Al-Azhar Med. J. *Vol. 53(1), January, 2024, 85-100*
DOI: 10.21608/amj.2024.338092
https://amj.journals.ekb.eg/article_338092.html

COMPARATIVE STUDY BETWEEN EARLY PERIOPERATIVE OUTCOMES OF LEVOSIMENDAN VERSUS INTRA-AORTIC BALLOON PUMP IN LOW CARDIAC FUNCTION PATIENTS UNDERGOING OFF PUMP CORONARY ARTERY BYPASS SURGERY

By

El-Huseiny El-Huseiny Gamil, Tarek Mohamed Helmy Esayed*, Ahmed Mohamed Shawky Ragheb*, Medhat Ahmad Refaie Mohamed and Mohamed Mohamed Tawfik Zakzouk

Departments of Cardiothoracic Surgery and Anesthesia*, Faculty of Medicine, Al-Azhar and Cairo Universities, Cairo, Egypt

ABSTRACT

Background: Off-pump coronary artery bypass grafting (OPCABG) in patients with low left ventricular ejection fractions (LVEF) < 30% mostly complicated by hemodynamic instability that is prevented by intra-aortic balloon pump (IABP). Compared to IABP, levosimendan can be used as it has a beneficial hemodynamic and cardioprotective effects with favorable outcome effect.

Objectives: Was to compare the use of Levosimendan versus IABP in OPCABG patients with low LVEF in the early perioperative period.

Patients and Methods: Between July 2019 and July 2021, a prospective randomized study was performed on a group of 60 patients with LVEF< 35%, who underwent elective OPCABG at Azhar University and Safa Hospitals. These patients were divided into 2 groups, according to the treatment they received – either levosimendan (Levo group) or IABP group. Hemodynamic parameters and cardiac function assessed as well as postoperative major events were recorded.

Results: Cardiac functions were significantly improved postoperatively in IABP group compared to Levo group. Five minutes after induction, MAP was significantly lowered in IABP group compared to Levo group while CVP was significantly higher in IABP group compared to Levo group. There was a significant mechanical ventilation time among IABP group compared to Levo groups. And there were a significant more blood loss and higher incidence of AF and LCO in Levo group compared to IABP groups. Levo group had a significantly lower ICU stay than the IABP group with no statistically significant difference between them regarding mortality and morbidity.

Conclusion: Levosemindan is easy to use and lowering the incidence of use of IABP and decreases hospital stay and morbidity for LVEF patients but can't be reached the effectiveness of IABP done by expert hands.

Keywords: Intra-aortic balloon pump, off-pump coronary artery bypass grafting, levosimendan.

INTRODUCTION

Off-pump coronary artery bypass grafting (OPCABG) is often complicated by hemodynamic instability which may lead to multiple organ dysfunctions, particularly in patients with with low LV

ejection fraction (LVEF <35%) *(Mate et al., 2020)*.

Preoperative conditioning for cardiac surgery includes a range of treatments aimed at the optimization of biological, hemodynamic and infectious parameters. The use of intra-aortic balloon pump (IABP) as a mechanical support has shown a prophylactic benefit in CABG *(Deppe et al., 2017)*. Also, in the last decade, levosimendan, a calcium sensitizer drug, has shown a beneficial hemodynamic and cardioprotective effects and a favorable outcome effect in cardiac surgery *(Allama et al., 2020)*.

Several randomized studies have shown benefit from the use of levosimendan when it was used prior to surgery *(Levin et al., 2012; Anastasiadis et al., 2016; Jimenez-Rivera et al., 2020)*. However, controversies do exist even in meta-analysis studies *(Lim et al., 2015; Mehta et al., 2017; Elbadawi et al., 2018)*. So, our study aimed to compare the use of Levosimendan versus the IABP support in OPCABG patients with low LVEF in the early perioperative period.

PATIENTS AND METHODS

Between July 2019 and July 2021, this prospective randomized study was performed on a group of 60 consecutive patients with left ventricular ejection fraction < 35%, who underwent elective off-pump CABG without concomitant procedures at Azhar University and Safa Hospitals.

Patients were divided to two groups (30 patients each group): Levosimendan group (Levo group) and Intra-aortic balloon pump group (IABP group).

Current study was performed after informed consent obtained from each patient as well as approval from our department council and local ethical committees.

Inclusion criteria:

Patients between 35 and 75 years of age with severe LV dysfunction (LV ejection fraction <35% determined by preoperative transthoracic echo-cardiography) indicated for off-pump CABG confirmed by coronary angiographic studies and preoperative echocardiography.

