According to the ruling of the Medical Sciences Publications Commission No. 14313-80/10/1 and 36914-85/2/10 signed by the Minister of Health and Medical Education and the Head of the Medical Sciences Publications Commission of the Islamic Republic of Iran, this journal has been granted accreditation as a scientific-research journal.

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EDITORIAL

In the Name of God, the Most Beneficent, the Most Merciful

Dear colleagues and friends,

We are delighted to present to you Volume 18, Number 1 (Spring, 2017) issue of The Iranian Heart Journal, which contains some interesting new studies and case reports in the domains of cardiovascular medicine and surgery from our colleagues across Iran.

The Iranian Heart Journal is indexed in the Scientific Information Database (WWW.SID.IR), IMEMR, Index Copernicus, Scopus, and CINAHL, thereby facilitating access to published literature. There is no doubt, however, that our journal requires your opinions, ideas, and constructive criticism in order to accomplish its main objective of disseminating cutting-edge medical knowledge.

As ever before, we continue to look forward to receiving your latest research and cases.

Yours truly,

A. Hussein Tabatabaei, MD
Editor-in-Chief,
The Iranian Heart Journal

F. Noohi, MD
Chairman,
The Iranian Heart Journal
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Original Article

Efficacy of the “Head-Up Position” in Returning Cardiopulmonary Bypass Blood to the Patient and Reducing the Required Blood Transfusion: A Randomized Trial

Rasoul Azarfarin¹, MD; Majid Dashti*, MD; Ziaei Totonchi ³, MD; Mohsen Ziyaeifard ³, MD; Mohamadjavad Mehrabanian ³, MD; Azin Alizadehasl ¹, MD; Farhad Gorjipour ³, MS

ABSTRACT

Background: All intraoperative strategies that may assist an anesthesiologist with lowering the blood transfusion rate must be considered. We assessed the efficacy of the 30° head-up position at the end of cardiopulmonary bypass (CPB) in returning CPB reservoir blood to patients, reducing the transfusion rate, and conferring hemodynamic stability after the transfer of patients to the intensive care unit (ICU).

Methods: In a single-center clinical trial, 88 adult patients undergoing elective isolated coronary artery bypass graft surgery were randomly allocated to the head-up group (n=44), in which the 30° head-up position was applied during separation from CPB, and the supine group (n=44), in which weaning from CPB was performed in the supine position. All the patients had left ventricular ejection fractions > 35%. The primary end point was the returned volume of filtered CPB blood to the patients. The secondary outcome measures were intraoperative and early postoperative hemodynamic parameters. Additionally, blood products transfused during surgery and in the 1st 6 hours following ICU admission were recorded.

Results: There were no statistically significant differences in intraoperative and early postoperative hemodynamics between the 2 groups except in the returned blood volume to the patients after separation from CPB (714 ± 99 mL in the head-up position group vs 285 ± 78 mL in the supine group; P = 0.0001). There were no significant differences between the 2 groups regarding the transfused blood products during surgery and the 1st 6 hours following ICU admission.

Conclusions: Using the 30° head-up position at the end of CPB conferred a higher return of blood to the patients but did not significantly reduce postoperative transfusion. (Iranian Heart Journal 2017; 18(1):6-15)

Keywords: Supine position, Coronary artery bypass surgery, Cardiopulmonary bypass, Blood transfusion, Hemodynamics
The role of anesthesiologists in the perioperative management of patients undergoing coronary artery bypass grafting surgery (CABG) is expanding. Anesthesiologists must be expert not only in performing safe anesthesia techniques but also in providing all aspects of perioperative care for ischemic heart disease patients. In order to achieve better outcomes, they must consider developments in pharmacological materials and instruments, new surgical techniques, anesthesia management, and monitoring techniques. Although due to the emergence of percutaneous interventions, the number of the patients referred for CABG is reducing, coronary artery disease is still accounts for 1 of 6 deaths in the United States.

It has been reported that 40%–70% of all red blood cell units are transfused throughout surgical procedures. A reduction in only 1 unit of the transfused blood products has been reported to lessen mortality and morbidity; therefore, all intraoperative strategies that may help an anesthesiologist with lowering the blood transfusion rate must be considered.

Some interventions can lower the required homologues blood transfusion volume; they include controlled hypotension, acute normovolemic hemodilution, autologous blood predonation, relative reduction of target hematocrit for transfusion, optimal surgical homeostasis, reducing cardiopulmonary bypass (CPB) time, ultrafiltration during CPB, and finally returning the remaining volume of reservoir and the tubing system just before aortic decannulation at the end of CPB. Stress response to surgery can be modified through surgical method and patient position. Hypotension and ventricular dysfunction are prevalent perioperative hemodynamic abnormalities in cardiac surgeries. In post-CABG patients undergoing low tidal volume mechanical ventilation, stroke volume variation can predict responsiveness to volume therapy and can assess its hemodynamic effects. Recently, dynamic changes in preload such as pulse pressure variation have been reported to be due to cyclic variations in stroke volume during mechanical ventilation by cardiopulmonary interaction. Also, dynamic variables of preload are important in directing fluid and inotrope therapy in critically ill patients. Supine position is the commonest position in surgery; hemodynamic reserve is best maintained in this position as the whole body is almost at cardiac level. The compensatory mechanisms of hemodynamic changes are blunted during anesthesia and only a few degrees of head-up or head-down position is enough to produce significant cardiovascular changes.

In the present study, we proposed that some volume of CPB reservoir blood could be pooled to the splanchnic veins and the lower extremity of patients by using the 30° head-up position at the end of CPB through blunting the autonomic nervous system and vascular autoregulation. Before the transport of patients, their position is returned to supine to allow some autotransfusion of pooled blood to the central circulation. Via invasive blood pressure and central venous pressure (CVP) monitoring, as well as monitoring the arterial blood gas and lactate levels, we ensured the return of adequate cardiac preload and avoided overloading the patients. The aim of this blood volume return to the patients was to reduce the rate of homologous blood transfusion after separation from CPB and to prevent hypotension in the early post-CABG period.

METHODS

The research proposal was approved by the institutional ethics committee. Written informed consent was obtained from all the patients. In this single-blind clinical trial, 88 patients (aged between 40 and 60 years) who underwent elective isolated CABG were recruited. All the patients had left ventricular ejection fractions > 35%, were weaned from CPB, and had acceptable arterial blood gas,
hemoglobin, and electrolyte profiles. Whitlock et al.\textsuperscript{14} returned a mean of 280 mL of processed blood from CPB to their patients. We hypothesized a 100-mL difference in the returned blood volume by applying the head-up position at the end of CPB. Considering an $\alpha$ of 0.05 and a $\beta$ of 0.1 and by using an online sample size calculator (http://www.stat.ubc.ca/~rollin/stats/ssize/n2.html), we calculated that each group was to comprise 44 patients. The patients were randomly allocated to 2 groups of head-up (n=44) and supine (n=44) by using online software (http://www.graphpad.com/quickcalc/s/randomize2/). The randomization list was kept concealed by the head of the anesthesiology department. The participants were entered in the study and assigned to the head-up and supine groups sequentially.

Intraoperative monitoring—including left radial arterial line; systolic, diastolic, and mean arterial pressures; CVP via the right internal jugular vein; ECG; and airway pressure—was performed in both groups. In 23 patients in the head-up group and 21 patients in the supine group, we planned to use a pulmonary artery catheter (PAC) to monitor the cardiac output (CO) during surgery. After the induction of anesthesia, a 7.0-Fr PAC (Swan-Ganz CCO/VIP PAC, Edwards Lifesciences) was placed via the right internal jugular vein and connected to a Vigilance\textsuperscript{TM} monitor (Version 6.3, Edwards Lifesciences). The anesthetics and techniques were the same in all the patients. The surgical methods of coronary revascularization and CPB priming and technique were similar in both study groups. The only difference between the 2 groups was the $30^\circ$ head-up at the end of CPB in the head-up group. Returning the volume of the tubing system and the reservoir of the CPB circuit to the patients was continued until a target CVP of 10–12 mm Hg was achieved. Subsequently, aortic decannulation was performed and the patients’ position was changed to supine at the end of surgery before transfer to the intensive care unit (ICU). All the hemodynamic parameters and total blood products (packed red blood cell, fresh frozen plasma, and platelet) transfused intraoperatively and within the 1st 6 hours following ICU admission were recorded.

**Statistical Analysis**

There was no loss to follow-up in the course of the present study. Intention-to-treat statistical analysis was utilized. The collected data were analyzed using IBM SPSS for Windows, version 21.0 statistical package (IBM SPSS Inc, Chicago, IL, USA). The Kolmogorov–Smirnov test was used to evaluate the adaptation of the collected data with normal distributions. The qualitative data were analyzed using the $\chi^2$ test or the Fisher exact test, and the quantitative parameters were analyzed using the independent samples $t$-test. A $P$ value $\leq 0.05$ was considered statistically significant.

**RESULTS**

Eighty-eight patients, at a mean age of 58.3 ± 5.9 years old, were studied. All the data were normally distributed according to the Kolmogorov–Smirnov test (all $P$ values $>$ 0.05). The patients were similar in both groups with respect to their demographic and background characteristics (Table 1).

There were no significant differences in intraoperative and early postoperative variables between the 2 groups, except in the returned blood volume to the patients after separation from CPB (714 ± 99 mL in the head-up group vs 285 ± 78 mL in the supine group; $P = 0.0001$) and the remaining volume in the CPB circuit (128 ± 95 vs 523 ± 125 mL, respectively; $P = 0.00010$) (Table 2). In both studied groups, the crystalloid fluids administered by the anesthesiologist or added by the surgery team were similar. The intraoperative urine output was not significantly different between the 2 groups. Totally, 30/88 (34%) of our CABG patients received packed red blood cells (PRBCs)
during surgery or in the early postoperative period. Also, there were no significant differences between the 2 groups in terms of the transfusion of blood and blood products in the intraoperative period and in the 1st 6 hours following ICU admission (Table 3).

**Table 1.** Basic characteristics of the patients undergoing CABG with or without applying the 30° head-up position after separation from CPB

<table>
<thead>
<tr>
<th></th>
<th>Head-Up Group (n=44)</th>
<th>Supine Group (n=44)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>59.1±6.3</td>
<td>57.4±5.5</td>
<td>0.214</td>
</tr>
<tr>
<td>Sex (male)</td>
<td>36(85.7%)</td>
<td>31(73.8%)</td>
<td>0.277</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>167±8.0</td>
<td>166±8.9</td>
<td>0.766</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>73.8±10.0</td>
<td>75.1±9.3</td>
<td>0.537</td>
</tr>
<tr>
<td>BSA (m²)</td>
<td>1.81±0.14</td>
<td>1.85±0.13</td>
<td>0.363</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>20(47.6%)</td>
<td>22(52.4%)</td>
<td>0.827</td>
</tr>
<tr>
<td>Hypertension</td>
<td>26(61.2%)</td>
<td>25(59.5%)</td>
<td>0.823</td>
</tr>
<tr>
<td>COPD*</td>
<td>47.3±5.7</td>
<td>46.6±6.3</td>
<td>0.589</td>
</tr>
<tr>
<td>Blood urea nitrogen (mg/dL)</td>
<td>19.3±6.8</td>
<td>19.0±6.0</td>
<td>0.215</td>
</tr>
<tr>
<td>Creatinine (mg/dL)</td>
<td>0.96±0.25</td>
<td>0.89±0.27</td>
<td>0.866</td>
</tr>
<tr>
<td>MR° severity (none, mild/moderate/severe)</td>
<td>33/8/1</td>
<td>31/11/0</td>
<td>0.464</td>
</tr>
<tr>
<td>TR° severity (none, mild/moderate/severe)</td>
<td>37/5/0</td>
<td>30/12/0</td>
<td>0.057</td>
</tr>
</tbody>
</table>

CABG, Coronary artery bypass graft surgery; CPB, Cardiopulmonary bypass; COPD, Chronic obstructive pulmonary disease; LVEF, Left ventricular ejection fraction; MR, Mitral regurgitation; TR, Tricuspid regurgitation

**Table 2.** Intraoperative and postoperative variables of the patients undergoing CABG with or without applying the 30° head-up position after separation from CPB

<table>
<thead>
<tr>
<th></th>
<th>Head-Up Group (n=42)</th>
<th>Supine Group (n=42)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPB time (min)</td>
<td>83.5±30.5</td>
<td>84.6±23.9</td>
<td>0.861</td>
</tr>
<tr>
<td>Aortic cross-clamp (min)</td>
<td>47.0±21.7</td>
<td>48.1±15.9</td>
<td>0.815</td>
</tr>
<tr>
<td>Coronary graft No. (mean)</td>
<td>3.17±0.85</td>
<td>3.05±0.66</td>
<td>0.477</td>
</tr>
<tr>
<td>Crystalloid administered by the anesthesiologist (mL)</td>
<td>2200±588</td>
<td>2032±456</td>
<td>0.148</td>
</tr>
<tr>
<td>Crystalloid added to the field by the surgery team (mL)</td>
<td>2588±652</td>
<td>2630±367</td>
<td>0.712</td>
</tr>
<tr>
<td>CPB prime and added volume (mL)</td>
<td>2786±825</td>
<td>2754±492</td>
<td>0.829</td>
</tr>
<tr>
<td>Waste suction volume (mL)</td>
<td>1032±382</td>
<td>1007±300</td>
<td>0.740</td>
</tr>
<tr>
<td>Filtered volume (by the perfusionist) (mL)</td>
<td>1154±845</td>
<td>1163±854</td>
<td>0.964</td>
</tr>
<tr>
<td>Returned volume to the patient after separation from CPB (mL)</td>
<td>714±99</td>
<td>285±78</td>
<td>0.0001</td>
</tr>
<tr>
<td>Remaining volume in the CPB circuit (mL)</td>
<td>128±95</td>
<td>523±125</td>
<td>0.0001</td>
</tr>
<tr>
<td>CO after the induction of anesthesia (liter/min)</td>
<td>4.7±1.1 (n=23)</td>
<td>4.6±1.2 (n=21)</td>
<td>0.744</td>
</tr>
<tr>
<td>CO at the end of CPB before the return of the residual volume (liter/min)</td>
<td>4.9±1.3 (n=23)</td>
<td>4.8±1.3 (n=21)</td>
<td>0.800</td>
</tr>
<tr>
<td>CO at the end of CPB after the return of the residual volume (liter/min)</td>
<td>5.5±1.6 (n=23)</td>
<td>5.2±1.4 (n=21)</td>
<td>0.513</td>
</tr>
<tr>
<td>Intraoperative urine volume (mL)</td>
<td>1319±542</td>
<td>1135±429</td>
<td>0.090</td>
</tr>
<tr>
<td>Intraoperative furosemide (mg)</td>
<td>5.9±3.8</td>
<td>4.8±2.9</td>
<td>0.436</td>
</tr>
<tr>
<td>Intraoperative inotrope use</td>
<td>21.4%</td>
<td>17.1%</td>
<td>0.549</td>
</tr>
<tr>
<td>Postoperative inotrope use</td>
<td>7.1%</td>
<td>14.3%</td>
<td>0.374</td>
</tr>
</tbody>
</table>

