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The major problem for perfusionists during cardiopulmonary bypass: Vent aspirator not sucking! solutions

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Abstract

Objective: The objective of this study is to investigate the frequency, causes and solutions of the problem of 'vent aspirator not sucking' encountered during cardiopulmonary bypass (CPB) and to evaluate its relationship with professional experience, institutional environment and educational status.

Materials and methods: A descriptive cross-sectional study was conducted through an online survey of 186 actively practicing perfusionists across Turkey. A 17-item structured questionnaire was used to collect data on demographics, vent usage habits, problem frequency, perceived causes, interventions, and training background. Data were analyzed using descriptive statistics, chi-square tests, and multivariate logistic regression.

Results: Approximately 65% of participants reported experiencing the vent problem occasionally or frequently, with the rewarming phase being the most common stage of occurrence (45.7%). The most frequently cited causes included incorrect cannula positioning (72.6%) and vacuum system issues (59.1%). Less experienced perfusionists and those working in private hospitals or high-volume centers reported significantly more problems. Receiving specific training on vent management reduced the risk by 45% (OR = 0.55, p = 0.035), yet 58.1% of perfusionists indicated insufficient training. Moreover, only 18.3% reported having standard protocols in their institutions.

Conclusion: The "vent aspirator not sucking" issue is a widespread and multifactorial technical problem during CPB, significantly affected by experience, institutional factors, and training. Addressing this challenge requires the development of standardized procedures, structured education programs, and increased awareness of alternative venting strategies to improve patient safety and surgical outcomes.

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Introduction

Cardiopulmonary bypass (CPB) is a vital technique in cardiac surgery in which heart and lung functions are temporarily taken over to provide myocardial protection and maintain systemic perfusion (1,2). A heart-lung machine is used for this purpose (3-5). In addition, venting, suction and myocardial protection circuit are important components of the machine (6). The vent system used in this process undertakes critical tasks such as unloading the left heart, preventing left ventricular distention, reducing the risk of air embolism and clarifying the surgical field (7). Most of the air evacuation procedures routinely performed are posture change, lung inflation and aspiration through the vent cannula. The vent system not only optimises myocardial protection but also improves the safety of the surgery by ensuring cardiopulmonary stability. Aspiration is the most common method of air evacuation (8). However, the technical functionality of this system may be interrupted for various reasons (9,10). One of the problems frequently encountered by perfusionists in clinical practice, but often not systematically evaluated, is that the vent system does not work effectively or does not 'sucking'.

This problem, called 'no venting', may develop due to many technical reasons such as incorrect positioning of the cannula, inadequacies in the vacuum system, occlusions in the circuit line or insufficient negative pressure levels (9,10). This not only impairs the surgical field of view, but may also lead to undesirable clinical outcomes, such as increased left intracardiac pressure, risk of air embolism and increased ventricular wall stress. During maintenance of CPB, adverse events reflect failure to achieve optimal perfusion (11).

Although some technical information about the vent system and case-based narratives are included in the literature, studies providing large-scale, quantitative data based on the actual experiences of perfusionists in the field are very limited (12). Considering the differences in clinical practice, diversity of equipment, and variability in the level of training, especially in developing countries such as Turkey, there is an important need to address this technical problem comprehensively.

In this context, this study aims to reveal the vent system usage habits of perfusionists actively working throughout Turkey, their observations regarding the "vent aspirator not sucking" problem, how often and under what conditions this problem occurs, possible causes and solution strategies. In addition, it was also investigated whether variables such as professional experience, type of institution, number of operations per year and technical training affect the vent problem. This study aims to make an important contribution to the literature in terms of multidimensional evaluation of a technical problem that may affect patient safety in perfusion practice.

Materials and methods

Study design and participants

This study is a descriptive and cross-sectional study aiming to reveal the experiences of perfusionists actively working in Turkey regarding the "vent aspirator not sucking" problem encountered during CPB, their evaluations regarding the causes and solution strategies. The study was carried out with an online survey method based on volunteerism.

The population of the participants consisted of perfusionists actively working in various public, university and private health institutions in Turkey. A total of 186 perfusionists selected among easily accessible people were included in this study.

Data collection

The data were collected through a 17-item structured questionnaire developed by the researchers. The questionnaire consists of five main sections:

1. Demographic and professional information of the participants (gender, duration of experience, institution, number of operations per year),
2. Vent system usage habits,
3. Frequency, time and possible causes of the problem "Vent aspirator not sucking'',
4. Applied intervention and solution methods,
5. Educational status and general views on the subject.

The questionnaire form was created through the Google Forms platform and delivered to perfusionists via various digital internet resources (professional e-mail groups, online forums, WhatsApp groups) and social media channels. Online informed consent was obtained from the participants.