Exclusion criteria:

- Preoperative LVEF more than 35%.
- Abnormal cardiac rhythm or Pacemaker dependent.
- Intractable pulmonary edema or the need to mechanical ventilation preoperative or severe hemodynamic unstability.
- Previous cardiac surgery.
- Neurological dysfunction disease which severely affecting ambulation or day to day functioning.
- Chronic kidney or liver diseases.
- Any morphological valvular lesions which needs valve repair or replacement.

Methods:

In all cases, history taking and physical examination, NYHA classification as well as complete laboratory investigation, chest x-ray, echocardiography, and myocardial viability study (if available) were reviewed.

Ejection fraction:

Ejection fraction was estimated using Simpson's method by 2D transthoracic echocardiography.

Operative protocol:

Patients in Levo group; Levosimendan infusion was started 12-24hrs before operation with an initial dose of 12 u/kg over 10 minutes, followed by 0.1 u/kg/min over 24 hours.

Patients in IABP group; IABP was inserted through the femoral artery by the percutaneous sheathless technique, using an 8F 40-mL intra-aortic balloon catheter connected to the IABP machine. The position of the balloon was confirmed by radiography. Heparin infusion was started at a rate of 5–10 U/kg/h to maintain activated coagulation time within 140 – 160 sec. The IABP was continued until at least the first day after surgery.

Anesthetic management and surgical procedures were the same in both groups. Induction and maintenance of general anesthesia with endotracheal intubation was standardized in both groups. All procedures were performed using the off-pump technique.

The OPCAG was performed using the left internal mammary artery (LIMA) and revised great saphenous vein grafts (rSVGs) as conduits. Left anterior descending (LAD) artery was revascularized by LIMA, while other coronary arterial targets were revascularized by rSVGs via an aortocoronary anastomosis.

Criteria for IABP removal were: cardiac index >2.0 L/m2 and/or mixed venous oxygen saturation >60% with minimum inotropic support (epinephrine < 0.05 ug/kg/min or dopamine <5 ug/kg/min), and a normal lactate level without metabolic acidosis. In the absence of new zones of dyskinesia on echocardiography and ischemic changes on the electrocardiogram, the IABP was removed. Otherwise, IABP was continued at the initial settings until the next morning and further new assessment.

Data collected:

Hemodynamic parameters (heart rate, mean arterial blood pressure and central venous pressure were assessed before induction, 5 minutes after anesthesia induction and post-operatively at ICU admission.

Echocardiography was done the day before surgery and 48 hours postoperative to measure the Ejection Fraction, left ventricular end systolic diameter, Left ventricular end diastolic diameter, and Pulmonary artery pressure.

Low cardiac output syndrome (LCOS) was defined as the presence of low CI (<2.2 L/min/m2) with elevated PCWP (>16 mmHg) and a partial pressure of arterial oxygen (PaO2) of <60 mmHg.

Biochemical data collected:

Total CK, CKMB and cardiac troponin I (cTnI) levels are performed for each patient on the day before surgery and 48 hours postoperative.

Outcomes:

The primary end point was early outcome including the success rate, improvement of EF and mortality, while secondary end points were ICU and hospital stays.

Statistical analysis:

IBM Statistical Package for Social Sciences (SPSS) software (SPSS Inc., Chicago, IL, USA) was used for the statistical analysis. All continuous data were analyzed by Student's t test; Chi square test and Fisher's exact test. The results are reported as the mean ± standard deviation. P < 0.05 was considered statistically significant.

RESULTS

Demographic data, risk factors of cardiac diseases and cardiac characteristics of the studied groups were demonstrated in Table 1. IABP group was more in NYHA class IV compared to Levo group with a significant difference between them (p<0.05).

Cardiac functions assessed by echocardiography (ejection fraction (EF%), end diastolic dimension (EDD/mm) and pulmonary artery systolic pressure (PASP/mmHg) were significantly improved postoperatively in IABP group compared to Levo group. In IABP group, the patients had an EF% with a mean of 43.56±5.21, while in Levo group, with a mean of 36.73±3.64% (p<0.01). Also in IABP group, the patients had EDD with a mean of 57.0±1.50 mm, while in Levo group, with a mean of 62.2±1.95mm (p<0.01) **(Table 2)**.

Hemodynamic parameters (heart rate (HR), mean arterial pressure (MAP), oxygen saturation (SpO2) and central venous pressure (CVP)) were recorded basal, 5 minutes after induction and at ICU admission. Five minutes after induction, MAP was significantly lowered in IABP group compared to Levo group (p<0.01) while CVP was significantly higher in IABP group compared to Levo group (p<0.01). On ICU admission, significant higher MAP was observed in IABP group compared to Levo group (p<0.01) while CVP was significantly lowered in IABP group compared to Levo group (p<0.01) **(Table 3)**.