* CABG, Coronary artery bypass graft surgery; CPB, Cardiopulmonary bypass; CO, Cardiac output

**Table 3.** Transfused units of blood and blood products in the patients undergoing CABG with or without applying the 30° head-up position after separation from CPB

<table>
<thead>
<tr>
<th></th>
<th>Head-Up Group (n=44)</th>
<th>Supine Group (n=44)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intraoperative</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Packed RBC*</td>
<td>0/1/2/more (units)</td>
<td>27/15/0/0</td>
<td>0.504</td>
</tr>
<tr>
<td>FFP*</td>
<td>0/1/2/more (units)</td>
<td>38/1/4/2</td>
<td>0.384</td>
</tr>
<tr>
<td>Platelets</td>
<td>0/1/2/more (units)</td>
<td>33/2/5/2</td>
<td>0.114</td>
</tr>
<tr>
<td>Early ICU</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Packed RBC</td>
<td>0/1/2/more (units)</td>
<td>25/13/3/1</td>
<td>0.344</td>
</tr>
<tr>
<td>FFP</td>
<td>0/1/2/more (units)</td>
<td>33/1/6/2</td>
<td>0.315</td>
</tr>
<tr>
<td>Platelets</td>
<td>0/1/2/more (units)</td>
<td>35/2/4/1</td>
<td>0.589</td>
</tr>
</tbody>
</table>

RBC, Red blood cell; FFP, Fresh frozen plasma
Figure 1 demonstrates the variations of systolic and diastolic blood pressures and the heart rate in both study groups. There were no significant differences in hemodynamics between the head-up and supine groups. As Figure 2 shows, the patients’ PaO₂ decreased from the end of CPB to the ICU admission. It, however, remained at clinically acceptable levels. There were no statistically significant differences between the 2 groups regarding the PaO₂ or PaCO₂ levels during the study period. Figure 3 shows that serum lactate levels slightly deceased and the base deficit increased slightly during CABG. However, their levels were not altered to the levels to be considered harmful to the patients. There were no significant differences between the 2 groups regarding these parameters. The patients’ hematocrit and hemoglobin levels decreased during CPB in acceptable degrees and returned to clinically acceptable values in the ICU, without significant differences between the 2 groups (Fig. 4).

We also recorded the patients’ CVP and the mean airway pressure during surgery and up to 1 hour after admission to the ICU. There were minimal changes in airway pressure in both groups. The mean CVP in both groups decreased at the end of CPB (to about 4 mmHg), but returned to about 8 mm Hg and increased up to 10 mm Hg 1 hour after admission to the ICU (Fig. 5).
Returning CPB Blood to Patients by Head-Up Position

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Figure 3. Acid-base variations of the patients undergoing coronary artery bypass graft surgery with or without applying the 30° head-up position after separation from CPB.

CPB, Cardiopulmonary bypass

Figure 4. Blood levels of hemoglobin and hematocrit in the patients undergoing coronary artery bypass graft surgery with or without applying the 30° head-up position after separation from CPB.

CPB, Cardiopulmonary bypass

Figure 5. Mean airway and central venous pressures of the patients undergoing coronary artery bypass graft surgery with or without applying the 30° head-up position after separation from CPB.

CPB, Cardiopulmonary bypass
DISCUSSION

We hypothesized that retuning more filtrated CPB residual blood volume to patients by applying head-up positioning at the end of CPB and then re-directing the pooled blood of the splanchnic veins and the lower extremities to the central circulation by returning the patients to supine position during their transfer to the ICU could prevent hypovolemia and hypotension and also, this “autotransfusion” might reduce the need to homologous transfusion in the postoperative period.

We succeeded in returning a mean value of 429 mL of filtered (processed) blood to our patients after separation from CPB through the application of the 30° head-up position. Although this return volume is clinically significant, we could not find any significant differences in hemodynamic parameters (blood pressure or the CO) and also in the number of the required blood product units between the 2 study groups.

Institutions vary considerably in their transfusion practices for CABG. In a study performed by Stover et al, a substantial variability (27%–92%) in transfusion practice was observed in institutions for PRBCs. Elsewhere, Lokosky et al found that the transfusion of small (1–3) units of PRBCs was common, yet different, across geographic areas. The authors posited that differences in regional practice, consisting of transfusion triggers and perioperative anemia management, might affect variability in the transfusion rates of PRBCs. Other investigators have also presented similar findings on the institutional variability of transfusion practice.

On the other hand, it seems that there is also a significant variability in transfusion practice among surgeons and also among anesthesiologists within a single institution. Frank et al reported a significant discrepancy in this regard among surgical services and techniques, and also among individual surgeons and anesthesiologists. The use of the RBC salvage technique, fresh frozen plasma, and platelets varied 3-4 times among individual surgeons compared with their colleagues carrying out the same surgical technique. In the present study, the surgical operations were performed by 7 different surgeons and 6 anesthesiologists. Given the significant individual variability in transfusion practice among our hospital’s surgeons and anesthesiologists, this powerful confounding factor may have overcome small differences in blood-saving properties via the application of the head-up position and the return of the reservoir blood to the patients at the end of CPB in our intervention group.

Some studies have demonstrated the beneficial effects of returning the hemoconcentrated residual CPB volume to patients on biochemical and clinical patient outcomes in the postoperative period but not on either coagulation parameters or postoperative bleeding following cardiac surgery. Daane et al suggested that processing and transfusing the residual CPB volume had no effects on complement activation, hemostasis, or the postoperative blood loss and volume of transfusion in their cardiac surgery patients. As was previously mentioned, various techniques are used to return the CPB residual blood to patients with different laboratory and clinical results. In our study, we sought to demonstrate the new technique of the head-up position so as to redistribute the venous and splanchnic blood to the lower body segments and to allow the return of the CPB residual blood to the patients at the end of CPB. On average, we managed to return 400 mL of filtered and hemoconcentrated residual CPB blood to our patients; however, this technique failed to show any beneficial effects on postoperative hematocrit levels or needs for transfusion in our patient population.

In 2013, Bubneky-Turconi et al compared 2 methods of measuring the CO (ie, noninvasive Nexfin [NAPCO] and PAC) in
Returning CPB Blood to Patients by Head-Up Position

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cardiac surgical patients before and after preload-modifying maneuvers, including fluid challenge or passive leg-raising maneuver. Both methods reliably showed preload-induced changes in the CO in the stable patients. We used continuous CO monitoring using PAC in nearly half of our patients. Although a small increase was observed in the head-up group, in comparison with the supine group, we could not find any significant increase in the CO by returning more residual CPB reservoir blood volume to the patients after separation from CPB. The small sample size of the study might have contributed to the absence of any statistically significant increase in the CO in the head-up group after CPB.

CONCLUSIONS

In this single-center clinical trial, through the application of the 30° head-up position, a mean value of 429 mL of filtered (processed) blood was returned to the CABG patients after separation from CPB. This volume return, despite being clinically significant, was statistically insignificant. Additionally, no significant differences were observed in the hemodynamic parameters (blood pressure and the CO) and also in the number of required blood product units between the 2 study groups.

Limitations

This trial was a single-center study, performed on 88 CABG patients, which limits its generalizability. Further, we succeeded in measuring the CO only in 23 patients in the head-up group and 21 patients in the supine group. This lowers the study’s power regarding advanced hemodynamic monitoring to assess effects of the head-up position at the end of CPB. In our study, the patients underwent surgery by 7 different surgeons and 6 different anesthesiologists. Regarding the significant individual variability in transfusion practice among our hospital’s surgeons and anesthesiologists, this powerful confounding factor might have contributed to small differences in blood-saving properties through the application of the head-up position and the return of the reservoir blood to the patients at the end of CPB in our intervention group.

ACKNOWLEDGEMENTS

We hereby thank the staff and perfusionists of the operating rooms at Rajaie Cardiovascular, Medical, and Research Center for their assistance with the management of the patients. This research project was supported by the aforementioned center.

Conflict of Interest: The authors declare no conflict of interest. This study was financially supported by Rajaie Cardiovascular, Medical, and Research Center, Iran University of Medical Sciences, Tehran, Iran.

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Returning CPB Blood to Patients by Head-Up Position


Original Article

*Results of 3 Years’ Experience in Pulmonary Embolectomy: A Single-Center Experience*

Aliasghar Moeinipour¹, MD; Mohammad Abbasi Teshnizi¹, MD; Atefeh Ghorbanzadeh¹, MD; Mohammad Sobhan Sheikh Andalibi¹, MD; Mohamadreza Akbari¹, MD; Hamid Hoseinikhah¹*, MD

**ABSTRACT**

*Background:* Pulmonary embolism is associated with high mortality rates despite improvements in its management. The aim of the present study was to analyze the outcome of 20 patients who underwent surgical pulmonary embolectomy in our institution.

*Methods:* The medical records of all patients undergoing pulmonary embolectomy during a 3-year period at our institution were studied for demographic and preoperative data as well as hospital mortality.

*Result:* Twenty patients underwent pulmonary embolectomy. The patients were aged between 35 and 76 years old. Fourteen (70%) patients were male. The most common risk factor in these patients was a history of major surgery (55%). The hospital mortality rate was 25%.

*Conclusions:* Pulmonary embolectomy can be considered an effective approach in patients with pulmonary embolism and carries low mortality and morbidity. (*Iranian Heart Journal 2017; 18(1):16-19*)

**Keywords:** Pulmonary embolectomy, Thromboembolism, Cardiac surgery

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1 Venous thromboembolism (VTE) is a relatively common disease associated with high mortality and morbidity.¹² The incidence of VTE ranges from 75 to 269 cases per 100000 persons per annum. VTE includes deep vein thrombosis (DVT), which mostly occurs in the leg, thigh, or pelvis, and also its complications such as pulmonary embolism (PE).¹ More than 90% of clinically detected pulmonary emboli are associated with lower extremity DVT, although more than half of patients with DVT and PE are asymptomatic. VTE is a difficult diagnosis because its clinical presentations are not unique.² Historically, the predisposing factors that lead to DVT are termed “Virchow’s triad”, which comprises immobility or stasis, hypercoagulation state, and endothelial injury. Most of the patients who suffer from DVT...
have a history of prolonged immobility because of limb or pelvic fracture and major orthopedic or abdominal surgery. Other common reasons include malignancy, multiple trauma, prior VTE, and chronic heart failure. Although VTE prophylaxis has been shown to improve the outcome of patients over time, PE remains the most common cause of in-hospital death and also the most common preventable cause of in-hospital death. Treatment options in this condition include systemic thrombolytic therapy, catheter-based treatments, and surgical embolectomy. Surgical embolectomy is a valuable lifesaving treatment in patients who have not benefitted from fibrinolysis or who have an absolute contraindication for fibrinolytic therapy.

We analyzed the outcome of 20 patients who underwent surgical pulmonary embolectomy in Imam Reza Hospital, in Iran.

**METHODS**

We evaluated 20 patients with a documented diagnosis of PE that underwent surgical intervention with pulmonary embolectomy in Imam Reza Hospital in Mashhad. The diagnosis of PE was confirmed via transthoracic echocardiography (TTE), transesophageal echocardiography (TEE), and computed tomography (CT) angiography. The indications for surgery were instability in hemodynamic status and respiratory insufficiency.

**RESULTS**

The study population comprised 20 patients, aged between 35 and 76 years. Fourteen patients were male. The predisposing risk factors that lead to DVT and PE included major orthopedic and pelvic surgery in 6 patients and major abdominal surgery in 5. A history of malignancy was present in 5 patients. Some types of hypercoagulation syndrome like Pro C and Pro S deficiency were found in 3 patients. All the patients underwent pulmonary embolectomy with support cardiopulmonary bypass (CPB). After median sternotomy and opening the pericardium, heparin was administrated and aortic bicaudal cannulation was initiated and at the time of the procedure. After the arteriotomy of the pulmonary artery, clot and embolic material was removed from the main, right, and left pulmonary arteries separately. Following the closure of the pulmonary artery, the aortic cross-clamp was released and the patients were weaned from CPB. For a successful weaning, usually inotropic support was needed.

Out of the 20 patients in the study, 4 patients died: 2 patients died in the operating room (they could not be weaned from CPB and developed severe right ventricular failure and high pulmonary artery pressure) and the remaining 2 patients expired in the intensive care unit in the 1st 24 hours after the procedure due to severe heart failure and unstable hemodynamics status.

**DISCUSSION**

PE is associated with high mortality and morbidity. An overall mortality rate of 17.4% within 90 days (365 of 2393 deaths) was reported by the International Cooperative Pulmonary Embolism Registry (ICOPER). Although there has been much advancement in the diagnosis of PE, many cases are asymptomatic and clinically undiagnosed. In about 90% of the cases, DVT is formed in the lower extremities and then breaks free before it passes through the right side of the heart and into the pulmonary artery system. According to the literature, the risk factors for PE can be classified into 2 groups: acquired risk factors such as major surgery, trauma, immobility, cancer, pregnancy, oral contraceptives, obesity, old age and anticardiolipin antibodies and continuation of primary hypercoagulation state. All hospitals have documented programs for the prevention of PE. Earlier mobilization of bed-
rest patients after any type of surgery, especially orthopedic and pelvic and major abdominal surgery, should be borne in mind. Heparin at a prophylactic dose is administrated for some high-risk patients like those with hypercoagulation state and those with a history of malignancy. The administration of subcutaneous low molecular weight heparin, fondaparinux, and unfractionated heparin is considered the initial standard therapy in hemodynamically stable patients with PE. 

