Original Article

Cardiac and renal protective effects of dexmedetomidine in cardiac surgeries: A randomized controlled trial

ABSTRACT

Background: Cardiac and renal injuries are common insults after cardiac surgeries that contribute to perioperative morbidity and mortality. Dexmedetomidine has been shown to protect several organs against ischemia/reperfusion-(I/R) induced injury. We performed a randomized controlled trial to assess the effect of dexmedetomidine on cardiac and renal I/R injury in patients undergoing cardiac surgeries.

Materials and Methods: Fifty patients scheduled for elective cardiac surgeries were randomized to dexmedetomidine group that received a continuous infusion of dexmedetomidine initiated 5 min before cardiopulmonary bypass (1 μg/kg over 15 min, followed by 0.5 μg/kg/h) until 6 h after surgery, whereas the control group received an equivalent volume of physiological saline. Primary outcome measures included myocardial-specific proteins (troponin-I, creatine kinase-MB), urinary-specific kidney proteins (*N*-acetyl-beta-D-glucosaminidase, alpha-1-microglobulin, glutathione transferase-pi, glutathione transferase alpha), serum proinflammatory cytokines (tumor necrosis factor alpha and interleukin-1 beta), norepinephrine, and cortisol levels. They were measured within 5 min of starting anesthesia (T_0), at the end of surgery (T_1), 12 h after surgery (T_2), 24 h after surgery (T_3), 36 h postoperatively (T_4), and 48 h postoperatively (T_5). Furthermore, creatinine clearance and serum cystatin C were measured before starting surgery as a baseline, and at days 1, 4, 7 after surgery.

Results: Dexmedetomidine reduced cardiac and renal injury as evidenced by lower concentration of myocardial-specific proteins, kidney-specific urinary proteins, and pro-inflammatory cytokines. Moreover, it caused higher creatinine clearance and lower serum cystatin C.

Conclusion: Dexmedetomidine provided cardiac and renal protection during cardiac surgery.

Key words: Cardiac injury; cardiac surgeries; dexmedetomidine; renal injury

Introduction

Cardiac surgeries performed under cardiac arrest by using cardiopulmonary bypass (CPB) have potentially been associated with cardiac and renal injuries. The pathogenesis of cardiac injury is multifactorial but related mainly to surgical stress response and sympathetic nervous system overactivity with consequent elevation of plasma levels of epinephrine and norepinephrine that lead to impairment of the myocardial oxygen supply-demand balance whereas the etiology of renal injury is due mainly to elevation of renin levels as a

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result of sympathetic overactivity in addition to nephrotoxic, inflammatory, and hemodynamic components.[1,2] Decreasing these injuries is likely to improve outcome in patients undergoing cardiac surgery.[2,3] Consequently, different measures have been adopted to reduce the incidence of these cardiac and renal injuries.[4,5]

The use of α2-adrenergic agonists as adjuncts during general anesthesia and Intensive Care Unit (ICU) sedation has become popular in recent years. Both clonidine and dexmedetomidine have sympatholytic, analgesic, and sedative effects. However, dexmedetomidine has a relatively high ratio of α2/α1 activity (1620:1) and so is considered a more selective α2 receptor agonist (8 times more selective than clonidine).[6]

Variable experimental studies have shown protective effects of these agents on cardiac and renal injuries.[7-9] However, there are limited data concerning the impact of the intraoperative administration of dexmedetomidine on postoperative cardiac and renal injuries in patients undergoing cardiac surgeries.[10,11]

The aim of our study was to evaluate cardiac and renal protective effects of dexmedetomidine in patients undergoing cardiac surgeries. We hypothesized that dexmedetomidine may reduce postoperative cardiac and renal injuries in patients undergoing cardiac surgeries.

Materials and Methods

The current prospective randomized controlled study was conducted between June 2012 and February 2014 on 50 American Society of Anesthesiologists Class II or III patients scheduled for cardiac surgery by using CPB. Written informed consent was obtained from patients and the Institutional Review Board approval was obtained. The study was registered with PACTR201507000984471. The exclusion criteria included age >75 years, left ventricular (LV) ejection fraction <55%, preexisting severe LV hypertrophy, cardiomyopathies, Grade II (pseudonormal filling) and Grade III (restrictive filling) diastolic dysfunction, preoperative atrial fibrillation, pericardial disease, drug dependence, cerebrovascular diseases, use of alpha-2 agonists, type I diabetes mellitus, renal disease, significant pulmonary disease, and hepatic insufficiency. Thorough clinical examination, electrocardiogram (ECG), echocardiography, and laboratory investigations were performed as a routine diagnostic checkup. The patients were randomized to dexmedetomidine group that received a continuous infusion of dexmedetomidine initiated 5 min before CPB (1 μg/kg over 15 min, followed by 0.5 μg/kg/h) until 6 h after surgery, whereas the control group received an equivalent volume of physiological saline. Randomization was done through using a random number table generated by Microsoft Excel. An independent statistician was assigned to perform central randomization to ensure proper concealment of the study management from patients and investigators until the release of the final statistical results.