Regards to markers of myocardial damage (CK, CK-MB and troponin I), levels of CK-MB and troponin I in levosimendan group was significantly lower at 48 h after the operation compared to IABP group (p<0.01) while there was no significant difference between them in regard to total CK level (p>0.05) **(Table 4)**.

We used norepinephrine with nearly all patients to avoid peripheral vasodilatatory effects in both groups to maintain cardiac index above 2 L/min/m2 with no statistically significant difference in both groups, regarding use of inotropes (p=0.620).

There was a significant mechanical ventilation time among IABP group compared to Levo groups (p<0.01). And there were a significant more blood loss (p<0.01) and higher incidence of AF and LCO (p<0.05) in Levo group compared to IABP groups (p<0.01). While there were no statistically significant differences between the 2 groups, regarding postoperative MI or stroke. No patient required reexploration due to bleeding in current study **(Table 5)**.

Among IABP group, the lengths of ICU and hospital stay were higher compared to Levo group. The mean ICU stay in IABP group was 4.90±0.98 days compared to Levo group (3.23±0.60 days) (p<0.001). The patients in IABP group had delayed hospital discharge at 7.97 days, compared to Levo group (6.63 days) (p<0.001) **(Table 6)**.

Although, there was no statistically significant difference between the 2 groups regarding mortality, there was only one and two in-hospital mortality Levo

and IABP groups respectively. In Levo group, one patient developed severe LCO syndrome immediately postoperative CABG and did not respond to maximum inotropic support. While in IABP group, one patient developed severe HF on 2nd day postoperative to CABG and died suddenly inspite of postoperative Echo changes and normal serum electrolytes. The second patient died due to LCO and multiple organ dysfunctions.

Table (1): Demographic data of studied groups

Parameters \ Groups	Levo. Group No= 30	IABP Group No=30	Test	P Value
Age (years)	56.85±4.12 (45-68)	58.23±7.29 (43-69)	0.903	0.370
Gender Males Females	 23 (77%) 7 (23%)	 22 (73%) 8 (27%)	0.240	0.624
BMI	30.22±4.22	29.01±5.10	1.001	0.320
Dyslipidemia	15 (50%)	15 (50%)	0.010	0.920
Systemic hypertension	22 (73%)	18 (60%)	1.083	0.298
Diabetes mellitus	19 (63%)	20 (67%)	0.069	0.792
Smoking history	21 (71%)	19 (63%)	0.366	0.545
NYHA class Class II Class III Class IV	 6 (20%) 16 (53%) 8 (27%)	 3 (10%) 13 (43%) 14 (47%)	 9 .780	 0 .007

Table (2): Echocardiographic parameters of studied cases

Parameters \ Groups	Levo. Group No= 30	IABP Group No=30	Test	P Value
Preoperative				
EF (%)	30.98±3.63	31.26±2.65	0.341	0.734
EDD (mm)	64.9±4.4	64.1±3.9	0.745	0.459
PASP (mmHg)	28.05±4.86	27.83±7.13	0.140	0.889
Postoperative				
EF (%)	36.73±3.64	43.56±5.21	5.886	<0.001
EDD (mm)	62.2±1.95	57.0±1.50	11.57	<0.001
PASP (mmHg)	23.25±3.69	23.30±3.39	0.055	0.956

EF= Ejection fraction, EDD=End diastolic dimension, PASP= Pulmonary artery systolic pressure

Table (3): Hemodynamic parameters of studied cases

Parameters \ Groups	Levo. Group No= 30	IABP Group No=30	Test	P Value
Preoperative				
Heart rate (beat/minute)	80.63±6.73	80.76±7.39	0.071	0.943
Mean arterial pressure (mmHg)	78.00±5.60	77.27±3.80	0.591	0.557
Oxygen saturation (Spo2) %	94.54±2.48	93.48±3.76	1.289	0.202
Central venous pressure (mmHg)	8.92±4.55	7.70±3.65	1.146	0.256
5 minutes after induction				
Heart rate (beat/minute)	91.6±6.47	93.79±7.99	1.167	0.248
Mean arterial pressure (mmHg)	72.35±4.78	64.81±3.82	6.749	<0.001
Oxygen saturation (Spo2) %	98.57±0.49	98.58±0.49	0.079	0.937
Central venous pressure (mmHg)	2.30±2.60	5.48±3.03	4.362	<0.001
on ICU admission				
Heart rate (beat/minute)	81.45±7.45	82.43±8.66	0.470	0.640
Mean arterial pressure (mmHg)	78.80±3.81	82.83±4.59	3.700	< 0.001
Oxygen saturation (Spo2) %	98.45±0.50	98.43±0.49	0.156	0.876
Central venous pressure (mmHg)	9.62±2.65	7.04±1.91	4.326	<0.001