Thrombolytic therapy should be performed as 1st-line treatment in patients with massive PE with circulatory shock or persistent hemodynamic instability. A meta-analysis compared thrombolytic therapy with heparin and showed benefits in high-risk cases, especially in patients with massive pulmonary emboli who presented with hemodynamic instability. It is, however, not recommended in unselected patients because it can increase the risk of bleeding and intracranial hemorrhage. Many antithrombotic drugs such as streptokinase, urokinase, and tissue plasminogen activator are available and can be used with varying degrees of success. This type of agents, albeit unable to prevent new clot formation, can remove the existing clot in the pulmonary vasculature. Recently, there has been a trend toward nonoperative management in most cases of clinical PE. After the initiation of anticoagulation with heparin, an antithrombotic agent is used for the lysis of the exiting embolic material in the pulmonary vasculature. For every patient with contraindications for anticoagulant administration or recurrence of PE, some prophylactic devices like the inferior vena cava filter can be inserted; however, it does not affect the free-floating proximal DVT. Although the uses and benefits of this modality are not clearly defined, the analysis from the ICOPER showed a substantial reduction in the mortality rate in 3 months with inferior vena cava filters. At present, the only absolute indications for cardiac surgery intervention in cases of PE are hemodynamic instability, respiratory failure, contraindications to anticoagulation, and failure of thrombolysis. In most of these cases, there is massive saddle PE. 

Hospital mortality rates for pulmonary embolectomy vary greatly and depend on hemodynamic condition at the time of surgery. Recently, improvements in surgical techniques and perioperative care as well as proper patient selection have conferred a reduction in the mortality rate. A cohort study by Kilic et al demonstrated a mortality rate of 27.2% after pulmonary embolectomy. Elsewhere, Keeling and colleagues reviewed data from the local Society of Thoracic Surgeons’ database, which comprised 44 patients, and reported a significant improvement in morbidity and mortality rates (2.3% mortality in a 30-day period). In our study, in-hospital death occurred in 4 (25%) patients. Elsewhere, the mortality rates ranged from 23% to 40%, with the rate being lower among the stable patients.

CONCLUSIONS

Pulmonary embolectomy can be deemed an effective approach in patients with PE and carries low mortality and morbidity.

Conflict of Interest: None declared.

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Original Article

Comparison of Serum Prolactin Levels Between the Acute Phase of Heart Failure and After Guideline-Directed Medical Therapy

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ABSTRACT

Background: Prolactin (PRL) has increasingly been recognized to play a stimulatory role in inflammatory response. Recently, studies have reported an increase in the PRL level among patients with chronic heart failure (HF); however, there are conflicting data about its role as a prognostic factor in these patients. We aimed to measure the PRL level in the acute phase of HF and the post guideline-directed medical therapy (GDMT) of HF to clarify whether PRL is an acute-phase reactant or more than an acute phase-reactant in patients with HF.

Methods: The serum PRL level was assessed in 94 patients with HF in the acute phase of HF decompensation and post-GDMT of HF. Serum N-terminal pro-brain natriuretic peptide, high-sensitive C-reactive protein, 6-minute walk test, erythrocyte sedimentation rate, CRP, blood urea nitrogen, creatinine, serum sodium, and white blood cell count were also measured. Our secondary end points were mortality, transplantation, and hospitalization due to acute HF. All the patients were followed up for 6 months.

Results: The mean serum PRL level in the acute phase was 31.3 ng/mL, which was significantly higher than the normal reference values (4.04–15 ng/mL) (P < 0.001). The mean serum PRL level before discharge was 34.84 ng/mL, which was significantly higher than the normal reference values and similar to the acute phase values. The mean PRL level in the patients with dilated cardiomyopathy was 33.61 ng/mL in the acute phase and 43.15 ng/mL after the GDMT of HF. The mean PRL level in the patients without dilated cardiomyopathy was 33.42 ng/mL in the acute phase and 29.92 ng/mL before discharge. The mean PRL level in the patients with re-admission was higher (27.7 ng/mL in the acute phase and 29.7 ng/mL before discharge in the patients with no re-admission and 37.4 ng/mL in the acute phase and 42.5 ng/mL before discharge in the patients with re-admission).

Conclusions: In 57% of the patients, the mean level of PRL increased after treatment. The level remained unchanged in 3.5% of the patients and had a drop in 39.2%. Our findings suggest that PRL may be more than an acute-phase reactant alone. Larger studies are needed to further elucidate the role of PRL in patients with HF. Research regarding the treatment of patients suffering from HF with high levels of PRL post-GDMT of HF with bromocriptine may have consequences like those in peripartum cardiomyopathy. (Iranian Heart Journal 2017; 18(1):20-24)

Keywords: Hyperprolactinemia, Cardiomyopathy, Peripartum
Heart failure (HF), a major cause of morbidity and mortality throughout the world, is responsible for a high rate of hospitalization and is a principal complication of all forms of heart diseases. Although the results of extensive investigations in this field have a great role in understanding the HF pathophysiology and better management of patients, the prognosis of this disorder remains poor.1,2

The pathophysiology of HF is closely associated with neuroendocrine changes. The activation of neuroendocrine systems contributes to the progression of HF. Many neuroendocrine factors are changed in congestive HF. Not only are the neuroendocrine changes a marker of the severity of cardiac dysfunction, but also they directly worsen it. The cornerstone of HF therapy is modulating these neuroendocrine changes and decreasing their adverse effects.4-6

Prolactin (PRL), mainly its 16-kDa angiostatic and proapoptotic form, is a key factor in the pathophysiology of peripartum cardiomyopathy (PPCMP). Previous reports have suggested that bromocriptine may have beneficial effects in women with the acute onset of PPCMP.3

Serum PRL is associated with neurohormonal/immune activation and depressive symptoms and is an independent predictor of prognosis in advanced congestive HF.

The aim of this study was to assess the PRL level in patients admitted with acute HF and post guideline-directed medical therapy (GDMT) with a view to assessing whether or not PRL has an acute-phase reactant role.

**METHODS**

**Study Participants**

A total of 94 patients with the diagnosis of HF according to the European Society of Cardiology’s Guidelines1 admitted to our Heart Failure Clinic between June and March 2014 were enrolled. The inclusion criteria were ischemic cardiomyopathy and dilated cardiomyopathy (DCM) in patients with a left ventricular ejection fraction (LVEF) < 50% and New York Heart Association (NYHA) functional classes II–IV.

Patients had to be on standard HF therapy with diuretics and neurohormonal blockers according to the latest guidelines on HF management.1 The study population was subsequently followed up for 6 months. Hospitalization due to acute HF, transplantation, and death were also registered. No patient was lost during the follow-up, and HF medications were not changed unless an expected event occurred.

**Data acquisition and laboratory measurements**

Primary evaluation, clinical history, and physical examination were obtained from all the patients, and the demographic data and the NYHA classifications were recorded. The NYHA class was evaluated, whereby class I indicated no limitations of physical activity, class II indicated slight limitation of physical activity, class III indicated limitation of physical activity, and finally class IV indicated symptoms of dyspnea at rest.1 The exercise tolerance and functional performance of the patients were assessed via the 6-minute walk test (6MWT) according to the protocol of Guyatt and colleagues.8
The levels of N-terminal pro-brain natriuretic peptide (NT-proBNP) for neurohormonal status and high-sensitive C-reactive protein (hs-CRP) as a pro-inflammatory marker have been recognized as important quantitative plasma biomarkers for the development of prognostic tools for idiopathic dilated cardiomyopathy. Peripheral blood samples were collected for NT-proBNP analysis using the ELISA method (BioMedia Corp, Bratislava, Slovakia). Serum hs-CRP levels were measured via the slide agglutination method and immunoturbidimetry using an hs-CRP latex kit (Bionic, USA) for each sample. Serum PRL was measured via the 2-site immunoradiometric assay (IRMA) (Pathan, Iran). The reference range was 4.04–15.2 ng/mL. Thyroid-stimulating hormone (TSH) was also measured through radioimmunoassay (Autobio, China) in all the patients with a reference range of 0.27–4.2 mU/mL. All the blood samples were collected from the patients in a fasting state and sitting position, an hour after awakening from an overnight sleep.

After GDMT and before discharge, the aforementioned biomarkers (especially PRL) were checked again to compare their pre- and post-treatment levels.

**Statistical Analysis**

IBM SPSS Statistics 19.0 for Windows (IBM Corp. Armonk, NY, USA) was used for the statistical analysis. The data are expressed as mean ± standard deviation (SD) for the interval and count (percent) for the categorical variables. The one-Sample Kolmogorov–Smirnov test was used to test the normal distribution of the interval variables. The one-sample t-test was employed to analyze differences in the mean values of hormonal concentrations between the patients and the normal reference values and between the pre- and post-treatment values. The interval variables were compared between the 2 groups using the Student t-test (for the normally distributed data) or its non-parametric equivalent, the Mann–Whitney U-test (for the non-normally distributed data). The Pearson correlation coefficient (r) was also utilized to show linear correlations between the interval variables. A P value < 0.05 was considered significant. A logistic regression model was applied for multivariable analysis.

**RESULTS**

**Baseline Characteristics**

There were 94 patients, comprised of 30 (31.9%) female and 64 (68.1%) male patients, at a mean age of 48.8 years old (range =14–89 y). The mean LVEF was 19.4%. Concerning the NYHA functional class, 2 (2.1%) patients were in class II, 71 (75.5%) in class III, and 21(22.3%) in class IV. Twenty-nine (30.9%) patients had DCM. All the patients were on standard recommended medical treatment for HF, including angiotensin-converting enzyme (ACE) inhibitors/angiotensin receptor blocker (ARB), beta-blockers, spironolactone, diuretics, and digoxin. The mean number of admission days was 13.3 days (3–42 d). Thirty-eight(40.4%) patients had re-admission.

**Serum prolactin changes between the acute phase of heart failure and after guideline-directed medical therapy and before discharge and its associations with the NYHA function class and other prognostic factors**

The mean serum PRL level in the acute phase was 31.3 ng/mL, which was significantly higher than the normal reference values (4.04–15 ng/mL) (P < 0.001). The mean serum PRL level before discharge was 34.84 ng/mL, which was significantly higher than the normal reference values and similar to the values in the acute phase. The mean PRL level in the patients with DCM was 33.61 ng/mL in the acute phase and 43.15 ng/mL after the GDMT of HF. The mean PRL level in the non-DCM patients was 33.42 ng/mL in
the acute phase and 29.92 ng/mL before discharge. The mean PRL level in the patients with re-admission was higher (27.7 ng/mL in the acute phase and 29.7 ng/mL before discharge in the patients with no re-admission and 37.4 ng/mL in the acute phase and 42.5 ng/mL before discharge in the patients with re-admission). The mean PRL level in the female patients, pre and post treatment, was higher than that in the male patients. Vis-à-vis the TSH level, none of the patients had hypothyroidism. As an important prognostic factor in these patients, the associations between the NYHA function class, serum PRL pre and post treatment, and the other prognostic factors were assessed specifically. The mean PRL level in the patients with DCM after treatment and before discharge was higher than that in the non-DCM patients (43.15 ng/mL vs 29.92 ng/mL), but there was no significant correlation. The mean PRL level in the patients with re-admission was higher, but the difference did not constitute statistical significance. The relationships between the serum PRL level and the other prognostic factors were also investigated. No significant correlations were seen between PRL and age (r = 0.05; P = 0.64), erythrocyte sedimentation rate (r = 0.05; P = 0.59), hs-CRP (r = -0.06; P = 0.67), serum sodium (r = -0.04; P = 0.69), serum uric acid (r = 0.10; P = 0.39), serum creatinine (r = 0.04; P = 0.66), NT-proBNP (r = 0.07; P = 0.51), and duration of hospitalization (r = -0.014; P = 0.89).

Findings in the patients’ follow-up
All the patients were followed up for 6 months for events such as mortality due to HF, hospitalization for acute HF, and transplantation. During this follow-up period, 20 (21.2%) patients died (all of them with LVEF < 20% and NYHA class IV). Additionally, 7 (7.4%) patients underwent transplantation and 38 (40.4%) were hospitalized at least once with a diagnosis of acute HF. The patients with events had higher NT-proBNP, hs-CRP, and TSH levels and lower LVEF and 6MWT. Nevertheless, except for NT-proBNP, none of the differences was statistically significant. Despite the higher mean level of PRL in the patients with re-admission and in those with DCM, this correlation was not significant.

DISCUSSION
In the present study, we found a higher-than-normal serum PRL concentration among our 94 patients. There are several reports on the measurement of the serum PRL level in patients with HF. Opalinska et al 3 measured the levels of several hormones, including PRL, in 27 male patients suffering from HF with an LVEF < 35% and found hyperprolactinemia. Limas et al 4 reported that hyperprolactinemia was present in 25% of their patients with HF. In 2 recent studies, Landberg et al 5 and Parissis et al 6 showed elevated levels of serum PRL in different groups of patients with HF.

The aim of the current study was to assess the PRL level in patients admitted with acute HF and post GDMT with a view to assessing whether or not PRL has an acute-phase reactant role. We presumed that PRL might be an acute-phase reactant and elevated levels of PRL in the acute phase might decrease following the GDMT and stabilization of patients. In this study, the mean level of PRL was significantly different from its normal value, especially in the patients with DCM. In 57% of our patients, the mean level of PRL increased after treatment. The mean level remained unchanged in 3.5% of the patients and decreased in the remaining 39.2%. In light of this finding, it can be posited that PRL may play a role more than that of an acute-phase reactant alone. Be that as it may, larger studies are required to shed sufficient light on the role of PRL in patients with HF. Research into the treatment of patients suffering from HF with high levels of PRL following the GDMT of HF with bromocriptine may have consequences like those in PPCMP.
One of the strengths of this study is its utilization of a new design to clarify the role of PRL in patients with HF.

**CONCLUSIONS**

PRL, as a multifunctional hormone, plays an important role in immune-regulation, osmoregulation, metabolism, and angiogenesis and there is substantial evidence in favor of its involvement in the pathogenesis of PPCMP. However, given the results of the current and other studies regarding the role of PRL in patients with HF, this role cannot simply be considered as a prognostic factor in HF and further investigations are needed to shed more light on the role of PRL in the pathophysiology of HF.

