bleeding at the surgical site, could be avoided if the chest drainage system provided optimal drainage during the ongoing bleeding with the removal of all retained blood and clots.

Quote

“At least 30% of rexplorations could be prevented by optimising chest drain management”.

1. Balzer F, von Heymann C, Boyle EM, Wernecke KD, Grubitzsch H, Sander M. Impact of retained blood requiring reintervention on outcomes after cardiac surgery. *J Thorac Cardiovasc Surg*. Aug 2016;152(2):595-601.e4. doi:10.1016/j.jtcvs.2016.03.086
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4. Shou BL, Aravind P, Ong CS, et al. Early Reexploration for Bleeding Is Associated With Improved Outcome in Cardiac Surgery. *Ann Thorac Surg*. Jan 2023;115(1):232-239. doi:10.1016/j.athoracsur.2022.07.037
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Post-op Drainage Management: Is It Important, and What Do We Know About It?

Prof. Dr. Theodor Fischlein

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Key Message

Chest drain management has a significant impact on surgical outcomes, underscoring the importance of maintaining chest drain patency immediately after surgery.

Chest drainage aims to completely evacuate blood and fluids from around the heart and lungs. Professor Fischlein explained the mechanisms behind RBS and the new drainage technologies that can improve patient outcomes. Around 36% of chest drains clot, and 86% occlude below the skin, making it difficult to detect[1]. The impact of RBS was measured in a retrospective study of nearly 7,000 patients, and it was found that 20% had RBS, leading to a four-fold increase in in-hospital mortality, prolonged length of ICU, and hospital stay[2]. Similar results were seen in a study of coronary surgery[3]. A few hundred millilitres of blood can cause inflammation and postoperative atrial fibrillation (POAF). Pericardial fluid analysis shows higher levels of myoglobin, troponin-1, and CK-MB than in plasma, inducing cardiac muscle injury[4].

Chest drainage technology has improved the outcomes for patients undergoing cardiac surgery. Active tube clearance (ATC) technology clears thrombi from the chest drains and has shown a significant reduction in reexploration rates[5] and between a 30% and 44% reduction in RBS and POAF[6,7]. In patients who received left ventricular assist device (LVAD implantation), active clearance resulted in a 65% reduction in reexploration rates and an 82% reduction in the need for delayed sternal closure compared to conventional chest drains[8].

Digital chest drainage systems are safe and effective. The advantage over traditional drainage systems is that they permit early mobility, improve patient satisfaction, do not require wall suction, and allow dynamic digital data collection, measuring fluid loss (and air leak in thoracic surgery). They also result in higher drainage volumes in the early postoperative period, which may indicate more effective drainage[9]. Compared to traditional drainage systems, digital drainage systems significantly reduce the incidence of POAF, reexploration rates, interventions for RBS, deep sternal wound infections, and a shorter ICU and hospital stay[10]. The limitation is that it remains difficult to prove that all the mediastinal blood has been removed.

Compared to conventional or active clearance chest drains, hydrogel-coated drains offer higher drainage volumes, better patency, reduced pleural effusions, and shorter length of hospital stay[11]. Therefore, combining a digital drainage system with hydrogel-coated drains could offer an optimal combination.

Quote

“We need to improve perioperative management with more data on fluid dynamics and fluid quality”.

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Minimally Invasive Cardiac Surgery (MICS) and how Proactive Chest Drain Management Could Help.

Prof. Nestoras Papadopoulos, FRCS, FRCS (CTh)

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Key Message

There is no consensual evidence for chest drain management in MICS. Multiple chest drains are not associated with any advantages in preventing complications.

Professor Nestoras Papadopoulos (Zurich) described the evolution of surgical techniques and chest drain management. A risk analysis study of minimally invasive surgery via right-sided thoracotomy has low perioperative morbidity and mortality rates, with a reexploration rate of 2.6%[1]. Retrospective analysis of patients undergoing aortic root surgery found that compared to full sternotomy, the less invasive partial upper sternotomy reduced trauma. The reexploration rate was around 4% in both groups[2].

Blood drainage in the first 24 hours is crucial. Inadequate chest drainage has been discussed, but prolonged chest drainage can also lengthen recovery times, reduce pulmonary recovery, and increase the hospital length of stay. Evidence shows that drains' type, number, placement, and duration and surgical technique impact postoperative outcomes. The improved postoperative outcomes following active tube clearance (ATC) lead to fewer hours in the ICU and hospital length of stay, corresponding to significant cost savings[2]. Increasing the number of chest drains does not provide advantages for preventing reexploration for bleeding or tamponade[3].

Drain placement can significantly affect postoperative outcomes[4]. A systematic review of patients undergoing cardiac surgery found that placing the drain in the posterior pericardium resulted in a 90% reduction in cardiac tamponade, a 58% reduction in POAF, and a significant reduction in early pericardial effusions (80%), and mortality (50%)[4,5]. However, opening the pericardial space results in blood in the left thorax, increasing pleural effusions[4].

Using published evidence, Prof. Papadopoulos has implemented standard operating procedures depending on the type of minimally invasive performed.

- Partial upper sternotomy using one drain[1] (posterior pericardium).
- Right mini-thoracotomy using a drain in the posterior pericardium (inserted via oblique sinus) and the right pleural cavity.
- Left mini-thoracotomy using a single drain in the left thoracic cavity.

Simultaneously to CABG, a posterior pericardiectomy is performed to avoid interaction with the bypass graft and manage the drainage of blood in the left pleural cavity.

Quote

“Optimisation of drain placement is evolving, but will depend on the type of surgery.”

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Posterior Pericardiotomy In Cardiac Surgery: An Alternative to Conventional Drainage Management?

Stak Dushaj, MD PhD

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Key Message

Posterior pericardiotomy is easy to perform, and results in less effusion recurrence, less POAF, fewer complications and shorter length of hospital stay.

Pericardial effusion is a bloody or serous fluid that accumulates in the pericardial space between the parietal and visceral pericardium. Following cardiac surgery, pericardial effusion occurs in around 60% of patients. Not all cases are hemodynamically relevant, but around 6% are due to cardiac tamponade, requiring reexploration[1]. One sign of pericardial effusion is POAF, which occurs in around 30% of patients following cardiac surgery[2]. POAF is associated with higher mortality, renal dysfunction, increasing hospital length of stay, and overall costs. Several studies have shown that the incidence of POAF can be significantly reduced by conducting a posterior pericardiotomy (PP) in coronary artery bypass graft (CABG) surgery[3]. PP also significantly reduces cardiac tamponade[4]. PP is easy to perform, which results in a lower rate of recurrent effusions and POAF. Care needs to be taken to avoid lung adhesions.

Quote

“The recurrence rate of pericardial effusion was 34% after pericardiocentesis and 0% after posterior pericardiotomy.”

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