Table (4): Markers of myocardial damage among studied cases

Cardiac markers \ Groups	Levo. Group No= 30	IABP Group No=30	Test	P Value
Baseline				
CK (IU/L)	88.6±10.6	90.7±11.4	0.739	0.462
CK-MB (IU/L)	18.2±2.91	19.1±3.44	1.094	0.278
Cardiac Troponin I (ng/ml)	0.12±0.11	0.11±0.01	0.496	0.621
48 hours postoperative				
CK (IU/L)	208.5±14.6	214.5±15.1	1.565	0.123
CK-MB (IU/L)	50.4±4.59	56.6±7.22	3.969	<0.001
Cardiac Troponin I (ng/ml)	1.55±0.45	2.20±1.02	3.193	0.002

Table (5): Need for inotropic support and major postoperative adverse events among studied groups

Adverse events \ Groups	Levo. Group No= 30	IABP Group No=30	Test	P Value
Need for inotropic support (%)	23 (77%)	21 (70%)	0.245	0.620
Mechanical ventilation (hours)	16.20±13.05	25.62±3.47	3.821	<0.001
Blood loss in first 24 hrs. (L)	0.7±0.22	0.5±0.19	5.504	<0.001
Myocardial infarction (MI)	0	1 (3.3%)		
Stroke	1 (3.3%)	2 (6.7%)	0.900	0.342
Atrial fibrillation (AF)	11 (37%)	6 (20%)	4.491	0.034
Low cardiac output syndrome	8 (27%)	4 (13%)	4.225	0.039
Reexploration	0	0		

Table (6): Postoperative outcomes of studied groups

Groups / Outcome	Levo. Group No= 30	IABP Group No=30	Test	P Value
Total ICU stay (days)	3.23±0.60 (2 – 5)	4.90±0.98 (1 – 6)	7.960	<0.001
Total hospital stays (days)	6.63±0.71 (5 – 8)	7.97±1.45 (1 – 10)	4.546	<0.001
In-hospital mortality	1 (3.3%)	2 (6.7%)	0.900	0.342

DISCUSSION

Regarding preoperative and postoperative cardiac functions (measured by estimating the ejection fraction (EF%) and end diastolic dimension (EDD/mm) they were significantly improved in IABP group compared to levosimendan group. While no significant difference between the two groups regards to pulmonary artery systolic pressure (PASP/mmHg) ($p>0.05$). These results were in agreement with *Lomivorotov et al., (2011)*; *Gandham et al. (2013) and Mate et al., (2020)* studies.

In current study, postoperatively on ICU admission we noticed significantly lower MAP in levosimendan group compared to IABP group ($p<0.01$) while CVP was significantly higher in levosimendan group compared to IABP group ($p<0.01$) and no significant difference in the heart rate and oxygen saturation at all times between both groups. Compared to these findings, *Mate et al., (2020)* found that HR, MAP, and VIS were comparable in both groups at all time points.

Also, *Gandham et al. (2013)* showed a significant higher HR in the conventional group at mostly all times postoperatively $P<0.05$. This difference may be due to that they were mainly comparing dobutamine with levosimendan.

Although, Levosimendan, is a calcium-sensitizing inotrope and ATP sensitive potassium channel opener and has been reported to be effective in decreasing LCOS *(Tena et al., 2018)*. Current study revealed that levosimendan-treated patients experienced statistically significantly higher LCOS events (27% vs. 13%; $P = 0.039$) compared to IABP group.

Supporting our work, the double-blind randomized trial by *Shah et al. (2014)* tested preoperatively administered levosimendan 200 µ/kg infusion for 24 h against placebo for OPCABG in 50 patients with LVEF <30% revealed that, the levosimendan-treated patients had higher LCOS events during the operative and early postoperative periods.

Against our study, *Lomivorotov et al. (2014)* compared levosimendan and IABP in high-risk cardiac patients. They found that Levosimendan was effective in reducing LCOS when compared with placebo (14.8% in the levosimendan group vs 29.0% in the placebo group). Also, *Toller et al. (2015)*, had found that administering the drug in the ICU (late postoperative) in the event of LCOS result in unfavorable outcome. However, early treatment reflects better results.

Regards to adverse events of levosimendan, our patients did not

develop significant hypotension, any hemodynamic instability, and other side effects such as nausea and headache in the preoperative period and the regimen was tolerated well. Moreover, patients given levosimendan had a lower level of troponin I at 48 h after the operation compared to IABP group (p<0.01). Similar to our findings *Lomivorotov et al., (2011)* revealed that, infusion of levosimendan after anesthesia induction contributes to lower cardiac Troponin I concentration and improved hemodynamics compared with a preoperative IABP.