**ACKNOWLEDGEMENTS**

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Original Article

Comparison of the Coronary Vessel Diameter During and After Primary Percutaneous Intervention in Patients with Acute Myocardial Infarction

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ABSTRACT

Background: An increase in the plasma levels of catecholamines and other neurohormones after acute myocardial infarction (AMI) leads to coronary vasoconstriction and may cause the undersizing of stents during primary percutaneous coronary intervention (PCI) in ST-segment elevation myocardial infarction (STEMI). We aimed to compare the reference vessel diameter of the infarct-related artery during and after primary PCI in patients with AMI.

Methods: This prospective interventional study was performed on 43 consecutive patients with STEMI (TIMI flow grade III), who were candidate for primary PCI. The main proximal diameter of the coronary artery (reference vessel diameter) was assessed at baseline and also 3 days to 3 months after 2nd angiography. The study end point was to compare the reference vessel diameter within and after primary PCI.

Results: Comparison between the mean diameter of the involved coronaries after PCI and the mean diameter during the procedure showed a significant increase in the real size of the right coronary artery (RCA) and a slight decrease in the size of the left circumflex artery (LCx). However, the mean sizes of the left anterior descending coronary artery remained insignificant. The decrease in the LCx diameter and inversely the increase in the RCA diameter remained significant in the study population even after adjusting cardiovascular risk factors as potential confounders.

Conclusions: The changes in the diameter of the reference coronary arteries, namely an increase in the RCA diameter and a decrease in the LCx diameter, are expected following primary PCI in patients with STEMI. (Iranian Heart Journal 2017; 18(1):25-29)

Keywords: Primary percutaneous coronary intervention, Acute myocardial infarction, Intervention

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The sympathetic nervous system and myocardial ischemia link together and, thus, the activation of the sympathetic and adrenal systems leads to increased levels of circulating catecholamines, epinephrine, and norepinephrine and accelerates the development of ischemic heart disease and acute myocardial infarction (AMI). The increase in catecholamines occurs early in AMI and majorly affects the course of AMI. There is a close association between catecholamines and the infarct size and the progression of myocardial cell damage. Various mechanisms may account for the local accumulation of catecholamines in the extracellular space of the ischemic myocardium. In early MI, plasma noradrenaline and adrenaline concentrations are enhanced, reflecting the increased activity of the whole sympathetic nervous system. In other words, even mildly increased levels of plasma catecholamines directly induce a major deterioration of myocardial function during the ischemic process. More interestingly, the plasma levels of catecholamines and other vasopressors are elevated during AMI and coronary vasoconstriction is frequent, which may lead to the undersizing of stents during primary percutaneous coronary intervention (PCI) in ST-segment elevation myocardial infarction (STEMI). This size underestimation may even give rise to higher rates of stent thrombosis and, thus, poorer prognosis of STEMI.

We aimed to compare the reference vessel diameter (RVD) of the infarct-related artery during and after primary PCI in patients with AMI.

METHODS

This prospective interventional study was performed on 43 consecutive patients with STEMI, who were candidated for primary PCI. All the eligible patients had more than 1 involved coronary vessel and needed staged PCI. In all the subjects, the involved vessel was opened (TIMI flow grade III) and PCI was conducted on the non-culprit vessel within further angiography. Initially, the main proximal diameter of the coronary artery (RVD)—after the separation of the vessel at a distance of 3 mm from the ostium—was assessed via quantitative coronary angiography at baseline and also 3 days to 3 months after 2nd angiography. The study end point was to compare the RVD within and after primary PCI.

The results are presented as mean ± standard deviation (SD) for the quantitative variables and are summarized by frequencies (percentages) for the categorical variables. The continuous variables were compared using the t-test or the Mann–Whitney test whenever the data did not appear to have a normal distribution or when the assumption of equal variances was violated across the study groups. The categorical variables were, on the other hand, compared using the $\chi^2$ test. The changes in the parameters after the intervention were compared to the values before the intervention using the paired t-test. For the statistical analyses, the statistical software SPSS, version 16.0, for Windows (SPSS Inc, Chicago, IL) was employed. A $P$ value $\leq 0.05$ was considered statistically significant.

RESULTS

The average age of the patients was 59.77±10.52 years, and 74% of them were male. Regarding the cardiovascular risk profile, 44.2% of the patients were diabetics, 34.9% were hypertensive, 39.5% were hyperlipidemic, and 48.8% were smokers. Family history of coronary artery disease was revealed in 18.6%, and 16.3% were found to have ischemic heart disease. As is shown in Table 1, a comparison of the mean diameter of the involved coronaries after PCI compared to that during the procedure showed a significant increase in the real size of the right
coronary artery (RCA) as well as a slight decrease in the size of the left circumflex artery (LCx). Nevertheless, the mean sizes of the left anterior descending coronary artery remained insignificant. A comparison of the mean arterial sizes after primary PCI between the men and women demonstrated only a significant increase in the RCA size in the men ($P = 0.049$). Also, the assessment of the change in the mean diameters of the involved arteries in the different age subgroups showed a significant decrease in the LCX size only in the patients aged 60 to 75 years ($P = 0.055$). No significant difference was found in the mean diameters of all the coronaries after PCI in both diabetics and nondiabetics. Moreover, a significant decrease in the mean LCx diameter ($P = 0.039$) as well as an increase in the mean RCA diameter ($P = 0.021$) after PCI was detected only in the normotensive patients. Additionally, a significant increase in the mean RCA diameter was observed only in the hyperlipidemic subjects ($P = 0.022$). There was also a significant decrease in the mean LCx diameter following PCI in the smokers ($P = 0.054$), and not in the nonsmokers. Positive family history of coronary artery disease did not affect the change in the mean size of the coronary vessels after PCI. In total, the difference in the mean diameters of all the coronary vessels remained significant between the men and the women, between the different age subgroups, and between the subgroups with and without each of the cardiovascular risk factors. In the multivariable linear regression model, only hypertension was identified to predict the change in the LCx real size after primary PCI. Also, a similar regression model showed that none of the baseline variables could predict the change in the mean diameters of the coronary arteries following PCI (Table 2 and Table 3).

<table>
<thead>
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<th>N=43</th>
<th>Primary</th>
<th>Secondary</th>
<th>$P$</th>
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<td>Mean LAD real size</td>
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<td>3.52 ± 0.77</td>
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<tr>
<td>Mean LCx real size</td>
<td>3.31 ± 0.89</td>
<td>3.14 ± 0.64</td>
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<tr>
<td>Mean RCA real size</td>
<td>3.69 ± 0.87</td>
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<td>Mean lesion real size</td>
<td>3.57 ± 0.96</td>
<td>3.64 ± 0.87</td>
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LAD, Left anterior descending coronary artery; LCx, Left circumflex coronary artery; RCA, Right coronary artery

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
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</table>

a. Dependent variable: secondly LCX real size
LCx, Left circumflex coronary artery
Our study succeeded in finding an interestingly paradoxical change in diameters at the secondary angiographic assessment of stented coronary arteries when compared to primary assessments. There was a significant reduction in the size of the LCx, while there was an increase in the size of the RCA after stenting in our patients with STEMI. More interestingly, the size of the left anterior descending artery or even the size of the lesions remained unchanged. Some similar changes were also revealed in different subgroups of cardiovascular disorders, whereby the change in the RCA diameter was only observed in the men and also in the hyperlipidemic ones (not in the women). Additionally, the change in the LCx was observed in those aged between 60 and 75 years and in those with a history of smoking. Further, the change in the LCx size was observed in the normotensive patients and in those without family history of coronary artery disease. To determine the predicting or confounding role of the baseline risk profile in the changes in the arterial diameters, we employed the multivariable logistic regression models and managed to show that the role of these baseline factors was all limited to their confounding effects. In other words, a reduction in the LCx diameter and inversely an increase in the RCA diameter remained significant in the study population even after adjusting cardiovascular risk factors as the potential confounders. Moreover, it seems that the conflicting changes found in the LCx and RCA may have been related to the special anatomical patterns of each coronary artery and, thus, different effects of catecholamine and other hormones on their specific receptors on the arterial walls. In total, as was previously described, in the early phases of AMI, the activation of the sympathetic nervous system can lead to a rise in noradrenaline and adrenaline concentrations, which act as vasopressors, and result in coronary vasoconstriction. 5, 6 This pathway may cause underestimation of the considered stents and lead to deterioration of the stenting outcome. Accordingly, the assessment and prediction of the change in the diameters of the coronary vessels, especially in the LCx and RCA, should be considered to improve the procedural outcome.

Our literature review found a limited number of similar studies on the change in non-culprit vessels within secondary angiography. In a similar study by Sahin et al, 7 coronary angiography on 58 patients with STEMI after PCI showed significant elevations in the coronary artery diameter with lowering the area of the lesion. Elsewhere, Cristea et al 8 evaluated 2974 patients with 3589 lesions undergoing 2233 stentings and reported an initially higher mean coronary artery diameter.
Coronary Vessel Diameter During and After Primary PCI in Patients With Acute MI

Shakerian F, et al

Iranian Heart Journal; 2017; 18 (1)

Coronary Vessel Diameter During and After Primary PCI in Patients With Acute MI

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Coronary Vessel Diameter During and After Primary PCI in Patients With Acute MI

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Coronary Vessel Diameter During and After Primary PCI in Patients With Acute MI

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Iranian Heart Journal; 2017; 18 (1)

diameter, which was alternatively reduced at 1-year follow-up. The latter study, thus, shows that the significant change in the arterial diameter after PCI may be time-independent and reversing the diameter can be also predicted in a long-term period after stenting.

REFERENCES


Original Article

Cardiovascular Magnetic Resonance in Predicting the Reduction in Pulmonary Artery Pressure in Patients With Mitral Stenosis After Surgical or Interventional Treatment

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ABSTRACT

Background: Pulmonary hypertension (PH) is a common consequence of mitral stenosis (MS). After treatment, PH reverses depending on the chronicity and severity of MS. The characteristic changes in the pulmonary artery (PA) secondary to an elevated pulmonary artery pressure (PAP) can be evaluated via cardiovascular magnetic resonance imaging (CMR). In this study, we aimed to evaluate if there was any correlation between PAP and hemodynamic findings measured by CMR and whether these findings could be useful in predicting the PAP response after MS relief.

Methods: Thirty-three patients with a diagnosis of severe MS, who were candicidated for percutaneously transvenous mitral commissurotomy (PTMC) or mitral valve replacement (MVR), were included. CMR was performed in all of them before the procedure and PA distensibility, PA peak velocity, PA forward volume, and PA forward flow were measured. Transthoracic echocardiography was performed at baseline, immediately after the procedure, and 3 months after MS relief for the assessment systolic PAP.

Results: Thirty-three patients with a diagnosis of MS+PH (15 PTMC and 18 MVR) were enrolled in this study. The mean PAP at baseline catheterization ranged from 25 to 70 mm Hg. There was a significant drop in systolic PAP immediately after the procedure and 3 months after MS relief. There was no relationship between the PA distensibility index and systolic PAP changes after MS relief. PA peak velocity was significantly higher in the patients with > 50% drops in their systolic PAP 3 months after the treatment. The multivariable analysis showed that none of the CMR findings was an independent predictor of a more systolic PAP decline.

Conclusions: Although we found no significant relationship between CMR findings and systolic PAP changes after MS treatment, the result of this study can be used for further investigations in this regard. (Iranian Heart Journal 2017; 18(1):30-36)

Keywords: Pulmonary artery pressure, Cardiovascular magnetic resonance imaging, Mitral stenosis
Pulmonary hypertension (PH) is a common consequence of left-heart diseases, including mitral stenosis (MS). Pulmonary artery pressure (PAP) rises chronically in these patients as a result of chronic pathologica lchanges in pulmonary arteries and veins secondary to an increase in left ventricular filling pressures. After treatment, PH reverses depending on the chronicity and severity of MS and the underlying pathophysiological remodeling.

Generally, in MS, a rapid decline in PAP is observed after relieving the stenosis. However, PAP remains high or decline more slowly in some patients. The prediction of the PAP response to the treatment is very difficult. Consequently, an investigation of the predictive factors is of great importance. Cardiovascular magnetic resonance imaging (CMR) has been used in the evaluation of PH for the past 25 years. The characteristic changes of the right heart and the pulmonary artery (PA) secondary to an elevated PAP can be evaluated via CMR examination. In this study, we aimed to evaluate whether there was any correlation between PAP and hemodynamic findings measured by CMR and whether these findings could be useful in predicting the PAP response after MS relief.

METHODS

In this case series, a total of 33 patients with severe rheumatismal MS who had PH (mean PAP ≥ 25 mm Hg in right-heart catheterization) and were candidat ed for percutaneous transvenous mitral commissurotomy (PTMC) or mitral valve replacement (MVR) in Rajaie Cardiovascular, Medical, and Research Center were included. The diagnosis of severe MS (mitral valve area [MVA] < 1.5 cm²) was made in accordance with the European guideline for the management of valvular heart disease. The presence of PH was confirmed in the catheterization laboratory using the European guideline for the diagnosis and management of PH.

The exclusion criteria were comprised of the presence of other valvular heart diseases with more than moderate severity needing intervention, mitral regurgitation, significant left ventricular (LV) systolic dysfunction (left ventricular ejection fraction [LVEF] ≤ 40%), and inability to attend the CMR field (claustrophobia).

Echocardiographic examination

Comprehensive transthoracic echocardiography was performed by an echocardiography specialist using a Vivid 7 ultrasound system (GE Medical System, Horten, Norway) and a 1.7/3.4 MHz transducer. Images were acquired with the subjects at rest, lying in the left lateral supine position at the end of expiration. 2D ECG was superimposed on the images, and end-diastole was considered at the peak R-wave of the ECG. LV global systolic function was evaluated using a modified biplane Simpson method for calculating LVEF. In all the patients, the MVA was assessed using the 2D planimetry method in the parasternal short-axis view at valve tips. PAP was evaluated considering the guidelines on the assessment of the right heart before the procedure, the 1st time after the procedure during index hospitalization and subsequently 3 months after discharge.

Cardiovascular magnetic resonance examination

CMR with 1.5-T clinical magnet (Magnetom Avento; Siemens Medical Solutions, Erlangen, Germany) with a gadolinium-based contrast agent (Magnevist) was performed, and the following data were obtained from a thorough CMR examination: PA diameter in systole and diastole, distensibility index (the difference between the maximum and minimum PA diameter divided by the maximum diameter), PA peak velocity, PA forward volume, PA forward flow. CMR study was performed with the patients in the supine position by using a phased-array imaging.
surface coil as a receiver and retrospective ECG gating. Images were obtained during end-expiratory breath holds preceded by brief hyperventilation. After obtaining standard localizer views, 2 double-oblique views oriented along the main axis of the pulmonary trunk and the ascending aorta were acquired with a standard steady-state free precession cine MR sequence. The 1st one was in a double-oblique section perpendicular to the direction of the ascending aorta at the level of the pulmonary bifurcation, and the 2nd was in a double-oblique section perpendicular to the main PA, 10 mm above the pulmonary valves. Only 1 set of velocity measurements was acquired for each patient, perpendicular to the main PA.