All preoperative medications, except angiotensin-converting enzyme inhibitors, were continued until the morning of surgery. Oral hypoglycemic drugs and insulin in diabetic patients were omitted in the morning of surgery. Oral diazepam 5-10 mg was given the night before surgery and morphine 0.1 mg/kg intravenously 30 min before surgery. Upon arrival to the operating room, standard monitoring (5 lead ECG, SpO_2 probe, and noninvasive blood pressure) was applied. A 20-gauge arterial cannula was inserted under local anesthesia in the radial artery and a triple lumen central venous pressure (CVP) catheter inserted into the right internal jugular vein under complete aseptic technique.

Induction of anesthesia in both groups was performed by propofol 1.5-2 mg/kg and fentanyl 3-5 μg/kg titrated according to hemodynamics. Tracheal intubation was facilitated by giving cis-atracurium 0.1 mg/kg and anesthesia was maintained with isoflurane 1 minimum alveolar concentration in 50% oxygen and air, fentanyl 3-5 μg/kg/h, and cis-atracurium 2 μg/kg/min. The bispectral index scale (BIS) electrode (BIS-Sensor, Aspect Medical Systems, Norwood, MA, USA) was positioned on the patient's forehead to monitor the depth of anesthesia where BIS value was kept between 45 and 55 in both groups through modulating isoflurane concentration. Ventilation was adjusted to maintain arterial carbon dioxide tension ($PaCO_2$) between 35 and 45 mmHg. Heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure (MAP) along with CVP were continuously monitored. The pressure transducers were zeroed against atmospheric pressure and maintained at the midaxillary level. MAP was maintained above 60 mmHg by vasoconstrictors (phenylephrine 50-100 μg or norepinephrine 5-10 μg), and CVP was kept constant within normal range by intravenous fluid infusion. Maintenance of normothermia was achieved with fluid warming and forced-air warming (Bair-Hugger). Blood glucose level was maintained to normoglycemia (70-150 mg/dl). One investigator was blinded regarding the anesthetic study drug during conduct of the study by covering the infusion pump, lines, and by numeric codes during the whole process of data evaluation. In addition, physicians who were in charge for postoperative care of the patients and for their discharges from ICU and hospital were effectively blinded to the study protocol.

Primary outcome measures included myocardial-specific proteins (troponin-I "cTn-I", creatine kinase-MB "CK-MB") and urinary-specific kidney proteins (*N*-acetyl-beta-D-glucosami nidase [beta-NAG], alpha-1-microglobulin [alpha-1-M], glutathione transferase-pi [GST-pi], glutathione transferase alpha [GST-alpha]). They were measured within 5 min of starting anesthesia as a baseline (T_0), at the end of surgery (T_1), 12 h after surgery (T_2), 24 h after surgery (T_3), 36 h postoperatively (T_4), and 48 h postoperatively (T_5). Serum pro-inflammatory cytokines (tumor necrosis factor-α [TNF-α] and interleukin-1 beta [IL-1β]), norepinephrine, and cortisol levels were measured at the same time points. Furthermore, creatinine clearance and serum cystatin C were measured before starting surgery as a baseline and at days 1, 4, 7 after surgery. Blood samples were immediately centrifuged, and the serum was separated, divided into aliquots, and placed in Eppendorf tubes and frozen at −80°C until assay. Commercial kits were used for the determination of TNF-α and IL-1β (enzyme-linked immunosorbent assay [ELISA] Kit; Biomed, Diepenbeek, Belgium) based on ELISA. Recordings were done on a plate reader (General Elisa System Technology, Menarini Labs, Badalona, Spain) for the automatic ELISA technique in triplicate.

High-performance liquid chromatography method was used for the assay of serum norepinephrine and cortisol levels.