Table 1: Demographic characteristics of the participants, vent system usage habits and findings related to the 'vent aspirator not sucking' problem (n=186)

Section / Question		n	%
A. Participant Information			
Gender	Female	77	41.4
	Male	109	58.6
Occupational Experience	0–5 years	40	21.5
	6–10 years	77	41.4
	11–20 years	50	26.9
	21 years and over	19	10.2
Working Institution	University hospital	89	47.8
	Training and research hospital	52	28.0
	Private hospital	35	18.8
	Other	10	5.4
Annual Number of CPB Cases	0–50	23	12.4
	51–100	47	25.3
	101–200	66	35.5
	201 and above	50	26.8
B. Vent System Usage Habits			
*Vent system intended use (multiple choice)	Evacuation of the left heart	157	84.4
	Prevention of left ventricular distension	144	77.4
	Prevention of air embolism	132	71.0
	Other	12	6.5
C. 'Vent Aspirator Not Sucking' Problem and Its Effects			
Frequency of 'Vent Aspirator Not Sucking'	Never	15	8.1
	Rarely	50	26.9
	Occasionally	99	53.2
	Frequently	22	11.8
	Always	0	0.0
Stage of emergence	At the beginning of the CPB	22	11.8
	After aortic cross-clamp	60	32.3
	Rewarming (reheating)	85	45.7
	At random times	19	10.2
*Most likely causes of the problem (multiple choice)	Inappropriate vent cannula position	135	72.6
	Technical problem in vent system (occlusion adjustment)	110	59.1
	Blockage in the circuit line (occlusion, kink, etc.)	80	43.0
	Other	28	15.1
D. Intervention and Solution Methods			
*Type of intervention (multiple choice)	Changing / correcting the cannula position	149	80.1
	Increasing the vacuum speed (pump flow rate)	142	76.3
	Flushing (flush)	128	68.8
	Checking pressure and negative values	117	62.9
	Vent pump/line occlusion control	105	56.4
	Contacting the surgeon	116	62.4
Presence of standard procedure	Yes	34	18.3
	No	122	65.6
	Not sure	30	16.1
E. Training and Opinions			
Have you received adequate vocational training on vent problems?	Yes	78	41.9
	No	108	58.1

CPB: Cardiopulmonary bypass. Note: * Percentages may exceed 100% as multiple responses were allowed.

Ethical approval

For this study, approval was obtained from the local ethics committee (Harran University Social and Human Sciences Ethics Committee) on 09.07.2025 with session number 7 and board decision number 2025/247. Informed consent was obtained from all individuals participating in the study. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Statistical analysis

The study data were analysed using IBM Statistical Package for the Social Sciences 25 (IBM SPSS Statistics 25®) software. Firstly, demographic data of the participants, vent system usage habits and findings related to the problem of 'vent aspirator not working' were analysed with descriptive statistics. In this context, frequency (n) and percentage (%) values were calculated for categorical variables.

Pearson Chi-square test (χ^2) was applied to determine the relationship between the duration of professional experience and the frequency of vent problems.

Multiple logistic regression analysis was performed to determine the independent variables affecting the vent problem. In this analysis, the dependent variable was 'experiencing vent problems' (i.e. 'frequently/occasionally' versus 'rarely/never') and the independent variables were gender, duration of professional experience, type of institution, number of CPB cases per year and vent training status. The results of the analyses are reported with Odds Ratio (OR), 95% Confidence Interval (CI) and p-value. Results with $p<0.05$ were considered statistically significant.

Results

Table 1 includes the demographic information, vent system usage habits, frequency of "vent aspirator not sucking" problem, stages of occurrence, possible causes and solution strategies of 186 perfusionists who participated in the study. 58.6% of the participants were male and 41.4% were female. The duration of professional experience is distributed as 0-5 years (21.5%), 6-10 years (41.4%), 11-20 years (26.9%) and over 21 years (10.2%). 47.8% of the participants worked in a university hospital, 28% in a training and research hospital, and 18.8% in a private hospital. Those with an annual number of 101-200 CPB cases constituted the largest group with 35.5%, while those with 201 or more cases constituted 26.8%. The most common purpose of the participants to use the vent system was evacuation of the left heart (84.4%). The most common "vent aspirator not sucking" problem was observed during the rewarming phase (45.7%). The most commonly reported causes were inappropriate cannula position (72.6%) and technical problems in the vacuum system (occlusion setting) (59.1%). When problems were encountered, the most common interventions were changing the cannula position (80.1%) and increasing the vacuum level (76.3%). 65.6% of the participants stated that there is no defined procedure for vent problem in their institution. In addition, 58.1% of the participants stated that they did not receive adequate vocational training on vent problem.