Both cine loops were used as the reference to prescribe a plane truly perpendicular to the main PA for the acquisition of phase-contrast MR images and to ensure that the imaging plane remained between the pulmonary valve and the PA bifurcation throughout the whole cardiac cycle.

The imaging plane was selected on an oblique sagittal localizing image that showed the ascending aorta. We preferred an imaging plane at the level of the pulmonary bifurcation since it was easy to reproduce. This imaging plane also had a sufficient distance from the aortic valve so that the effect of mild valvular disease did not disturb the flow measurements.

Phase-contrast MR images were acquired with a segmented fast gradient-echo MR sequence, with velocity encoding perpendicular to the imaging plane and a predefined upper velocity limit of 100 cm/sec. If aliasing was noted, the velocity was progressively raised in 50-cm/sec steps until the aliasing disappeared. Imaging parameters comprised the following: 7.5/3.1; flip angle, 15°; section thickness, 6 mm; field of view, 320–380 × 240–300 mm; matrix, 256 × 128 (typical in-plane resolution, 2.7 × 1.4 mm); number of signals acquired, 1; number of segments, 5 to 7; temporal resolution, 75–105 msec; number of reconstructed cardiac phases, 20; and bandwidth, 260 Hz/pixel. The typical breath-hold time ranged from 15 to 25 seconds. The patients were encouraged to hold their breath during the whole acquisition. Supplemental oxygen was administered as clinically indicated or if the patients experienced difficulties completing the period of apnea. If obvious breathing artifacts were noted, the acquisition was repeated.

The study was approved by institutional research and ethics committee, and informed consent was obtained from all the study participants.

Statistical Analysis

All the analyses were conducted using SPSS software, version 22 (SPSS Inc, Chicago, IL, USA). All the data initially were analyzed using the Kolmogorov–Smirnov test to assess for normality. The categorical variables are presented as numbers (percentages) and analyzed using the χ² test. The normally-distributed quantitative variables are presented as means ± standard deviations (SDs) and those with non-Gaussian distributions are presented as medians (interquartile ranges [IQRs]). For the analysis of the quantitative variables, the Student t-test was drawn upon. The relationships were assessed using the Spearman rank correlation coefficient (ρ) or the Pearson correlation test as appropriate. Binary logistic regression analysis was applied to assess the independent CMR factors associated with a higher drop in systolic PAP (> 50% decline in systolic PAP or systolic PAP ≤ 35 mm Hg immediately after the procedure or 3 months after the procedure). All the P values were 2-tailed, and a P value < 0.05 was considered statistically significant.

RESULTS

Thirty-three patients with a diagnosis of MS+PH (15 patients scheduled for PTMC and...
18 for MVR) were enrolled in this study. About 70% of the patients were female and the mean (SD) of age was 51.3 (12) years (between 32 and 74 y). The most common chief complaint was dyspnea on exertion, which was obvious in all the patients. The median (IQR) of the MVA was 0.82 (0.5–1.3) cm², and the mean (SD) of systolic PAP was 62 (19) mm Hg in baseline echocardiography. The mean PAP at baseline catheterization ranged from 25 to 70 mm Hg in our study population (mean [SD] = 42 [12.1]).

There was also no difference between the PA distensibility index and systolic PAP at baseline, immediately after the procedure, or 3 months after the treatment. There was also no difference between the patients who had a greater drop in their systolic PAP (systolic PAP < 35 mm Hg or > 50% decrease in systolic PAP) and those who did not regarding the PA distensibility (P = 0.3).

The PA peak velocity was significantly higher in the patients who had > 50% drops in their systolic PAP 3 months after the treatment compared to the baseline (mean [SD] PA peak velocity [cm/sec] = 76.2 [20] vs 60 [16.7]) (P = 0.04).

The PA forward volume and the PA forward flow showed no association with baseline systolic PAP or systolic PAP after the treatment. However, in the subgroup analysis, the PA forward flow showed a significant negative correlation with systolic PAP 3 months after the procedure in the PTMC group (P = -0.6 and P = 0.01).

**Table 1.** Demographic, clinical, and echocardiographic findings of the study population (N=33)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Mitral Stenosis Treatment Group (N=33)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MVR (n=18)</td>
<td>PTMC (n=15)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (y) mean (SD)</td>
<td>48.6(11.5)</td>
<td>53.5(12.2)</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>Gender, F/M, count (%)</td>
<td>11(47.8)/4(40)</td>
<td>12(52.2)/6(60%)</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>NYHA class, count (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-II,II</td>
<td>7(46.6)</td>
<td>8(44.4)</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>II-III,III</td>
<td>6(40)</td>
<td>7(38.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>2(13.3)</td>
<td>3(16.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orthopnea, count (%)</td>
<td>4(27)</td>
<td>8(44.4)</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td>Palpitation, count (%)</td>
<td>6(40)</td>
<td>7(38.9)</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>Chest pain, count (%)</td>
<td>2(13.3)</td>
<td>3(16.7)</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td>Concomitant CAD, count (%)</td>
<td>1(6.7)</td>
<td>1(5.6)</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>LVEF, %, mean (SD)</td>
<td>49.6(7.2)</td>
<td>47.7(7.1)</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>MVA,cm², median (IQR)</td>
<td>0.7(0.6-1.1)</td>
<td>0.9(0.7-1)</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>Baseline PASP</td>
<td>65.7(25)</td>
<td>59(12)</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>PASP after the procedure</td>
<td>46(13)</td>
<td>43.6(13.8)</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td>PASP 3 months after the procedure</td>
<td>38.3(11.6)</td>
<td>35.3(7.8)</td>
<td>0.4</td>
<td></td>
</tr>
</tbody>
</table>

NYHA, New York Heart Association; LVEF, Left ventricular ejection fraction; MVA, Mitral valve area; PASP, Pulmonary artery systolic pressure

**Cardiac magnetic resonance findings**

Table 2 shows the CMR findings in our study population. There was no relationship between the PA distensibility index and systolic PAP at baseline, immediately after the procedure, or 3 months after the treatment. There was also no difference between the patients who had a greater drop in their systolic PAP (systolic PAP < 35 mm Hg or > 50% decrease in systolic PAP) and those who did not regarding the PA distensibility (P = 0.3).
The multivariable analysis was performed using binary logistic regression with the low likelihood backward elimination method to assess whether any CMR findings might predict > 50% drops in systolic PAP 3 months after MS relief independently. This analysis showed that none of the above-mentioned CMR findings was an independent predictor of a more systolic PAP decline. The same result was observed when we considered a systolic PAP < 35 mm Hg 3 months after MS relief as the end point in the multivariable analysis.

### Table 2. Cardiac magnetic resonance findings in the study population (N=33)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Mitral Stenosis Treatment Group (N=33)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PTMC N=15</td>
<td>MVR N=18</td>
<td></td>
</tr>
<tr>
<td>Distensibility, %,mean (SD)</td>
<td>21(8)</td>
<td>21(9)</td>
<td>0.9</td>
</tr>
<tr>
<td>PA peak velocity, cm/sec, mean (SD)</td>
<td>65.7(21.5)</td>
<td>59.8(17.4)</td>
<td>0.3</td>
</tr>
<tr>
<td>PA flow per minute, ,mean (SD)</td>
<td>6(1.7)</td>
<td>5.8(1.3)</td>
<td>0.7</td>
</tr>
<tr>
<td>PA forward Volume mean (SD)</td>
<td>80.6(33)</td>
<td>75.5(19.2)</td>
<td>0.5</td>
</tr>
</tbody>
</table>

PA, Pulmonary artery

### DISCUSSION

In the present study, we could not find any relationship between PA hemodynamic measures in CMR and systolic PAP in our severe MS patients with PH in the multivariate analysis and none of the CMR hemodynamic measures was independently correlated with systolic PAP. It is, therefore, not useful for predicting PH reversal after MS relief.

Recently, many investigators have focused on CMR findings in PH in order to better manage approaches and follow-ups. Several studies in idiopathic pulmonary arterial hypertension (IPAH) have shown a significant relationship between PA peak velocity, distensibility, and PA forward flow and hemodynamic findings including vasoreactivity. We aimed to assess such correlations in patients with MS and PH as another category of PH. However, despite a good correlation between PAP and PA distensibility as well as PA velocity in CMR among the patients with IPAH in some studies, systolic PAP at baseline as well as post procedure was not associated with these variables in our study population.

The only positive finding of the present study was a higher PA peak velocity in the patients who had > 50% drops in their systolic PAP 3 months after MS relief, which showed a higher reversibility tendency in this group of patients. Laffon et al studied IPAH patients and showed that those with a higher PA velocity were more probable to be vasoreactive to pulmonary vasodilators in the vasoreactive challenge test. A similar mechanism can be considered for our study population. However, the multivariable study demonstrated that none of these factors, including PA peak velocity, was independently correlated with a higher drop in systolic PAP. The different pathophysiology mechanism for PH in MS setting (post capillary PH) might be responsible for this finding.

On the other hand, our sample size was small and we considered systolic PAP measured by echocardiography. Our results would have been augmented had we been able to consider catheterization data, including mean PAP, pulmonary vascular resistance, and trans-pulmonary gradient.
CONCLUSIONS

Considering the limitation of this study, we would recommend that future studies investigate the association between catheterization data as gold standard and CMR findings in different categories of PH. These studies may shed some light on the pathophysiologic mechanisms in PH and enhance the management and follow-up of this group of patients.

REFERENCES


Original Article

Outcome of Carotid Stenting in Patients Undergoing Angioplasty

Seifolah Abdi 2, MD; Faramarz Amiri 1, MD; Omid Shafe*2, MD; Reza Ebrahimi Rad 3, MD; Hamid Fakhreddin 1, MD; Alireza Jebeli 1, MD; Seyed Abdullah Sayadmanesh 1, MD; Moslem Shadmani 1, MD; Ebrahim Ghobadi 1, MD

ABSTRACT

Background: Carotid artery stenosis accounts for 10% of all ischemic strokes. Carotid endarterectomy (CEA) and carotid artery stenting (CAS) are currently the treatment for stroke prevention.

Methods: We sought to compare the efficacy and safety of each treatment in patients with carotid artery stenosis. After treatment, the patients were evaluated regarding their outcomes during the 1st and 6th postprocedural months.

Result: Sixty-nine patients (45 male [65.2%] and 24 female [24.8%]) at a mean age of 63.85 ± 14.17 years were enrolled. In 12 (17.4%) patients, both left and right carotid arteries were stenotic. Neither CEA nor CAS had in-hospital and procedural complications. However, in longer-term follow-up, transient ischemic attack occurred in 2 (2.9%) patients in the CEA group, while significant in-stent restenosis occurred in 2 (2.9%) patients after CAS. Multivariate analysis showed no association between smoking, coronary artery disease, dyslipidemia, hypertension, diabetes mellitus, and age and stent stenosis ($P = 0.9$, $P = 0.9$, $P = 0.5$, $P = 0.6$, $P = 0.8$, and $P = 0.1$, correspondingly).

Conclusions: Both CEA and CAS are approved therapeutic strategies for the treatment of carotid artery stenosis. Low complications and good results can be expected if case selection is done according to the current guidelines. (Iranian Heart Journal 2017; 18(1):37-43)

Keywords: Carotid stenosis, Carotid artery stenting, Carotid endarterectomy

For the treatment of extracranial carotid artery disease in patients at high risk for adverse events, in 2004, the United States’ Food and Drug Administration (FDA) approved the 1st endovascular device system, carotid endarterectomy (CEA), for practice in the country. Meanwhile, carotid artery stenting (CAS) has been performed with increasing numbers in different hospital settings. After the 1st adoption phase in CAS,
there was a noticeable decrease in the rates of adverse outcomes, conceivably related to improved patient selection and increased operator experience. Owing to this accumulating CAS experience, a better understanding of the factors related to the increased risk of adverse outcomes has been possible. During the past 5 years, it has been confirmed that patient-related factors such as age, symptom status, timing of symptoms before CAS, patient comorbidities, concurrent medications, and smoking history all might influence the outcome. CAS outcomes are also impacted by physician-related factors, including training and experience, as well as hospital volume. Furthermore, these factors are not yet well characterized, while the progression in our understanding of risk predictors and the improvement of outcomes for CAS seem to mirror the experience previously demonstrated for CEA. In the North American Symptomatic Carotid Endarterectomy Trial (NASCET), contralateral occlusion was not excluded, but it resulted in a 30-day risk of stroke and death of 14.3%. Additionally, in the Asymptomatic Carotid Atherosclerosis Study (ACAS), it led to a 2% increase in stroke and death compared with medical therapy. Since the publication of these 2 trials, there has been a broad use of CEA, including in patients with high surgical risks, as a result of the extrapolation of the outcomes of these studies. CEA has been revealed effective as the preventive treatment for symptomatic and asymptomatic diseases. CAS was introduced in 1994 and provides another choice of treatment. There are different results of randomized trials comparing CAS with CEA for symptomatic patients. The Carotid Revascularization Endarterectomy Versus Stenting Trial (CREST) compared CAS with CEA in both symptomatic and asymptomatic patients. The aim of the present study was to analyze the outcomes of CEA for physician- or site-related variables associated with differential outcomes for CAS.

**METHODS**

In this case series, 69 patients who underwent angioplasty between Jun 2013 and June 2015 in our tertiary care center were enrolled. Two methods of treatment are performed for carotid stenosis (CS), namely CEA with surgery or stenting through the femoral artery access. All the patients who underwent carotid stenting were enrolled, and those with intra-arterial coiling and angiography without angioplasty were excluded. A large number of studies have compared these 2 methods. In the present study, all the data on the patients who underwent carotid angioplasty were recorded regarding the presence of neurological and clinical symptoms—whether bilateral or ipsilateral—via Doppler sonography. The success of treatment was evaluated in terms of the patients’ recovery and absence of symptoms as well as follow-up outcomes by Doppler sonography. The patients underwent carotid angiography and carotid stenting 1 day after hospitalization, and primary care and laboratory examination were performed. In this study, the patients who were diagnosed with CS via Doppler sonography but did not show considerable stenosis on angiography and had no need for stenting were entirely excluded.

