

# ACUTE KIDNEY INJURY IN CARDIAC SURGERY PATIENTS

The Clinical Journey from Cardiac Surgery to Renal Replacement Therapy

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# What is cardiac surgery associated-acute kidney injury?

# **AKI** is a **COMMON** complication of **cardiac surgery**<sup>1–7</sup>



In patients who undergo cardiac surgery, the development of AKI is associated with an **INCREASED RISK OF MORBIDITY AND MORTALITY**<sup>2–4,7–10</sup>



greater for those with AKI compared with those without AKI<sup>8,11</sup>



Retrospective single-centre cohort study of cardiac surgery admissions from June 1998 to May 2002

\*Incidence typically reported in published studies

## A **LARGE PROPORTION** of patients undergoing **CARDIAC SURGERY** develop **AKI**<sup>1-7</sup>

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# **CSA-AKI** is a **SERIOUS** condition<sup>2-4,7-10</sup>



# Among patients who have undergone cardiac surgery, the **ECONOMIC BURDEN** is significantly

No AKI (n = 258)\$13,836 **TOTAL** POST-CARDIAC \$129 SURGERY COST WAS \$19,211 \$1083 **MORE** FOR A PATIENT WITH CSA-AKI<sup>8</sup> \$796 \$234

#### **CSA-AKI** is associated with both a high **CLINICAL BURDEN** and a high **ECONOMIC BURDEN**<sup>1–11</sup>

#### Why do cardiac patients get AKI?

#### In addition to **PATIENT RISK FACTORS**, there are many **PROCEDURE-RELATED RISK FACTORS** for developing CSA-AKI<sup>12–15</sup>



#### **CSA-AKI** has **UNIQUE** risk factors that **DIFFERENTIATE** it from other causes of **AKI**<sup>12–15</sup>

#### **HAEMODYNAMIC PERTURBATIONS** during surgery can lead to **CSA-AKI**<sup>12,14</sup>

#### There are several mechanisms that may contribute to the **DEVELOPMENT** of **CSA-AKI**<sup>12–15</sup>

Effect of CPB circuit Low cardiac output **Blood** pressure Venous pressure Preload/volume Anaemia/haemolysis Ischaemia/reperfusion

Emboli Arterial obstruction Venous congestion Perfusion pressure Abdominal hypertension

> Neurohormonal Vasoconstriction Venous congestion **Tubular toxicity**

Inflammation Oxidant stress Complement activation Toxins/drugs Contrast media

## What about patient haemodynamics?

Patients who undergo cardiac surgery may experience perioperative HAEMODYNAMIC PERTURBATIONS; FLUIDS and vasopressors are typically used to restore haemodynamic stability<sup>16–18</sup>



During or after CARDIAC SURGERY, patients may experience a significant SHIFT IN FLUIDS from the intravascular to the extravascular space<sup>18–20</sup>

Total perioperative (0–24 hr) fluid balance by AKI severity<sup>17</sup>



This fluid shift, in combination with the potentially LARGE VOLUMES of FLUID that may be needed to restore haemodynamic stability, can result in a positive fluid balance<sup>14,17</sup>



Low MAP and high vasopressor use\*



#### 2007 single-centre, prospective cohort study of 282 adult cardiac surgery patients<sup>17,21</sup>

Management of perioperative haemodynamic instability may lead to a **POSITIVE FLUID BALANCE** after cardiac surgery, especially in patients with AKI7,14,17,22

#### The development of **FLUID OVERLOAD** is associated with an increased risk of mortality and an increased risk of AKI or the need for RRT<sup>17,23</sup>







Higher need for RRT<sup>17</sup>

\*From the induction of anesthesia until 24 hr after commencement of cardiopulmonary bypass. 2007 single centre, prospective cohort study of 282 adult cardiac surgery patients.<sup>17,21</sup>

#### In patients who undergo cardiac surgery, HAEMODYNAMIC INSTABILITY and FLUID OVERLOAD are INDEPENDENTLY ASSOCIATED with an increased risk of **MORTALITY** and the need for **RRT**<sup>17,23,24</sup>

How should fluid removal be approached in a patient with CSA-AKI?

In PATIENTS with CSA-AKI, FLUID REMOVAL BY RRT can be challenging due to the risk of WORSENING HAEMODYNAMIC STATUS<sup>14,25,26</sup>

Current clinical practice guidelines recommend use of **CONTINUOUS** RRT in AKI patients who are HAEMODYNAMICALLY UNSTABLE<sup>14,25,26</sup>



Some patients require fluid removal by **RRT**, but **UNDESIRABLE FLUCTUATIONS** 

in fluid balance may occur with certain modalities<sup>25–27</sup>



RRT helps SUPPORT KIDNEY **RECOVERY** in patients with CSA-AKI, in part by restoring FLUID BALANCE and HAEMODYNAMIC STABILITY<sup>14,25–27</sup>



RRT modalities that are able to remove excess fluid in a slow, continuous manner may help **AVOID EXACERBATION** of HAEMODYNAMIC INSTABILITY<sup>14,25–27</sup>

The 20th ADQI International Consensus Conference for CSA-AKI RECOMMENDS the use of **CONTINUOUS THERAPIES** in patients with haemodynamic instability and in situations where shifts in fluid balance are poorly tolerated<sup>14</sup>

# Which RRT modality should be used in haemodynamically unstable patients?

# Summary



# **References/abbreviations/acronyms**

ADQI, Acute Dialysis Quality Initiative; AKI, acute kidney injury; BMI, body mass index; CKD, chronic kidney disease; COPD, chronic obstructive pulmonary disease; CPB, cardiopulmonary bypass; CRRT, continuous renal replacement therapy; CSA-AKI, cardiac surgery associated-acute kidney injury; DM, diabetes mellitus; ESRD, end-stage renal disease; ICU, intensive care unit; RIFLE, classification of kidney disease as Risk, Injury, Failure, Loss, End-stage (RIFLE-0, no risk; RIFLE-R, at risk; RIFLE-I, with kidney injury; RIFLE-F, with kidney failure); RRT, renal replacement therapy

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