Table 2 shows the relationship between the professional experience of perfusionists and the frequency of experiencing "vent aspirator not sucking" problem. Among those with 0-5 years of experience, 22.5% stated that they frequently experienced this problem; this rate was 11.7% among those with 6-10 years of experience, 6.0% among those with 11-20 years of experience and 5.3% among those with more than 21 years of experience. As the duration of experience increases, the rate of experiencing the problem frequently decreases. While the rate of those who stated 'never experienced' was 2.5% in the 0-5 years group, it was 6.0% and 5.3% in the 11-20 years and over 21 years groups. As a result of the chi-square test, this relationship was found to be statistically significant ($\chi^2=14.34$; $p=0.026$) with a small-to-moderate effect size (Cramer's $V=0.19$).

Table 2: The relationship between professional experience and the frequency of 'vent aspirator not sucking' problem (Chi-square test)

Occupational Experience	Frequently (n, %)	Occasionally (n, %)	Rarely (n, %)	Never (n, %)	Total	χ^2	P
0–5 years (n = 40)	9 (22.5%)	24 (60.0%)	6 (15.0%)	1 (2.5%)	40	14.34	0.026
6–10 years (n = 77)	9 (11.7%)	43 (55.8%)	22 (28.6%)	3 (3.9%)	77		
11–20 years (n = 50)	3 (6.0%)	24 (48.0%)	20 (40.0%)	3 (6.0%)	50		
≥21 years (n = 19)	1 (5.3%)	8 (42.1%)	9 (47.4%)	1 (5.3%)	19		
Total	22 (11.8%)	99 (53.2%)	57 (30.6%)	8 (4.3%)	186		

Table 3: Multiple logistic regression analysis: factors affecting vent problem

Independent Variable		Odds Ratio (OR)	%95 Confidence Interval (CI)	P
Gender (Female vs Male)		1.12	0.65 – 1.93	0.680
Occupational Experience (reference: 0-5 years)	6–10 years	0.28	0.12 – 0.65	0.003
	11–20 years	0.30	0.12 – 0.75	0.010
	21 years and over	0.35	0.10 – 1.20	0.100
Working Institution (reference: University hospital)	Training and Research Hospital	1.15	0.62 – 2.14	0.660
	Private Hospital	1.95	1.02 – 3.72	0.043
	Other	1.10	0.32 – 3.75	0.870
Annual Number of CPB Cases (reference: 0-50)	51–100	1.32	0.65 – 2.68	0.440
	101–200	1.48	0.75 – 2.91	0.260
	201 and above	1.89	1.01 – 3.53	0.046
Trained on Vent System (Yes vs No)		0.55	0.32 – 0.96	0.035

CPB: Cardiopulmonary bypass.

Table 3 shows the results of multiple logistic regression to analyse the variables affecting the experience of vent problems. Gender was not found to have a significant relationship with vent problems (p=0.680). The probability of having vent problems decreased with increasing professional experience; the probability decreased by 72% in those with 6-10 years of experience and by 70% in those with 11-20 years of experience, and these results were statistically significant (p=0.003 and p=0.010). Perfusionists working in a private hospital were approximately twice as likely to have vent problems compared with those working in a university hospital (OR=1.95; p=0.043). Those who performed 201 or more CPB cases per year also had a significantly higher risk compared to the reference group (OR=1.89; p=0.046). In addition, being educated about the vent problem significantly reduced the risk (OR=0.55; p=0.035).

Discussion

Although venting strategies are not covered in detail in many current cardiac surgery textbooks, knowledge and practical skills in the use of cardiac venting remains a core area of clinical competence for cardiac surgeons and perfusionists (13). This study is one of the first large-scale questionnaire surveys to evaluate the prevalence, causes and solution approaches to the problem of "vent aspirator not sucking" frequently encountered during CPB by perfusionists working actively throughout Turkey. The findings show that the vent system is widely used and accounts for a significant proportion of technical problems. Respondents reported that the most common purpose of the vent system was to unload the left heart (84.4%), prevent left ventricular distention (77.4%) and prevent air embolism (71.0%). These rates clearly demonstrate the clinical importance of the vent system and its place in perfusion practice.

In the literature, numerous problems and emergencies that may occur during cardiac surgery have been described. These include cannulation complications (dissection, malposition, gas embolism), CPB equipment failures (heater-cooler malfunction, oxygenator problems, electrical failure, and tubing rupture), CPB circuit thrombosis, drug-related issues, intraoperative awareness during CPB, and complications encountered during transcatheter aortic valve replacement. Various preventive approaches and intraoperative management strategies for these CPB emergencies have been detailed in the literature (14-18). However, according to our review, no study in the literature has directly focused on the problem of the vent aspirator not functioning (i.e., not sucking).