Secondary outcome measures included duration of mechanical ventilation, ICU stay time, hospital stay time, major postoperative complications, and 30-day mortality.

Statistical analysis

A preliminary study at our hospital had shown that for patients scheduled for cardiac surgeries, the mean values of cardiac Tn-I and creatinine clearance were 0.26 ± 0.15 ng/mL and 99 ± 17 mg/L, respectively. With a two-sided type I error of 5% and study power at 80%, it was estimated that 22 patients would be needed in each group in order to detect a difference of 0.16 ng/mL for cardiac Tn-I, and 20 patients might be needed in each group in order to detect a difference of 20 mg/L for creatinine clearance. We preferred to study 25 patients in each group in order to decrease the chance of insufficient power in case the observed variability was higher than expected. Numerical data are presented as mean ± standard deviation, and categorical variables are reported as numbers. Statistica for Windows version 10.0 software (SPSS Inc., Chicago, IL, USA) was used for statistical analyses. The Kolmogorov-Smirnov test was used to verify normal distribution of data. Distribution of residuals testing was done to confirm that analysis of variance (ANOVA) was appropriate to our data. Data were analyzed on an intention to treat basis using two-way ANOVA for repeated measures. This was followed by Student-Newman-Keuls test, if a difference between groups had been detected. $P < 0.05$ was considered statistically significant (SigmaStat, Systat Software, Richmond, CA, USA).

Results

Patients' baseline data and operative characteristics were comparable in both groups [Table 1].

Patients in the dexmedetomidine group had a lower concentration of myocardial-specific proteins (cTn-I, CK-MB) at most time points after surgery except at 48 h postoperatively (T_5) where the concentrations were comparable and near baseline values in both groups [Table 2].

Table 1: Patients' baseline data and operative characteristics

Variables	Dexmedetomidine group (n = 25)	Control group (n = 25)
Age (years)	55.4±7.1	59.1±6.2
Sex (male/female)	20/5	18/7
Weight (kg)	76.4±10.3	75.8±9.4
Height (cm)	168.9±11.3	170.5±13.6
Diabetes mellitus	18	16
Hypertension	22	19
Cardiac medications		
Beta-blockers	24	23
Calcium channel antagonists	15	12
ACE or AIIR inhibitors	20	18
Nitrates	19	20
Statins	13	15
Antiplatelet (clopidogrel)	25	25
Surgery time (h)	3.7±0.9	3.6±0.7
Bypass time (min)	65.1±6.2	67.3±5.7
Aortic cross clamp time (min)	53.7±5.6	55.3±6.1
Intraoperative crystalloids infused (ml)	3500±600	3300±750
HES 130/0.4 infused (ml)	650±330	700±340
Total dose of fentanyl (μg)	720±150	690±135
Total dose of phenylephrine (μg)	445±68	452±77

Data are expressed as mean ± SD; Categorical variables are expressed as numbers. $P > 0.05$ denotes statistical insignificance. ACE: Angiotensin converting enzyme; AIIR: Angiotensin II receptors; HES: Hydroxy ethyl starch; SD: Standard deviation

Table 2: Changes in cardiac troponin-I and creatine kinase-MB

Time points	Dexmedetomidine group (n = 25)		Control group (n = 25)	
	cTn-I (ng/mL)	CK-MB (IU/L)	cTn-I (ng/mL)	CK-MB (IU/L)
T_0	0.22±0.13	15.4±3.0	0.24±0.14	14.5±3.3
T_1	0.29±0.16	40.8±8.6†	0.27±0.16	43.2±9.6‡
T_2	0.7±0.19†,*	43.5±11.8†,*	1.3±0.15‡,*	55.2±16.0‡,*
T_3	0.4±0.18†,*	30.2±9.9†,*	1.3±0.27‡,*	40.7±11.1‡,*
T_4	0.26±0.17	19.2±4.1†,*	0.7±0.15‡,*	28.5±5.9‡,*
T_5	0.27±0.16	15.0±2.6	0.3±0.13	16.5±3.7

Data are expressed as mean±SD. $^{\dagger}P < 0.05$ within the dexmedetomidine group; $^{\ddagger}P < 0.05$ within the control group; $^{*}P < 0.05$ between both groups; cTn-I: Cardiac troponin-I; CK-MB: Creatine kinase-MB; SD: Standard deviation

Similarly, dexmedetomidine group patients developed lower levels of kidney-specific urinary proteins (beta-NAG, alpha-1-M, GST-pi, GST-alpha) at most time points after starting surgery whereas the levels in both groups were comparable and near baseline data at T_5 [Table 3].