**Statistical Analysis**

The Mann–Whitney U-test was used to measure the relationship between the ordinal and categorical variables. SPSS 18.0 (Chicago, USA) was used for all the statistical analyses. The continuous and categorical variables are presented as means ± standard deviations (SDs) and percentages. The Student t-test was utilized to compare the quantitative variables, and the \( \chi^2 \) test was applied to compare the categorical variables. The 2 groups were compared using the Pearson \( \chi^2 \) or the Fisher exact test for the
categorical variables. A nonparametric test (Kruskal–Wallis test) was employed to remove the effect of the confounding factors of the variables.

RESULTS

In this study, 69 patients (45 [65.2%] male and 24 [24.8%] female) at a mean age of 63.85 ± 14.17 years were enrolled. The patients were divided into 3 groups: 11 (15.9%) patients who showed occlusion during the accidental assessment of their carotid arteries, 50 (72.2%) patients who were hospitalized due to cerebrovascular accident/transient ischemic attack (CVA/TIA) and were referred due to carotid occlusion, and 8 (11.6%) cases with neurological disorders who were hospitalized due to CS. All the patients’ demographic and clinical data are depicted in Table 1. The patients were evaluated regarding their outcomes during the 1st and 6th postprocedural months via Doppler sonography and were administered ASA (80 mg/d) and Plavix (75 mg/d) and then continued on ASA (80 mg/d). Twenty-four (34.8%) cases had single right CS, 23 (33.2%) had left CS, and 12 (17.4%) had left and right stenoses. Two patients had left or right CS concomitant with vertebral, basilar, or subclavian stenosis. Six cases had complete left or right CS without any flow in addition to the severe stenosis of the other side and 2 (2.9%) cases were hospitalized owing to carotid dissection. The prevalence of the patients according the location of their CS is illustrated in Table 2. None of the patients showed periprocedural complications such as stroke, TIA, myocardial infarction, and bleeding. Apropos delayed postoperative complications, 2 (2.9%) cases suffered TIA, but their stent was open; therefore, it does not seem that it was related to the stent. With the exception of 1 case with a pacemaker, all the patients presented with sinus rhythm. As regards stent stenosis, 4 (5.4%) cases had mild stenosis (< 39%), 1 (1.4%) patient had moderate stenosis (40%–69%), 2 (2.9%) cases had severe stenosis (> 70%), and 1 (1.4%) patient had dissection. The stenoses were categorized as moderate to severe. Totally, 3 (4.5%) cases had moderate-to-severe stenosis and 1 (1.4%) case had dissection; nevertheless, none of the cases had CVA or TIA. Typically, the stenosis was unilateral. In 3 (4.3%) patients who underwent angioplasty, new stenosis was seen on the other side. The patients with severe stent stenosis had a history of CVA, and a significant relation between stent restenosis and previous CVA/TIA was found (P = 0.3). There was no association between stent stenosis and the side of stenting (P = 0.4). Stenting was performed in the common carotid to the eternal carotid in some of the patients; no significant difference was seen between restenosis and the length of the stent (P = 0.3). No significant relationship was also found between hypertension (P > 0.05), coronary artery disease (P = 0.6), diabetes mellitus (P = 0.9), dyslipidemia (P > 0.05), and smoking (P = 0.9). The result of the multivariate analysis showed no association between coronary artery disease, dyslipidemia, hypertension, diabetes mellitus, and age and CS (P = 0.9, P = 0.9, P = 0.5, P = 0.6, P = 0.8, and P = 0.1, respectively). The relationships between the clinical data and stent stenosis are shown in Table 3.

<table>
<thead>
<tr>
<th>Variables</th>
<th>N(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>54(65.2%)</td>
</tr>
<tr>
<td>Female</td>
<td>24(34.8%)</td>
</tr>
<tr>
<td>No symptoms</td>
<td>11(15.9%)</td>
</tr>
<tr>
<td>CVA/TIA</td>
<td>50(72.5%)</td>
</tr>
<tr>
<td>Neurological disorder</td>
<td>8(11.6%)</td>
</tr>
<tr>
<td>Right side</td>
<td>24(34.8%)</td>
</tr>
<tr>
<td>Left side</td>
<td>23(33.3%)</td>
</tr>
<tr>
<td>Right and left</td>
<td>12(17.4%)</td>
</tr>
<tr>
<td>R/L and vertebral or basilar</td>
<td>2(2.9%)</td>
</tr>
<tr>
<td>HTN</td>
<td>18(26.1%)</td>
</tr>
<tr>
<td>CAD</td>
<td>10(14.5%)</td>
</tr>
<tr>
<td>CS</td>
<td>3(4.3%)</td>
</tr>
</tbody>
</table>

R, Right; L, left; CVA, Cerebrovascular accident; TIA, Transient ischemic attack; HTN, Hypertension; CAD, Coronary artery disease; CS, Carotid stenosis
Table 2. Complications and clinical data during and after surgery or at follow-up

<table>
<thead>
<tr>
<th></th>
<th>No (%)</th>
<th>Mild Stenosis</th>
<th>Moderate Stenosis</th>
<th>Severe Stenosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stent stenosis</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild</td>
<td>4(5.8%)</td>
<td>1(1.4%)</td>
<td>2(2.9%)</td>
<td>1(1.4%)</td>
</tr>
<tr>
<td>Moderate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severe</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dissection</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bilateral stent stenosis</td>
<td>1(1.4%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unilateral stent stenosis</td>
<td>7(10.1%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No side</td>
<td>61(88.4%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stenosis on contralateral side</td>
<td>3(4.3%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complications</td>
<td>1(1.4%)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3. The relationship between the clinical and demographic data and stent stenosis

<table>
<thead>
<tr>
<th></th>
<th>No Stenosis</th>
<th>Mild Stenosis</th>
<th>Moderate Stenosis</th>
<th>Severe Stenosis</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>39</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0.8</td>
</tr>
<tr>
<td>Female</td>
<td>22</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0.8</td>
</tr>
<tr>
<td>CVA/TIA</td>
<td>45</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0.03</td>
</tr>
<tr>
<td>Neurological disorder</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0.03</td>
</tr>
<tr>
<td>No symptoms</td>
<td>10</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0.03</td>
</tr>
<tr>
<td>Side before stenting</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>22</td>
<td>1(1.4%)</td>
<td>0</td>
<td>0</td>
<td>0.4</td>
</tr>
<tr>
<td>Left</td>
<td>22</td>
<td>0</td>
<td>0</td>
<td>1(1.4%)</td>
<td></td>
</tr>
<tr>
<td>R+L</td>
<td>9</td>
<td>2(2.9%)</td>
<td>0</td>
<td>1(1.4%)</td>
<td></td>
</tr>
<tr>
<td>R/L+ vertebral of basilar</td>
<td>2(2.9%)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Stent stenosis, total occlusion</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Dissection</td>
<td>61</td>
<td>4</td>
<td>1(1.4%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CVA: Cerebrovascular accident; TIA: Transient ischemic attack; R: Right; L: Left
A P value < 0.05 was considered the level of significance.

DISCUSSION

The CREST study showed that out of 2000 patients who underwent angioplasty or endarterectomy, 120 cases developed restenosis during 2 years of follow-up. In these patients, hyperlipidemia and diabetes mellitus were the causes of restenosis. The stenosis was mostly seen in the 1st year of follow-up. Another study defined the time interval between the incidence of CVA and the performance of clinical treatment as a variable and suggested that angioplasty be avoided during the acute phase of the disease. Elsewhere, the rate of restenosis in patients with diabetes mellitus and TIA was in line with that in our study. We found no significant relationships between age, diabetes mellitus, and hyperlipidemia, which may be due to our small sample size. 10

Previous investigations demonstrated that CAS and CEA had comparable outcomes in symptomatic and asymptomatic male and female patients, although there was a lower incidence rate of myocardial infarction directly after CAS and a lower incidence of stroke immediately after CEA. 11, 12 One study reported that its older patients had a better outcome after CEA, while its younger patients had a slightly better outcome following CAS. 13 Consequently, patients’ preferences and their age may be important considerations in the choice of treatment for CS. The relationship between advancing age and increasing adverse events after CAS has been highlighted previously 14, 5, 15 and the effect of advancing age on treatment differences, CAS versus CEA, was revealed in the Stent-Protected Angioplasty versus Carotid Endarterectomy (SPACE) trial. The periprocedural safety outcomes for CAS and CEA are the best stated to date for patients with pre- and postprocedural medical, neurological, ECG, and enzyme evaluations.
An effective credentialing process for the surgeon, rigorous training and credentialing process for the interventionist, and increasing integration of endovascular expertise might be the reflection of these brilliant CREST outcomes. Advanced and supplementary medical therapies that are commonly used may also be an explanation for the favorable outcomes observed after CEA in the CREST study compared with outcomes in previous randomized clinical trials of CEA. Two analyses have confirmed the need for prospective neurological evaluations before and after CEA to best estimate the outcome, with a 3-fold increase in events via neurological assessment compared with outcomes that were otherwise self-reported; this is especially applicable since the NASCET and ACAS trials used such evaluations and constitute the basis for the guidelines of the American Heart Association (AHA). Likewise, it is remarkable that in the original CAPTURE study, CEA adjudication led to the identification of 50% more 30-day adverse outcome events compared with the site-reporting of events alone; thereby approving the importance of both prospective data gathering and the adjudication process in providing full reporting of the outcomes. In the present study, no significant relationship was found between neurological disorders and stent stenosis. While there continues to be disagreement in some circles regarding the actual definition of high surgical risk, recent randomized data have confirmed the perception vis-à-vis the increase in stroke and death outcomes in a predefined surgical population with both physiological and anatomical surgical risks. Nonetheless, in the 10 years since the publication of the AHA’s guidelines, there has not been a similarly rough demonstration of the fulfillment of the guidelines in the high-surgical-risk population undergoing CEA. CAS, when performed by experienced and skilled interventionists, has patient outcomes comparable to those of CEA performed by experienced and skilled surgeons. During the perioperative period, more incidences of stroke arise after CAS. Younger patients have a considerably better outcome with CAS and older patients have a better outcome with CEA. For the future, both CEA and CAS appear to be suitable tools for preventing stroke. In the present study, the rate of stent stenosis in the patients with CS who were hospitalized with CVA was higher than the other outcome (P < 0.05). The results of our study chime in with another investigation that showed that the most significant cause of CS was CVA/TIA. The rate of total occlusion in our study was 5%–7%. Additionally, the rate of postoperative complications was not considerable. It has been suggested that follow-up of the stenosis be continued on the other side of the carotid artery. Six months’ or yearly follow-up of the stented side has been recommended.

In the current study, successful flow was achieved by opening the occlusion in the patients with severe stenosis. Nevertheless, complete occlusion and concomitant absence of flow was detected on the other side. No treatment was performed while the other side was reopened, and there was no complication during surgery. Among our study population, the most significant complications were CVA and TIA; however, no myocardial infarction and major and minor bleeding occurred. Our results were in accordance with the outcomes of other studies, although the procedures were different. With regard to the patients’ recovery after surgery, almost 97% of the cases recovered well. The remaining few experienced delayed TIA after surgery. Regarding the patients suffering mild and severe stent stenosis, dissection was seen in 1 (1.4%) of the cases. One (1.4%) patient had Takayasu’s arteritis and had a different clinical outcome and showed bilateral stenosis. Stent stenosis was mostly seen in the patients who underwent stent implantation due to CVA (P = 0.03). Thirteen of the cases with CS had diabetes mellitus; no significant
relationship was, however, found between stent stenosis and diabetes mellitus \((P > 0.05)\). These results are not concordant with those previously reported. Two (2.9\%) cases were assessed regarding dissection with no significant stenosis.

In the CREST study, smoking was introduced as the main risk factor in patients undergoing endarterectomy. In contrast, in our study, no significant relationship was found between smoking and CS \((P > 0.05)\). There was only a significant relationship between the patients with CVA/TIA and restenosis; this finding is consistent with the results of the studies reporting the occurrence of stenosis during the 1st month of evaluation \((P < 0.05)\) [10]. Among the perioperative complications in our study, there was 1 (1.4\%) patient with TIA. In the present study, all the implanted stents were particularly bare-metal ones and the results are similar to those of the previous studies, although the latter investigations had larger populations.

**Limitations**

The major limitation of the present study is our small sample size, which underscores the essential need for further research with a greater sample size.

**ACKNOWLEDGEMENTS**

The authors express their gratitude to Dr Mona Heidarali for her assistance in the scientific writing of the manuscript.

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**REFERENCES**


Original Article

Effects of Lavender Oil Inhalation on Anxiety and Pain in Patients Undergoing Coronary Angiography

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ABSTRACT

Background: Cardiovascular diseases alone account for 48% of deaths in the world. There is a high rate of coronary angiography for the early diagnosis of such diseases. Not only do patients suffer from anxiety because of the invasive nature of this procedure but also they experience pain and discomfort for several hours after the procedure. We conducted this study to assess the effects of the inhalation of lavender essential oil on anxiety and pain in patients undergoing coronary angiography.

Methods: This clinical trial was performed at Rajaie Cardiovascular, Medical, and Research Center, Tehran, Iran. Eighty patients who were hospitalized for coronary angiography participated in this study. The patients were divided into 2 groups: control (n = 40) and intervention (n=40). Data collection tools included the 3 forms of demographic information, standard Spielberger questionnaire, and visual analog pain scale, which were completed by both groups before and after aromatherapy with lavender oil. The collected data were analyzed with SPSS software, version 16.0. (Armonk, NY, USA) using the χ², McNemar, Wilcoxon, Mann–Whitney, and t tests.

Results: The 2 groups were comparable apropos age, sex, marital status, and education level. After aromatherapy, the level of anxiety in the intervention group decreased significantly (P < 0.05) in comparison with the control group. Additionally, the extent of pain in the 2 groups showed a significant difference (P < 0.05).