Regard to inotropes usage, we used norepinephrine with nearly all patients to avoid peripheral vasodilatatory effects in both groups to maintain cardiac index above 2 L/min/m2. There was no statistically significant difference in both groups, regarding use of inotropes (p=0.620).

Allama et al., (2020) in their study showed that in IABP group, 34.4% patients needed minimal support, 34.4% patients needed moderate support, and 31.03% patients needed high inotropic support with the IABP which has already been inserted in this group. While in levosimendan group: 31.03% patients needed minimal support, 44.8% patients needed moderate support), 13.7% patients needed high inotropic support, and 10.3% patients needed to insert an IABP with the high support. There is significant decrease in the amount of support when levosimendan is used.

Regard to postoperative events, patients in levosimendan group have higher incidence of AF compared to those in IABP group (37% vs 20% with p=0.034). Similar to our finding, some investigators found that levosimendan was associated with an increased risk of postoperative AF *(Abacilar et al., 2013*; *Kandasamy et al., 2017*; *Elbadawi et al., 2018)*.

Against to current study, *Allama et al., (2020)* in their study found that no statistical significance between levosimendan and IABP groups regard to postoperative AF. Moreover, *Desai et al., (2018)* and *Mate et al., (2020)* revealed that, the incidence of postoperative AF was statistically significant lower in levosimendan group compared to IABP group (p=0.01).

No patient required reexploration due to bleeding in current study. Compared to our results, *Allama et al., (2020)* in their study, one patient, three patients and two patients in control, IABP and levosimendan groups respectively had reopening. But there was no statistical significance between the two groups. We believe that highly surgical expertise of participating pioneers, minimal handling of heart, and short anastomoses time might have contributed in this regard.

Regards to lengths of ICU and hospital stays, they were shorter in levosimendan group compared to IABP group (3.23 vs 4.90 and 6.63 vs 7.97 days for hospital and ICU stays respectively with p<0.001 for both. In agree with our results, *Severi et al., (2011)* observed a shorter ICU stay in patients pretreated with levosimendan compared to patients receiving prophylactic IABP. The patients in IABP group stayed in the ICU for a longer duration (6.5±0.1 days) compared to the patients in levosimendan group (4.6±0.2 days) group. Also, *Allama et al., (2020)* in

their study revealed that, the mean ICU stay in control group was 7.3±0.85 days, while in IABP group it was 5.2±0.85 days, in levosimendan group it was 4.4±0.77 days. There was statistical significance between the three groups.

Recently, *Mate et al., (2020)* study revealed that, the mean ICU stay in IABP group was 6.5±0.1 days compared to levosimendan group (4.4±0.2 days), with $p<0.001$). The patients in IABP group had delayed hospital discharge at 13.4 days, compared to levosimendan group (10.2 days), indicating a statistically significant difference ($p<0.001$).

Against our study, *Desai et al., (2018)* found that, ICU and hospital stay were similar in both groups. Also, *Kandasamy et al. (2017)* did not find any difference in terms of ICU and hospital stay.

Regards to hospital mortility, there was no statistically significant difference between the 2 groups, there was only one in levosimendan and two patients in IABP group have in-hospital mortality. Like our results, *Mate et al., (2020),* revealed that, mortality and the rate of other major complications showed no statistically significant difference between the 2 groups. Where two patients (one in each group) died due to sepsis and multiple organ dysfunction. Similarly, *Desai et al., (2018)* in their study, two patients died in IABP group due to cardiogenic shock and sepsis as compared to none in the levosimendan group.

In agreement with current results, *Landoni et al. (2017)* in their meta-analysis emphasized that the use of levosimendan contributed to a significant reduction of mortality in cardiac patients with favorable outcomes.

In *Allama et al., (2020)* study with respect to in hospital mortality, in control group, four patients died, two of them failed to come off bypass and two died from multiorgan failure due to the LCOS, one patient died at postoperative day 4 and the other at postoperative day 6, while in IABP group three patients died, one patient failed to come off bypass and of the other patients one developed acute renal failure and died at the fifth postoperative day, the third patient died from septicemia and died after 2 weeks. While in levosimendan group, two patients died, one of them failed to come off bypass and the other died on the first day postoperatively due to hemodynamic instability. There was no statistical significance between the three groups.

Landoni et al., 2012 showed a significant reduction of mortality with the use of levosimendan in high-risk cardiac patients.