Plasma pro-inflammatory cytokines (TNF-α, IL-1β) increased significantly in both groups at all time points after starting surgery but were significantly lower in the dexmedetomidine group at all these points [Table 4].

Furthermore, plasma norepinephrine and cortisol levels increased significantly at most time points after starting surgery in both groups but were significantly lower in the dexmedetomidine group. At T_5, the values were comparable in both groups but still higher than baseline values with respect to norepinephrine whereas cortisol levels returned to near normal in both groups [Table 4].

Moreover, creatinine clearance increased significantly in both groups at day 1 after surgery but was significantly higher in the dexmedetomidine group. However, it returned to near baseline values at days 4 and 7 in both groups [Table 5]. Serum cystatin C increased significantly in both groups at day 1 but was significantly lower in the dexmedetomidine group. It returned to near normal baseline value at days 4 and 7 in the dexmedetomidine and control groups, respectively [Table 5].

Postoperative characteristics were better in the dexmedetomidine group whereas the outcomes were comparable between both groups [Table 6].

Discussion

The findings of this study revealed that dexmedetomidine provided some degree of protection to the heart and kidney during cardiac surgery as evidenced by lower levels of myocardial-specific proteins (cTn-I, CK-MB) and urinary-specific kidney proteins (beta-NAG, alpha-1-M, GST-pi, GST-alpha) combined with lower levels of serum pro-inflammatory cytokines (TNF-α and IL-1β) and lower values of norepinephrine and cortisol. Furthermore, dexmedetomidine group showed higher creatinine clearance and lower serum cystatin C in addition to better postoperative characteristics. However, postoperative outcomes did not show significant difference between both groups.

It is well known that cardiac surgeries induce systemic inflammatory response and sympathetic nervous system activation that may potentially induce injuries to most body organs including the heart and kidney. Dexmedetomidine may impact the common pathway responsible for these injuries through inducing anti-inflammatory effects and stabilizing the sympathetic nervous system.

Some studies showed comparable results with our trial.[12-14] A retrospective study done on 724 patients undergoing

Table 3: Changes in kidney-specific urinary proteins

Time points	Dexmedetomidine group (n = 25)				Control group (n = 250)			
	Beta-NAG (U/L)	Alpha-1-M (mg/L)	GST-pi (μg/L)	GST-alpha (μg/L)	Beta-NAG (U/L)	Alpha-1-M (mg/L)	GST-pi (μg/L)	GST-alpha (μg/L)
T_0	2.3±0.3	4.4±1.3	11.4±2.8	5.0±1.2	2.2±0.8	4.7±1.4	12.1±2.9	5.1±1.4
T_1	8.3±2.4†,*	19.2±4.1†,*	26.0±5.1†,*	24.2±5.5†,*	17±4.1‡,*	34.5±8.1‡,*	40.1±8.6‡,*	36.5±.5‡,*
T_2	8.3±2.3†,*	7.5±2.6†,*	18.2±4.4†,*	16.2±2.3†,*	14.4±3.6‡,*	13.3±2.8‡,*	31.4±7.2‡,*	27.5±4.9‡,*
T_3	2.5±0.6*	5.4±1.9*	12.3±3.8*	7.3±2.3†	8.7±2.4‡,*	10.1±2.2‡,*	20.3±6.0‡,*	7.9±2.2‡
T_4	2.4±0.3	5.0±1.5	11.5±3.4	5.4±1.5	2.7±0.7	5.4±1.6	12.5±3.9	5.7±1.7

Data are expressed as mean ± SD; $^{\dagger}P < 0.05$ within the dexmedetomidine group; $^{\ddagger}P<0.05$ within the control group; $^{*}P < 0.05$ between both groups. Beta-NAG: *N*-acetyl-beta-D- glucosaminidase; Alpha-1-M: Alpha-1-microglobulin; GST-pi: Glutathione transferase-pi; GST-alpha: Glutathione transferase-alpha; SD: Standard deviation

Table 4: Changes in pro-inflammatory cytokines' tumor necrosis factor-alpha, interleukin-1 beta, norepinephrine and cortisol levels