Conclusions: Smelling the scent of lavender significantly reduced anxiety and pain in our patients, before and after coronary angiography. (Iranian Heart Journal 2017; 18(1):44-50)

Keywords: Lavender, Anxiety, Pain, Coronary angiography

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Today, the prevalence of cardiovascular diseases has increased as a consequence of changes in lifestyle, advances in technology, alterations in eating habits, smoking, aging, high blood pressure, and lipid levels, all of which in turn lead to diabetes. 1 Cardiovascular diseases are the most important cause of mortality in the world. 2 Given the life-threatening characteristics of this disease and its progressive course, it is necessary to use diagnostic procedures such as angiography. Despite its invasive nature, angiography is the gold standard and an important diagnostic procedure to determine the location and severity of blood flow blockage in coronary arteries. 3 Most of the invasive diagnostic tests are accompanied by anxiety for patients. Alongside diagnostic tests, hospitalization creates different levels of anxiety for patients. Patients’ non-acquaintance with the coronary angiography procedure is one of the most common causes of anxiety in these patients. This lack of information leads to the overstimulation of their nervous system. 4 A previous study showed that 82 patients who underwent coronary angiography had experienced anxiety before the procedure. 5 In order to prevent trauma to the arteries after angiography, which may be caused by the patients’ leg movement, an absolute bed rest is required. It is recommended to use sand bags weighing 2.5–4 kg around the procedure area. As a consequence, back pain is common among patients after coronary angiography and it is usually accompanied by immobility and limitation of movement. 6 According to a study conducted in Iran, the incidence rate of back pain in patients after coronary angiography was 71.8%. 7 Both pharmacological and non-pharmacological methods have been used to reduce anxiety. Among the non-pharmacological methods, complementary therapies such as aromatherapy have the benefits of being inexpensive, noninvasive, easy to implement, non-pharmacological in nature, and free from chemical adverse effects. 8 Lavandula angustifolia Mill (lavender), which is called ostokhodos in Iran, is a strong aromatic agent. 9 This plant belongs to the Lamiaceae family and is herbaceous, aromatic, and evergreen. Lavender plants are widely used in Iranian traditional medicine. They possess sedative and analgesic effects, confirmed by Iranian scientists such as Abu Ali Sina (Avicenna) and Razi (Rhazes). 10 We conducted the present study to evaluate the effects of lavender oil inhalation on anxiety and pain in patients undergoing coronary angiography.

METHODS

This randomized double-blinded clinical trial was performed at Rajaie Cardiovascular, Medical, and Research Center, Tehran, Iran. All patients who were admitted between August 2014 and April 2015 for coronary angiography were enrolled in this study. Eighty patients were eligible for this study after meeting the inclusion criteria, comprising age between 25 and 75 years, coronary angiography for the 1st time, complete consciousness, no history of taking psychiatric drugs, no history of pulmonary or liver insufficiency, allergies, and asthma. All the patients filled out a written consent form to participate in this study. The patients were enrolled in the study according to the table of a computerized randomization list: control (n = 40) and intervention (n = 40). The data encompassed demographic information, Spielberger standard questionnaire to measure anxiety, and visual analogue pain scale. The data were collected by a trained nurse, who was blinded to the study. The Spielberger questionnaire test consists of 2 separate parts, both parts containing 20 items. The 1st and 2nd parts determine state and trait anxiety, respectively. The feeling of anxiety at the moment is called state anxiety, whereas overall feeling of anxiety during a period is referred to as trait anxiety. The total scores of both state and trait anxiety scales are in the range of 20–80. Patients with total scores > 43

A computerized randomization list was used to assign patients to either the control or intervention group. The double-blind randomization was performed by a statistician who was not involved in the study. The patients were divided into 2 groups of 40 patients each. The randomization scheme was generated using the computerized randomization list.

Participants

Eighty patients were eligible for this study. All patients who were admitted between August 2014 and April 2015 for coronary angiography were eligible for this study. Eighty patients were enrolled in this study. The patients were divided into 2 groups of 40 patients each. The randomization scheme was generated using a computerized randomization list.

Inclusion criteria:

1. Patients over 25 years of age
2. Undergoing coronary angiography for the first time
3. Complete consciousness
4. No history of pulmonary or liver insufficiency
5. No history of allergies
6. No history of asthma
7. No history of taking psychiatric drugs
8. No history of smoking
9. No history of diabetes
10. No history of taking blood thinners
11. No history of taking hypertension medications
12. No history of taking cholesterol medications
13. No history of taking antiplatelet medications

Exclusion criteria:

1. Patients with a history of allergy to lavender oil
2. Patients with a history of asthma
3. Patients with a history of smoking
4. Patients with a history of diabetes
5. Patients with a history of taking blood thinners
6. Patients with a history of taking hypertension medications
7. Patients with a history of taking cholesterol medications
8. Patients with a history of taking antiplatelet medications

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13. No history of taking antiplatelet medications

Exclusion criteria:

1. Patients with a history of allergy to lavender oil
2. Patients with a history of asthma
3. Patients with a history of smoking
4. Patients with a history of diabetes
5. Patients with a history of taking blood thinners
6. Patients with a history of taking hypertension medications
7. Patients with a history of taking cholesterol medications
8. Patients with a history of taking antiplatelet medications

Methods
are considered anxious. This questionnaire is widely used by psychologists and psychiatrists. The validity and reliability of its Farsi translation were reviewed and approved by Shahid Beheshti University and Tehran Psychiatric Institute. The Spielberger questionnaires were completed for all the patients 1 hour before angiography. Before the procedure, the patients in the intervention group smelled a piece of cotton wool soaked in 5 drops of lavender essential oil, at a distance of 5 cm from the nose with deep inhalations for 5 minutes. The control group smelled a piece of cotton wool soaked in distilled water in the same manner. Thirty minutes later, the Spielberger questionnaires were completed again. Thereafter, all the patients underwent coronary angiography. One hour after the procedure, pain was measured in all the patients using the visual analogue pain scale. The interventions were subsequently performed on the patients again. Thirty minutes later, pain scoring was assessed using the visual analogue pain scale in all the patients. During the study period, none of the patients met the exclusion criteria, including refusing to give consent to continue the study, having any symptoms of myocardial infarction, and allergy.

RESULTS

The collected data were analyzed using IBM SPSS Statistics for Windows, version 16.0 (Armonk, NY, USA). The \( \chi^2 \) test revealed no significant differences between the 2 groups in terms of age, sex, marital status, and education level. State and trait anxiety levels in the patients are depicted in Table 2 and Table 3.

<table>
<thead>
<tr>
<th>Table 1. Review of the homogeneity of the demographic characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographic Characteristics</td>
</tr>
<tr>
<td>Sex</td>
</tr>
<tr>
<td>Intervention Group Number (%)</td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>14 (35)</td>
</tr>
<tr>
<td>Marital Status</td>
</tr>
<tr>
<td>Intervention Group Number (%)</td>
</tr>
<tr>
<td>Single</td>
</tr>
<tr>
<td>35 (87.5)</td>
</tr>
<tr>
<td>Education Level</td>
</tr>
<tr>
<td>Intervention Group Number (%)</td>
</tr>
<tr>
<td>Less than diploma</td>
</tr>
<tr>
<td>High school diploma</td>
</tr>
<tr>
<td>University degree</td>
</tr>
<tr>
<td>Age</td>
</tr>
<tr>
<td>Intervention Group Mean</td>
</tr>
<tr>
<td>50.48</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2. State and trait anxiety of the control group before and after the inhalation of distilled water</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Anxiety in the Control Group</td>
</tr>
<tr>
<td>Anxious</td>
</tr>
<tr>
<td>Frequency</td>
</tr>
<tr>
<td>Before Intervention</td>
</tr>
<tr>
<td>Trait Anxiety in the Control Group</td>
</tr>
<tr>
<td>Anxious</td>
</tr>
<tr>
<td>Frequency</td>
</tr>
<tr>
<td>Before Intervention</td>
</tr>
</tbody>
</table>
Feeling of pain was reduced dramatically in the intervention cases (Table 4).

Table 3. State and trait anxiety of the intervention group before and after the inhalation of lavender essential oil

<table>
<thead>
<tr>
<th></th>
<th>State Anxiety in the Intervention Group</th>
<th>Trait Anxiety in the Intervention Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before Intervention</td>
<td>After Intervention</td>
</tr>
<tr>
<td>Anxious</td>
<td>Frequency</td>
<td>Percentage</td>
</tr>
<tr>
<td>Anxious</td>
<td>30</td>
<td>75</td>
</tr>
<tr>
<td>Non-Anxious</td>
<td>10</td>
<td>25</td>
</tr>
</tbody>
</table>

Table 4. Pain assessment in the participants before and after the inhalation of lavender oil or distilled water

<table>
<thead>
<tr>
<th></th>
<th>Control Group</th>
<th>Intervention Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before Intervention</td>
<td>After Intervention</td>
</tr>
<tr>
<td>Pain Intensity</td>
<td>Frequency</td>
<td>Percent in Group</td>
</tr>
<tr>
<td>Mild</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Moderate</td>
<td>30</td>
<td>33</td>
</tr>
<tr>
<td>Severe</td>
<td>40</td>
<td>37</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>Total</td>
</tr>
<tr>
<td>Pain Intensity</td>
<td>Frequency</td>
<td>Percent in Group</td>
</tr>
<tr>
<td>Mild</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Moderate</td>
<td>30</td>
<td>33</td>
</tr>
<tr>
<td>Severe</td>
<td>40</td>
<td>37</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>Total</td>
</tr>
</tbody>
</table>

DISCUSSION

Coronary angiography is an invasive procedure that creates pain and anxiety for patients. Hospitalization and waiting for the procedure are the main causes of anxiety in these patients. Healthcare professionals should identify patients’ anxiety and try to prevent or relieve it. Both pharmacological and non-pharmacological methods are usually drawn upon to reduce anxiety. In the current study, the effects of lavender oil were assessed on the perception of anxiety and pain in patients candidated for coronary angiography. The results showed that smelling lavender essential oil reduced anxiety and pain before and after coronary angiography. Based on the results, 70%–75% of our patients experienced state anxiety before coronary angiography, which is compatible with previous studies. We also found a reduction in the state and trait anxiety levels after aromatherapy in the intervention group. Mirzaei et al showed that lavender aromatherapy was able to decrease anxiety and plasma concentrations of cortisol in nulliparous women during labor. Shiina et al reported the relaxation effects of lavender aromatherapy on improving coronary artery blood flow in their study. Elsewhere, Muzzarelli et al concluded that there was a statistically significant difference in anxiety before and after aromatherapy in their intervention group. Based on another study by Karadag et al, lavender essential oil aromatherapy improved sleep quality and decreased anxiety of patients who were hospitalized in the coronary care unit. The results of a study by Kim et al revealed...
decreased opioid requirements of patients after laparoscopic adjustable gastric banding (LAGB) as a consequence of postoperative lavender aromatherapy. Likewise, Karaman et al. showed that aromatherapy with lavender essential oil had a significant effect on reducing anxiety and pain associated with peripheral venous cannulation in patients undergoing surgery. In a study by Hasanzadeh et al., 24 hours after coronary artery bypass grafting, the patients’ perception of pain and anxiety during chest tube removal decreased dramatically as a result of lavender oil aromatherapy. In light of these studies and the results of the present one, it can be concluded that by stimulating the olfactory tract, lavender scent affects the hypothalamus and leads to a decrease in corticotropin releasing hormone. As a result, the pituitary gland secretes less adrenocorticotropic hormone, which can cause a reduction in the cortisol level.

Lavender contains linalool, ketone, and alcohol. Ketones reduce pain and inflammation effectively and have soporific effects. Ericksen also stated that lavender as cold compress on the forehead had anti-fatigue and refreshing effects. The analgesic properties of lavender essential oil can be attributed to the fact that it can stimulate the olfactory bulb and, thus, confer relaxation. All the results from the aforementioned studies are in accordance with the results of the present study. The analgesic mechanism of this essential oil is not fully understood. However, inhaling 1,8-cineol, which is one of the ingredients of lavender essential oil, can block the production of pain mediators such as prostaglandins and leukotrienes via inhibiting arachidonic acid metabolism.

CONCLUSIONS

Overall, the results of the current study indicated that most of the patients suffered from high levels of anxiety before coronary angiography. Accordingly, in order to prevent this undesirable feeling and its adverse complications, aromatherapy can be used as complementary therapy to reduce the anxiety and improve vital signs of patients before undergoing coronary angiography. Given the advantages of lavender essential oil aromatherapy as a simple, inexpensive, safe, and noninvasive method, it is recommended that this drug-free approach be used to reduce anxiety in patients before invasive diagnostic procedures.

Limitations

The major limitation of the present investigation is that it was a single-center study. Needless to say, multicenter studies with more patients will yield more powerful results.

Conflict of Interest: All the authors of the present study confirm that they have no conflict of interests to disclose regarding the publication of the manuscript or an institution or product that is mentioned in the manuscript and/or is important to the outcome of the study presented.

REFERENCES


Percutaneous Coronary Intervention and Pulmonary Balloon Valvuloplasty in a Patient With Severe Valvular Pulmonary Stenosis: A Case Report

Ata Firouzi¹, MD; Omid Shafe*,¹, MD; Farzad Kamali², MD; Foroozan Asgari², MS

ABSTRACT

Percutaneous balloon pulmonary balloon valvuloplasty is the treatment of choice among patients with severe pulmonary stenosis. We describe a 56-year-old woman with severe pulmonary stenosis who presented with hemodynamic disturbances due to pulmonary thromboembolism during hospitalization. Percutaneous pulmonary balloon valvuloplasty is a safe and effective treatment for valvular pulmonary stenosis. (Iranian Heart Journal 2017; 18(1):51-55)

Keywords: Severe valvular pulmonary stenosis, Percutaneous coronary intervention, Pulmonary balloon valvuloplasty

Case Report

Percutaneous Coronary Intervention and Pulmonary Balloon Valvuloplasty in a 56-Year-Old Woman With Severe Valvular Pulmonary Stenosis: A Case Report

A 56-year-old hypertensive woman with valvular PS presented with progressive dyspnea (functional class II–III) and typical chest pain of 2 months’ duration. She was referred to our center for further diagnostic and therapeutic investigation. On physical examination, her vital signs were normal. The jugular venous pressure was raised, and there was a prominent left sternal border lift. Auscultation revealed a wide S2 splitting as well as a mid-systolic murmur with moderate intensity (ie, 3/6). On echocardiography, there were biventricular failure (left ventricular ejection fraction = 25%), severe right ventricular enlargement, severe tricuspid regurgitation with a trans-regurgitation gradient of 115 mm Hg, and a severe valvular PS (peak pressure gradient = 120 mm Hg). The pulmonary valve annulus was measured at 22 mm (Fig. 1).
Coronary angiography showed the occlusion of the LAD from the ostium with a good distal runoff.