This study highlights the favorable hemodynamic profile of IABP in terms of reduced postoperative complications and improved EF% after its application. We consistently observed lower AF, LCOS and minimal blood loss in patients treated with IABP during intra- and postoperative period, compared to levosimendan.

The main disadvantages of IABP, particularly in patients with systemic atherosclerosis, is the development of complications associated with instillation of the balloon including includes limb ischemia, damage to the vessels, and bleeding (not recorded in current study) as well as its highly cost compared to levosimendan vial *(Abacilar et al., 2013).*

CONCLUSION

Levosemindan is easy to use in high-risk cardiac patients is as effective as the use of IABP, in terms of improves the overall myocardial function when administered 12 to 36 hrs before surgery.

Levosemindan lowering the incidence of use of IABP and decreases hospital stay and morbidity for low EF CABG patients but can't be used in acute hemodynamic unstable cases.

IABP needs expert hands and has better effect on patients but it also has more complications than levosemindan.

Further studies with a large number of patients and long term follow up to confirm the results were recommended as well as combined use of intra-aortic balloon pump and levosimendan deserves to be evaluated.

REFERENCES

1. **Abacilar AF and Dogan OF (2013):** Levosimendan use decreases atrial fibrillation in patients after coronary artery bypass grafting: A pilot study. Heart Surg Forum;16: E287 294.
2. **Allama AM, Dokhan AL, Onsi AH, and Hagag MG (2020):** Levosimendan vs intra-aortic balloon pump in low ejection fraction coronary artery bypass grafting patients. Menoufia Medical Journal, 33:1388–1392.
3. **Anastasiadis, K. Antonitsis P, Vranis K, Kleontas A, Asteriou C, Grosomanidis V, Tossios P, and Argiriadou H (2016):** Effectiveness of prophylactic levosimendan in patients with impaired left ventricular function undergoing coronary artery bypass grafting: a randomized pilot study. Interact Cardiovasc. Thorac. Surg. 23, 740–747.
4. **Deppe AC, Weber C, Liakopoulos OJ, Zeriouh M, Slottosch I, Scherner M, Kuhn EW, Choi YH, and Wahlers T. (2017):** Preoperative intra-aortic balloon pump use in high-risk patients prior to coronary artery bypass graft surgery decreases the risk for morbidity and mortality—A meta-analysis of 9,212 patients. Journal of Cardiac Surgery, 32: 177-185.
5. **Desai PM, Sarkar MS, and Umbarkar SR. (2018):** Prophylactic preoperative levosimendan for off-pump coronary artery bypass grafting in patients with left ventricular dysfunction: Singlecentered randomized prospective study. Ann Card Anaesth.; 21:123-128.
6. **Elbadawi A, Elgendy IY, Saad M, Megaly M, Mentias A, Abuzaid AS, Shahin HI, Goswamy V, Abowali H, London B (2018):** Meta-analysis of trials on prophylactic use of levosimendan in patients undergoing cardiac surgery. The Annals of Thoracic Surgery, 105:1403-1410.
7. **Gandham R, Syamasundar A, Ravulapalli H, Ranjith B, Karthekeyan M, Vakamudi M, Kodalli R, Nandipati S (2013):** A comparison of hemodynamic effects of levosimendan and dobutamine in patients undergoing mitral valve repair/replacement for severe mitral stenosis. Annals of Cardiac Anaesthesia, 16(1): 11-15.

8. **Jiménez-Rivera JJ, Alvarez-Castillo A, Ferrer-Rodriguez J, Iribarren-Sarrías JL, Garcia-Gonzalez MJ, Jorge-Perez P, Lacalzada-Almeida J, Perez-Hernández R, Montoto-Lopez J, and Martínez-Sanz R (2020):** Preconditioning with levosimendan reduces postoperative low cardiac output in moderate-severe systolic dysfunction patients who will undergo elective coronary artery bypass graft surgery: a cost-effective strategy. Journal of Cardiothoracic Surgery, 15: 108-112.

9. **Kandasamy A, Simon HA, Murthy P, Annadurai M, Ali MM and Ramanathan G (2017):** Comparison of levosimendan versus dobutamine in patients with moderate to severe left ventricular dysfunction undergoing off-pump coronary artery bypass grafting: a randomized prospective study. Ann Card Anaesth. 20: 200-205.

10. **Landoni G, Lomivorotov VV, Alvaro G, Lobreglio R, Pisano A, Guarracino F, Calabro MG, Grigoryev EV, Likhvantsev VV, Salgado-Filho MF, Bianchi A, Pasyuga VV, Baiocchi M, Pappalardo F, Monaco F, Boboshko VA, Abubakirov MN, Amantea B, Lembo R, Brazzi L, Verniero L, Bertini P, Scandroglio AM, Bove T, Belletti A, Michienzi MG, Shukevich DL, Zabelina TS, Bellomo R, and Zangrillo A, and the CHEETAH Study Group (2017):** Levosimendan for hemodynamic support after cardiac surgery. New England Journal of Medicine, 376: 2021-231.