Time points	Dexmedetomidine group (n = 25)				Control group (n = 25)			
	TNF-α (pg/mL)	IL-1β (pg/mL)	Norepinephrine (ng/mL)	Cortisol (ng/mL)	TNF-α (pg/mL)	IL-1β (pg/mL)	Norepinephrine (ng/mL)	Cortisol (ng/mL)
T_0	27±6	47±14	246±59	268±71	29±7	45±12	242±71	271±80
T_1	92±28†,*	77±21†,*	162±49†,*	128±36†,*	155±39‡,*	115±21‡,*	320±97‡,*	308±75‡,*
T_2	261±64†,*	181±27†,*	212±56†,*	218±66†,*	422±79‡,*	290±51‡,*	331±89‡,*	318±86‡,*
T_3	219±49†,*	187±34†,*	278±88†,*	301±81†	438±84‡,*	327±61‡,*	311±91‡,*	351±91‡
T_4	145±34†,*	103±19†,*	322±99†	272±79*	194±44‡,*	163±17‡,*	327±90‡	299±69‡,*
T_5	41±11†,*	67±21†,*	305±97†	264±79	72±23‡,*	107±31‡,*	311±86‡	274±79

Data are expressed as mean ± SD; $^{\dagger}P < 0.05$ within the dexmedetomidine group; $^{\ddagger}P < 0.05$ within the control group; $^{*}P < 0.05$ between both groups; TNF-α: Tumor necrosis factor-alpha; IL-1β: Interleukin-1 beta; SD: Standard deviation

Table 5: Changes of creatinine clearance and serum cystatin C

Time points	Dexmedetomidine group (n = 25)		Control group (n = 25)	
	Creatinine clearance (mL/min)	Serum cystatin C (mg/L)	Creatinine clearance (mL/min)	Serum cystatin C (mg/L)
Before surgery	100±14	0.89±0.19	99±15	0.90±0.2
Day 1 after surgery	144±26†,*	1.8±0.5†,*	123±20‡,*	3.9±0.8‡,*
Day 4 after surgery	101±15	1.2±0.3*	103±13	2.5±0.4‡,*
Day 7 after surgery	102±17	0.90±0.14	104±14	0.93±0.13

Data are expressed as mean ± SD; †$P < 0.05$ within the dexmedetomidine group; ‡$P < 0.05$ within the control group; *$P < 0.05$ between both groups. SD: Standard deviation

Table 6: Postoperative characteristics and outcome

Variable	Dexmedetomidine group (n = 25)	Control group (n = 25)	P
Mechanical ventilation time (h)	13.5±3.8	18.1±4.0	0.03*
ICU stay (h)	79.2±23.2	93.4±24.8	0.04*
Hospital stay days	6.6±2.3	8.6±2.6	0.04*
Major postoperative complications			
Cardiac arrest	0	0	N/A
Acute coronary syndrome	1	1	N/A
Heart block	1	1	N/A
Stroke	0	0	N/A
Renal failure	0	0	N/A
30-day mortality	0	0	N/A

Data are expressed as mean ± SD; Categorical variables are expressed as numbers; *$P < 0.05$ means significant difference between both groups. ICU: Intensive care unit; N/A: Nonapplicable; SD: Standard deviation

coronary artery bypass grafting (CABG) surgery reported that perioperative dexmedetomidine infusion initiated after CPB and continued for <24 h postoperatively was associated with better cardiac outcomes as evidenced by better in-hospital, 30-day, and 1-year survival rates.[12]

Another retrospective trial studied the effect of perioperative dexmedetomidine infusion on 1134 patients undergoing CABG surgery and CABG surgery plus valvular or other procedures and concluded that perioperative dexmedetomidine had favorable effect on postoperative in-hospital and 1-year mortality and incidence of postoperative complications (perioperative myocardial infarction, heart block, or cardiac arrest).[13]

A meta-analysis of randomized controlled trials was done on 840 patients who underwent noncardiac surgery. Dexmedetomidine infusion was associated with better cardiac outcomes; all-cause mortality (odds ratio [OR]: 0.27, 95% confidence interval [CI]: 0.01-7.13, $P = 0.44$), myocardial ischemia (OR: 0.65, 95% CI: 0.26-1.63, $P = 0.36$), and nonfatal myocardial infarction (OR: 0.26, 95% CI: 0.04-1.60, $P = 0.14$).[14]

Contrary to our findings, a multicenter randomized controlled trial reported that perioperative and postoperative low-dose clonidine use in patients with, or at risk for atherosclerotic disease undergoing noncardiac surgery was not associated with any favorable cardiac outcomes. However, it increased the risk of hypotension and bradycardia. This contradiction may be attributed to the lower dose of clonidine used in that study (0.2 mg/day).[15]

A study done by Okada *et al*.[16] approved a cardioprotective effect of dexmedetomidine in an isolated rat heart model of global ischemia, which was reversed by the alpha-2 adrenergic blocker yohimbine.