During hospitalization, the patient became thermodynamically unstable. She became hypotensive and unconscious. Pulmonary computed tomography angiography was performed and it showed segmental pulmonary thromboembolism PTE. The estimated risk of surgery was high; therefore, we opted for medical treatment. After a 4-day supportive therapy, her hemodynamic instability improved and we decided to perform percutaneous coronary intervention and valvuloplasty (Fig. 2).

**PROCEDURE AND RESULT**

The wiring of the stenotic pulmonary valve proved extremely challenging as it was heavily calcified and severely stenotic (Fig. 4). Multiple attempts were made to cross the wire, and finally a 0.035-inch straight wire was passed through the stenotic valve. As the wire passed through the stenosis, we found slight systemic hypotension, which was a sign for a high-risk situation and a very severe stenosis. Passing a multipurpose A1 catheter...
(6F size) caused more systemic hypotension (135/80 to 95/60 mm Hg). A severe peak-to-peak pressure gradient of about 100 mm Hg was measured between the right ventricle and the right atrium. After exchanging the non-stiff 0.035 wire with a stiff one, we utilized 2 different balloons for valvuloplasty to reduce the risk of procedural complications. The 1st balloon was an 8–40 Nucleus balloon used for predilation, followed by a 26–40 balloon to wrap up valvuloplasty. We inflated the 1st balloon twice, and there was a waist showing significant stenosis. The 2nd balloon was inflated 3 times, and the waist was eliminated after inflation (Fig. 5). Deep hypotension occurred during inflation; we, therefore, minimized the whole time of the crossing, inflating, and deflating of the balloons to less than 8 seconds. After valvuloplasty, we found that there was a 25 mm Hg peak-to-peak pressure gradient between the right ventricle and the pulmonary artery, which was the effect of infundibular stenosis due to severe right ventricular hypertrophy. Our final right ventricular injection proved the infundibular hypertrophy, so we considered a saline bolus injection so as to reduce this effect. Much as we expected hypotension due to the infundibular hypertrophy, it did not occur during the course of hospitalization after the procedure. Postprocedural echocardiography showed a left ventricular ejection fraction of about 30%, thickened and dome-shaped pulmonary valve leaflets with moderate pulmonary insufficiency, and no significant transvalvular stenosis with a peak pressure gradient of 20 mm Hg (Fig. 2).

Finally, the patient was discharged in good condition with antiplatelet and heart failure medications. Two months after balloon valvuloplasty and percutaneous coronary intervention, her symptoms were significantly relieved and follow-up transthoracic echocardiography showed a left ventricular ejection fraction of 35%, moderate right ventricular enlargement with mild-to-moderate right ventricular systolic dysfunction, trivial tricuspid regurgitation, and moderate pulmonary insufficiency with no significant residual PS (pulmonary pressure gradient = 12 mm Hg).

**Figure 4.** Right ventricular injection with a pigtail catheter shows severe right ventricular enlargement, thickened pulmonary valve leaflets, severe valvular stenosis, and post-stenotic dilatation.
DISCUSSION

PS is a relatively common congenital defect that occurs in approximately 10% of children with congenital heart diseases. It is usually associated with a benign clinical course, and there is, therefore, a high rate of survival to adulthood. The common cause of valvular PS is congenital, and acquired causes are rare. 4, 5 Patients with congenital valvular PS undergoing balloon valvuloplasty have a low rate of restenosis. 6

Balloon valvuloplasty is recommended in asymptomatic patients with a dome-shaped pulmonary valve and a peak instantaneous Doppler pressure gradient > 60 mm Hg or a mean pressure Doppler gradient > 40 mm Hg. This modality is also recommended in symptomatic patients with a dome-shaped pulmonary valve and a peak instantaneous Doppler pressure gradient > 50 mm Hg or a mean pressure Doppler gradient > 30 mm Hg. Balloon valvuloplasty is not recommended for asymptomatic patients with a peak instantaneous gradient by Doppler < 50 mm Hg in the presence of normal cardiac output, for symptomatic patients with PS and severe pulmonary regurgitation, and for symptomatic patients with a peak instantaneous pressure gradient by Doppler < 30 mm Hg. 7

According to the indications noted above, our patient could be treated surgically or via an interventional approach. The EuroSCORE for this patient was estimated to be 7, which means a high risk of surgery. Accordingly, our cardiac surgeons decided not to go on with the surgical approach.

Given the severity of the PS, crossing the lesion was very challenging. Finally, we managed to cross a straight-tipped wire through the pulmonary valve, which resulted in a drop in blood pressure. This was another sign for the severity of the PS in the patient. This phenomenon is known in severely stenosed aortic valve as “the Brockenbrough-Braunwald-Morrow sign”. We minimized the balloon inflation time to avoid cardiovascular collapse. Also, according to the recommendations, the size of balloons used for valvuloplasty in PS should be chosen at least 120% larger than the pulmonary valve annulus diameter. 8 Consequently, we used a 26-40 balloon for valvuloplasty (pulmonary valve annulus diameter was 22 mm), after predilation with a smaller size balloon (8-40) to reduce the probability of valve rupture and minimize the time of balloon inflation. As was mentioned before, because of the very severe stenotic pulmonary valve and difficulty in crossing the wire, the evaluation of the pressure gradient between the pulmonary artery and the right ventricle could not be performed simultaneously because one should pull back an end-hole catheter through a
stenoic valve to detect the pressure gradient. After the dilation of the pulmonary valve, we encountered a residual pressure gradient due to right ventricular outflow tract hypertrophy, which had been diagnosed before the procedure via echocardiographic evaluation, and a drop in blood pressure as its consequence. There was about a 30 mm Hg residual pressure gradient after balloon dilation, but no drop in blood pressure was detected, although we administered a saline injection and beta-blockers to prevent this situation. Nonetheless, there is an unresolved question as to the diagnosis of pulmonary thromboembolism in this patient inasmuch as she had severe PS and small amounts of clot, which can cause complete obstruction in the right ventricular outflow tract and cardiovascular collapse. Whether or not this thrombosis was in situ or was embolized has remained unclear and needs further observations.

REFERENCES


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Forthcoming Meetings

Master Class on Aortic Valve Repair: A Step-by-Step Approach  
Wednesday, March 22, 2017 to Friday, March 24, 2017  
L’Institut Mutualiste Montsouris (IMM)  
Paris  
France  
See map: Google Maps

13th International Congress of Update in Cardiology and Cardiovascular Surgery  
Thursday, March 23, 2017 to Sunday, March 26, 2017  
Cesme Sheraton Convention Center  
Izmir  
Turkey  
See map: Google Maps

Thursday, March 23, 2017 to Sunday, March 26, 2017  
Coex Convention and Exhibition Center  
Seoul  
South Korea  
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Thoracic Surgery: Part I  
Monday, March 27, 2017 to Friday, March 31, 2017  
EACTS House  
Windsor  
United Kingdom  
See map: Google Maps

Symposium on Robotic Mitral Valve Repair  
Friday, March 31, 2017 to Saturday, April 1, 2017  
Loews Chicago Hotel  
Chicago, IL  
United States  
See map: Google Maps

Donor Heart and Lung Procurement Simulation Lab sponsored by UPMC  
Monday, April 3, 2017  
The Center for the Future of Surgery, UCSD  
La Jolla, CA  
United States  
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Houston Methodist CMR Workshop  
Monday, April 3, 2017 to Friday, April 7, 2017  
Houston Methodist Hospital  
Houston, TX  
United States

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Cardiometry 2017  
Tuesday, April 4, 2017 to Wednesday, April 5, 2017  
Menoufi University Egypt  
Cairo  
Egypt  
See map: Google Maps

23rd Annual Conference of the Egyptian Society of Cardiothoracic Surgery  
Tuesday, April 4, 2017 to Thursday, April 6, 2017  
Mena House Hotel, Giza, Egypt  
Cairo  
Egypt  
See map: Google Maps

Re-Evolution Summit - MICS  
Thursday, April 6, 2017 to Friday, April 7, 2017  
Houston Methodist Research Institute  
Houston, TX  
United States  
See map: Google Maps

Toronto Anesthesia Symposium  
Saturday, April 8, 2017 to Sunday, April 9, 2017  
MaRS Discovery District-101 College Street  
Toronto, ON  
Canada  
See map: Google Maps

11th World Congress on Pediatric Cardiology and Congenital Cardiovascular Disease  
Tuesday, April 18, 2017 to Wednesday, April 19, 2017  
Doubletree by Hilton Hotel London - Ealing  
London  
United Kingdom  
See map: Google Maps

ESTS Skill Track Course "Elancourt in Copenhagen"  
Wednesday, April 19, 2017 to Friday, April 21, 2017  
Denmark  
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32nd EACTA Annual Congress 2017  
Wednesday, April 19, 2017 to Friday, April 21, 2017  
Maritime Hotel  
Berlin  
Germany  
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<td>Ritz-Carlton Hotel Vienna Austria</td>
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<td>AATS Mitral Conclave</td>
<td>Thursday, April 27, 2017 to Friday, April 28, 2017</td>
<td>New York Hilton Midtown New York, NY United States</td>
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<td>AATS Innovation Summit</td>
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<td>Massachusetts General Hospital Postgraduate Course in General Thoracic Surgery</td>
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<td>Royal Sonesta Hotel Cambridge, MA United States</td>
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<td>Toronto Update on Lung Transplantation and Artificial Lung Support</td>
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<td>Fundamentals in Cardiac Surgery: Part II</td>
<td>Monday, June 5, 2017 to Friday, June 9, 2017</td>
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<td>Monday, June 12, 2017 to Wednesday, June 14, 2017</td>
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<td>17th European Congress on Extracorporeal Circulation Technology</td>
<td>Wednesday, June 14, 2017 to Saturday, June 17, 2017</td>
<td>Palais des Congres, Parc Chanot Marseille France</td>
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<td>Ventricular Assist Device Co-ordinators Training Course</td>
<td>Thursday, June 15, 2017 to Saturday, June 17, 2017</td>
<td>Deutsches Herzzentrum Berlin (German Heart Institute Berlin) Berlin Germany</td>
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<td>18th Annual Cardiologists Conference</td>
<td>Monday, June 19, 2017 to Wednesday, June 21, 2017</td>
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Magna Græcia AOritic Interventional Project® (MAORI) 5th Symposium Complex Diseases of Thoracic and Thoraco-Abdominal Aorta
Tuesday, June 20, 2017 to Wednesday, June 21, 2017
University Campus “Salvatore Venuta” Italy Building H, Auditorium Room B, level 2
Catanzaro
Italy
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ASAIO 63rd Annual Conference
Wednesday, June 21, 2017 to Saturday, June 24, 2017
Hyatt Regency Chicago
Chicago, IL
United States
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WTSA 43rd Annual Meeting
Wednesday, June 21, 2017 to Saturday, June 24, 2017
The Broadmoor
Colorado Spring, CO
United States
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The New Orleans Conference - Las Vegas Edition
Wednesday, June 28, 2017 to Saturday, July 1, 2017
The Four Seasons Resort
Las Vegas, NV
United States
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Basic Science
Friday, June 30, 2017 to Saturday, July 1, 2017
EACTS House
Windsor
United Arab Emirates
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International Conference on Vascular Biology & Medicine
Monday, July 24, 2017 to Tuesday, July 25, 2017
Doubletree by Hilton
Chicago
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4th International Conference on Brain Disorder and Brain Injury
Monday, August 14, 2017 to Wednesday, August 16, 2017
Holiday Inn Toronto International Airport
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Canada
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International Coronary Congress
Friday, August 18, 2017 to Sunday, August 20, 2017

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27th Annual Congress of the World Society of Cardiovascular & Thoracic Surgeons
Friday, September 1, 2017 to Sunday, September 3, 2017
The Palace Of Independence
Astana
Kazakhstan
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Annual Conference on Heart Diseases
Monday, September 18, 2017 to Tuesday, September 19, 2017
Holiday Inn Toronto International Airport
970 Dixon Road
Toronto, ON M9W 1J9
Canada
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International Conference and Expo on Heart Surgery
Thursday, September 21, 2017 to Friday, September 22, 2017
Hilton San Antonio Airport Hotel
611 NW Loop 410
San Antonio, TX
United States
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13th International Conference on Pediatric Mechanical Circulatory Support Systems and Pediatric Cardiopulmonary Perfusion
Thursday, September 28, 2017 to Saturday, September 30, 2017
Ospedale Pediatrico Bambino Gesù / Pontificia Università Urbana
Via Urbano VIII
Rome 16 - 00165
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37th Annual Cardiothoracic Surgery Symposium
Thursday, September 28, 2017 to Sunday, October 1, 2017
Westin San Diego Gaslamp Quarter  
San Diego, CA  
United States  
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Cardiothoracic Trauma Webinar (Repeat)  
Sunday, October 1, 2017  
The Royal College of Surgeons of Edinburgh (RCSEd)  
Edinburgh  
United Kingdom  
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20th European Cardiology Conference  
Monday, October 16, 2017 to Wednesday, October 18, 2017  
Budapest  
Hungary  
See map: Google Maps

Fundamentals in Cardiac Surgery: Part III  
Monday, October 23, 2017 to Friday, October 27, 2017  
EACTS House  
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United Kingdom  
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27th Annual Congress of the Association of Thoracic and Cardiovascular Surgeons of Asia (ATCSA)  
Thursday, November 16, 2017 to Sunday, November 19, 2017

Melbourne Convention and Exhibition Centre  
Melbourne, VIC  
Australia  
See map: Google Maps

Thoracic Surgery: Part III  
Monday, December 4, 2017 to Wednesday, December 6, 2017  
EACTS House  
Windsor  
United Kingdom  
See map: Google Maps

14th International Conference on Pediatric Mechanical Circulatory Support Systems and Pediatric Cardiopulmonary Perfusion  
Thursday, May 3, 2018 to Saturday, May 5, 2018  
Ann & Robert H. Lurie Children’s Hospital of Chicago  
Chicago, IL  
United States  
See map: Google Maps

26th European Conference on General Thoracic Surgery  
Saturday, May 26, 2018 to Wednesday, May 30, 2018  
Cankarjev dom Culture and Congress Centre  
Ljubljana  
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