11. **Landoni G, Biondi-Zoccai G, Greco M, Teresa G, Elena B, Andrea M, Fabio G and Alberto Z (2012):** Effects of levosimendan on mortality and hospitalization. A meta-analysis of randomized controlled studies. Crit Care Med.40:634–646.

12. **Levin R, Degrange M, Del Mazo C, Tanus E, and Porcile R. (2012):** Preoperative levosimendan decreases mortality and the development of low cardiac output in high-risk patients with severe left ventricular dysfunction undergoing coronary artery bypass grafting with cardiopulmonary bypass," Experimental and Clinical Cardiology, 17, (3): 125–130.

13. **Lim JY, Deo SV, Rababa'h A, Altarabsheh SE, Cho YH, Hang D, McGraw M, Avery EG, Markowitz AH, and Park SJ. (2015):** Levosimendan reduces mortality in adults with left ventricular dysfunction undergoing cardiac surgery: a systematic review and metaanalysis. J Card Surg. 30: 547–554.

14. **Lomivorotov VV, Efremov SM, Pokushalov EA Romanov AB, Ponomarev DN, Cherniavsky AM, Shilova AN, Karaskov AM, Lomivorotov VN (2014):** Randomized trial of fish oil infusion to prevent atrial fibrillation after cardiac surgery: data from an implantable continuous cardiac monitor. Journal of cardiothoracic and Vascular Anesthesia, 28(5): 1278- 1284.

15. **Lomivorotov VV. Cherniavskiy AM, Boboshko VA, Kornilov IA, Lomivorotov VN, Karaskov AM (2012):** Levosimendan versus an intra-

aortic balloon pump in high-risk cardiac patients. J. Cardiothorac. and Vasc. Anesth. 26 (4):596-603.

16. **Mate R, Shaikh N, Raut C, De A, and Mishra P. (2020):** Comparison of prophylactic levosimendan versus intra-aortic balloon pump for off-pump coronary artery bypass grafting in patients with low ejection fraction: A randomized-controlled trial. Cardiovasc Surg Int.7(3):121-128.

17. **Mehta RH, Leimberger JD, van Diepen S, James Meza J, Wang A, Jankowich R, Harrison RW, Hay D, Fremes S, Duncan A, Soltesz EG, Luber J, Park S, Argenziano M, Murphy E, Marcel R, Kalavrouziotis D, Nagpal D, Bozinovski J, Toller W, Heringlake M, Goodman SG, Levy JH, Harrington RA, Anstrom KJ, John H. Alexander JH, and LEVO-CTS Investigators (2017):** Levosimendan in patients with left ventricular dysfunction undergoing cardiac surgery. New England Journal of Medicine, 376;2032-2042.

18. **Severi L, Angela Lappa A, Landoni G, Di Pirro L, Luzzi JL, Caravetta P, Cipullob P and Menichetti A (2011):** Levosimendan versus intra-aortic balloon pump in high-risk cardiac surgery patients. J. Cardiothorac. Vasc. Anesth. 25, 632–636.

19. **Shah B, Sharma P, Brahmbhatt A, Shah R, Rathod B, Shastri N, Patel J, Malhotra A (2014):** Study of levosimendan during off-pump coronary artery bypass grafting in patients with LV dysfunction: A double-blind randomized study," Indian Journal of Pharmacology, 46 (1):29–34.

20. **Tena MA. Stefano Urso S, Gonzalez JM, Santana L, Sadaba S, Juarez P, Gonzalez L, Portela F (2018):** Levosimendan versus placebo in cardiac surgery: a systematic review and meta-analysis. Interact Cardiovasc Thorac. Surg. 27, 677–685.

21. **Toller W, Heringlake M, Guarracino F, Algotsson L, Alvarez J, Argyriadou H, Ben-Gal T, Cerny V, Cholley B, Eremenko A, Guerrero-Orriach JL, Järvelä K, Karanovic N, Kivikko M, Lahtinen P, Lomivorotov V, Mehta RH, Music S, Pollesello P, Rex S, Riha H, Rudiger A, Salmenperä M, Szudi L, Tritapepe L, Wyncoll D, and Owall A (2015):** Preoperative and perioperative use of levosimendan in cardiac surgery: European expert opinion. Int J Cardiol. 2015; 184: 323-336.