More than 65% of the perfusionists surveyed stated that they encountered the problem of "vent aspirator not sucking" either occasionally (53.2%) or frequently (11.8%). This indicates that this problem is not rare, but rather a common problem that needs to be addressed systematically. The surgical phase in which

the problem occurred most frequently was reported as the rewarming period (45.7%). This finding may be related to the increased flow dynamics and pressure differences in the system during rewarming. Participants pointed to inappropriate cannula position (72.6%) and technical problems in the vacuum system (occlusion setting) (59.1%) as the main reasons for ineffective vent system operation. It is thought that these technical reasons, combined with lack of training and standardised procedures, may cause the problem to become more complicated.

While 22.5% of perfusionists with 0-5 years of experience reported that they frequently experienced vent problems, this rate decreased to 6% in the group with 11-20 years of experience and to 5.3% in the group with ≥21 years of experience ($p = 0.026$). This result supports the positive effect of professional experience on problem coping skills. Similarly, in multiple logistic regression analysis, those with 6-10 and 11-20 years of experience were 72% and 70% less likely to have vent problems than those with 0-5 years of experience, respectively. These findings suggest that in addition to clinical experience, in-house information sharing, mutual learning processes and structured communication models are also important. Indeed, in high-risk and multidisciplinary areas such as cardiac surgery, the adoption of standardised communication models increases team cohesion and enables more effective management of potential problems through planned implementation, immediate feedback and experience-based knowledge transfer (19).

However, perfusionists working in private hospitals were significantly more likely to experience vent problems than those working in university hospitals (OR = 1.95; $p = 0.043$). This may be due to differences in equipment infrastructure, procedure standardisation or multidisciplinary communication. Again, employees working in clinics that performed 201 or more CPB cases per year were significantly more likely to have vent problems (OR = 1.89; $p = 0.046$). This result suggests that increased caseload may increase the pressure on the system and affect the speed of problem resolution.

The education factor also stands out as a determining factor in coping with the vent problem. 58.1% of the participants stated that they did not receive sufficient vocational training on this subject. According to regression analysis, having received training on vent problem reduces the risk of experiencing this problem by 45% (OR = 0.55; $p = 0.035$). This result emphasises the importance of improving technical skills and systematic training for possible complications.

Overall, the findings of this study reveal the inadequacy of institutional procedures related to the vent problem and the impact of individual experience and training. Practical training, simulations and the development of standardised protocols, especially for early career perfusionists, may be effective in reducing the frequency of this technical problem. In addition, addressing technical problems related to the vent system with a multidisciplinary approach, increasing surgeon and perfusionist cooperation and improving equipment quality may also contribute to the solution process. As a matter of fact, although venting application has a critical importance in surgical processes, there is a lack of technical knowledge and experience in clinical practice. However, various alternative techniques have been described in the literature for cases where standard vent placement is not possible. One of these is the venting method proposed by Dr John Kirklin, which is performed by passing a needle from the right ventricle to the left ventricle. This technique is considered to be an effective option especially in minimally invasive surgeries or reoperations when the left ventricular vent cannot be placed (20). Increasing the awareness of such alternative vent strategies will contribute significantly to the surgeon and perfusionist teams to produce faster, safer and more effective solutions when vent problems are encountered.

Limitations

This study has several limitations. It was designed as a cross-sectional survey based on self-reported data, which may have caused recall or selection bias. The sample was limited to perfusionists working in Turkey, so the findings may not be generalizable to other countries or institutional settings. Moreover, equipment-related details, manufacturer differences, and standard protocols were not specifically assessed, which might have affected the frequency and causes of the reported suction vent problem. These factors should be considered when interpreting the results, and future studies with broader scope are warranted.

Conclusions

This study revealed that the "vent aspirator not sucking" problem encountered by perfusionists during CPB is a common and multifactorial problem in clinical practice. A large proportion of perfusionists working actively throughout Turkey reported that they encountered this technical problem occasionally or frequently; the problem was reported to occur most frequently during the rewarming phase and mostly due to cannula position or vacuum system-related causes.

It was observed that the probability of experiencing vent problems decreased as the duration of professional experience increased, while those working in private hospital settings experienced this problem more frequently. In addition, vent problems were more commonly reported in centres with a high number of cases per year. These findings suggest that both individual and institutional factors may affect the effective functioning of the vent system.

Adequate training on the vent system significantly reduces the risk of this technical problem. However, a significant proportion of perfusionists participating in the study stated that they did not receive adequate training on this subject. It is also noteworthy that most institutions do not have a defined standard procedure or algorithm for vent problems.

In the light of all these results, it is recommended that standardised procedures should be developed at institutional level to prevent technical problems related to the vent system, vent management should be included in perfusion training curricula, and applied and simulation-supported training programmes for early career perfusionists should be expanded. In this way, both patient safety and surgical success can be improved.

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Contributions

Research concept and design: BA, ME

Data analysis and interpretation: BA, ME

Collection and/or assembly of data: BA, ME

Writing the article: BA, ME

Critical revision of the article: BA, ME

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