Another experimental study in rats[17] reported that dexmedetomidine reduced myocardial infarct size resulting from regional ischemia/reperfusion (I/R) injury.

Regarding the impact of dexmedetomidine on renal injury, some clinical studies have reported favorable outcome.

A randomized controlled trial done on patients with normal renal function and scheduled for CABG surgery has shown that dexmedetomidine infusion during surgery and until 4 h after surgery caused a mean 74% increase in urinary output ($P < 0.001$). However, other indices of renal function showed no significant effect.[18] It should be noted that enhancement of urinary output with dexmedetomidine is a favorable effect though it does not necessarily indicate a good impact regarding the renal function. Dexmedetomidine is considered to have a diuretic action through sympatholysis mediated suppression of sodium reabsorption in the renal tubular cells via alpha-2 adrenergic effect.[19,20]

A retrospective trial has investigated the impact of post-bypass dexmedetomidine on potential acute kidney injury in patients undergoing cardiac surgery. Post-bypass dexmedetomidine caused significant reduction in the incidence of total renal injury (26.1% vs. 33.75%; adjusted OR: 0.7033; 95% CI: 0.540-0.916; $P = 0.0089$). Furthermore, it had favorable outcome on any complication and 30-day mortalities.[21]

A histopathologic study was done by Kocoglu *et al*.,[22] to assess the effect of dexmedetomidine on renal I/R injury in rats. Treatment with dexmedetomidine decreased the histopathologic findings associated with renal I/R injury, and the authors concluded that dexmedetomidine is useful in enhancing the tolerance of the kidney against I/R injury.

İnci *et al*.[23] evaluated the effect of dexmedetomidine infusion on the formation of reactive oxygen species during mesenteric

I/R injury in rats and concluded that dexmedetomidine infusion can prevent the increase in reactive oxygen species during mesenteric I/R injury in rats. Reactive oxygen species-induced lipid peroxidation is known to be one of the major factors causing I/R injury in all body organs.[23]

Alpha-2-adrenergic agonists have been proven to be protective against radiocontrast-induced nephropathy in mice by preserving outer medullary renal blood flow. This protection was inhibited by yohimbine.[24]

Khajuria *et al*.[25] suggested that dexmedetomidine reduces renal cell death through activation of the cell survival signal phosphatidyl-inositol 3-kinase (PI3K) that stimulates antiapoptotic proteins such as BCL-2 and BCL-xl and suppresses the inflammatory-associated high-mobility group protein B-1 (HMGB-1), toll-like receptor 4 (TLR4), in addition to inhibition of Janus kinase (JAK)/signal transducer and activator of transcription (STAT) signaling pathways. Similar explanation was reported by an animal study in rat which concluded that dexmedetomidine reduced renal cell damage and decreased a number of apoptotic tubular epithelial cells through suppression of injury-mediated activation of JAK/STAT signaling pathway.[26] Further explanation was provided by Gu *et al*.,[27] who reported renoprotection by dexmedetomidine through activation of cell survival signal PI3K through $\alpha 2$ adrenoceptors with subsequent reduction of cell death and HMGB-1 release and inhibition of TLR4 signaling.

An animal trial in mice reported that dexmedetomidine reduced remote lung injury triggered by renal I/R. The authors explained this protection through anti-inflammatory effect, suppression of myeloperoxidase activity and reduction of intercellular adhesion molecule-1 and TNF-α expression.[28] Cui *et al*. reported both *in vitro* and *in vivo* protection by dexmedetomidine against bilirubin-induced alveolar epithelial cell injury.[29] In another study, dexmedetomidine provided *in vitro* protection against oxidative stress induced alveolar epithelial cell apoptotic injury and cell cycle arrest through improving cell proliferation and survival.[30]

Conclusion

Dexmedetomidine use provided cardiac and renal protection during cardiac surgery as evidenced by lower levels of myocardial-specific proteins and urinary-specific kidney proteins combined with higher creatinine clearance and lower serum cystatin C though it had no impact on postoperative outcomes. However, it may have favorable impact on outcomes in patients with preexisting cardiac and or renal dysfunction.

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Conflicts of interest

There are no conflicts of interest.

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