دراسة مقارنة بين الليفوسيمندان و مضخة الشريان الأورطي البالونية في المرضى ذوي الضعف في عضلة القلب اللذين يجرى لهم عملية توصيل الشرايين التاجية بدون استخدام مضخة القلب-الرئة الصناعية

الحسيني الحسيني جميلن طارق محمد حلمي السيد، أحمد محمد شوقي راغب،

مدحت أحمد رفاعي، محمد محمد محمد توفيق زقزوق

قسمي جراحة القلب والصدر و التخدير، كلية الطب بنين، جامعة الأزهر وجامعة القاهرة

المقدمة: وتعتبر مضخة الشريان الأورطي البالونية أكثر الطرق شيوعا في المرضى الذين يعانون من ضعف في عضلة القلب نظرا لفوائدها لتنشيط عضلة القلب ولكن مع وجود مضاعفات بعد العملية ومع تقدم الأبحاث العلمية وجد أن عقار الليفوسمندان هوأحد الطرق الحديثة نسبيا في الاستخدام لهذه الفئة من المرضى حيث انه يحسن من كفاءة عضلة القلب عن طريق زيادة حساسية الخلايا للكالسيوم مع قليل من المضاعفات والاسراع في مغادرة المستشفي.

الهدف من الدراسة: كان الهدف من الدراسة الحالية هو مقارنة مضخة الشريان الأورطي البالونية بعقار الليفوسمندان في الفترة المبكرة ما حول الجراحة في المرضى ذوي الضعف في عضلة القلب الخاضعين لعملية توصيل الشرايين التاجية بطريقة القلب النابض.

المرضى وطرق الاستقصاء: أجريت الدراسة الحالية في الفترة من يوليو 2019 وحتي يوليو 2021علي ستون مريضا من الجنسين تتراوح أعمارهم بين 43 و 69 عاما الخاضعين لعملية توصيل الشرايين التاجية بكل من مستشفي الحسين الجامعي ومستشفي الصفا وتم تقسيمهم عشوائيا الى مجموعتين متساويتين تحتوي كل مجموعة على ثلاثين مريضا في المحموعة الاولي تم استخدام مضخة الشريان الأورطي البالونية وفي المجموعة الثانية استخدم عقار الليفوسمندان.

- تم حصد وتسجيل الوظائف الحيوية والفحص السريري والمشاهدة السريرية في الفترة ما حول الجراحة.

- عمل انزيمات القلب والموجات الصوتية على القلب لجميع المرضى من المجموعتين قبل وبعد الجراحة.

- تم حصد ومتابعة وعلاج المضاعفات وتسجيل حالات وأسباب الوفاة في الفترة ما بعد الجراحة.

النتائج:

أظهرت التحاليل الاحصائية ما يلي:

- وجود تحسن ملحوظ في وظائف القلب في مجموعة البالونة الأورطية مقارنة بمجموعة الليفوسمندان.

- انخفاض متوسط الضغط الشرياني في مجموعة الليفوسمندان مقارنة بمجموعة البالونة الأورطية.

- ارتفاع الضغط الوريدي المركزي في مجموعة البالونة الأورطية مقارنة بمجموعة الليفوسمندان.

- انخفاض مستويات انزيمات القلب (CK-MB, troponine) في مجموعة الليفوسمندان مقارنة بمجموعة البالونة الأورطية.

- تكرار استخدام التنفس الصناعي في مجموعة البالونة الأورطية مقارنة بمجموعة الليفوسمندان ومع ذلك كانت المجموعة الاخيرة هي الأكثر عرضة للنزيف ونقل الدم وارتفاع نسبة حدوث الرجفان الأذيني (AF) ومتلازمة انخفاض نتاج القلب (LCO).

- ارتفاع مدة بقاء المريض بالرعاية المركزة و القسم الداخلي في مجموعة البالونة الأورطية مقارنة بمجموعة الليفوسمندان.

- لا يوجد تباين احصائي بين المجموعتين في نسبة حدوث وفيات على الرغم من تسجيل حالتين في مجموعة البالونة الأورطية مقارنة بحالة وفاة واحدة بمجموعة الليفوسمندان.

الاستنتاج: علي الرغم من سهولة استخدام عقار الليفوسمندان وومدي كفاءته في تحسين عضلة القلب في المرضي الخاضعين لعملية توصيل الشرايين التاجية بطريقة القلب النابض الا أنه لا يرقي الي كفاءة استخدام البالونة الأورطية خاصة في وجود فريق ذو كفاءة عالية في استخدامها.

الكلمات الاستفتاحية: مضخة الشريان الأورطي البالونية، الليفوسمندان، توصيل الشرايين التاجية بطريقة القلب النابض.