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Incidence and Risk Factors of an Intraoperative Arrhythmia in Transhiatal Esophagectomy

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Abstract

Background: Transhiatal esophagectomy (THE) is a widely used technique for carcinoma of the esophagus and other conditions, such as benign strictures and motility disorders.

Objectives: The aim of our study was to quantify the incidence, predisposing factors, as well as types of arrhythmias in transhiatal esophagectomy.

Patients and Methods: In this prospective study, we selected 61 patients undergoing transhiatal esophagectomy during 2012 - 2013 in our hospital. The demographic information, site of the tumor, cardiopulmonary function, transfusion, preoperative and postoperative complications (i.e. arrhythmias, hypotension), operation time, duration of mediastinal manipulation, amount of hemorrhage, volume loss, volume intake, mean systolic and diastolic pressure, and death rate were evaluated by chi-square, Fisher's exact test, ANOVA, and t-tests.

Results: The mean age of patients was 61.24 ± 11.48. In the study group, 8.2% of the patients before, 50.8% during, and 11.2% after mediastinal manipulation showed arrhythmia. Tumor location, the need for transfusion, pathology of the tumor, presence of arrhythmia before the operation, FEV1 (Forced Expiratory Volume) > 2 liters, and volume intake were significantly different between the patients with and without arrhythmia. Hypotension was shown in 8.2% of the patients before and 57.7% during mediastinal manipulation. Manipulation times, volume loss, mean systolic and diastolic blood pressure after the operation, and FEV1 > 2 liters were statistically significant in occurrence of hypotension.

Conclusions: Our data showed that the amount of hydration, transfusion, pre-manipulation arrhythmia, and pulmonary function should be controlled to decrease the risk of arrhythmias. Minor mediastinal manipulation, few intraoperative hemorrhages, improvement of pulmonary function, and careful blood pressure monitoring can reduce the risk of hypotension.

Keywords: Hypotension, Arrhythmia, Transhiatal Esophagectomy

1. Background

Transhiatal esophagectomy (THE) is a widely used technique for carcinoma of the esophagus and other conditions, such as benign strictures and motility disorders (1-4). However, the transhiatal approach may present some potential problems for the anesthesiologist. Dissection of the esophagus through the posterior mediastinum may change the patient's hemodynamic. Intraoperative hemodynamic disturbances, such as hypotension and arrhythmias, may be significant and may result from compression and anterior displacement of the heart during blunt finger dissection of the esophagus through the posterior mediastinum, which interferes with cardiac filling and output (5, 6). Also, the dissection can induce marked vagal stimulation, resulting in bradyarrhythmia, ventricular escape beats, and rarely even cardiac arrest (7). Manual contact with the pericardium may also contribute to arrhythmias (8). Although hypotension and arrhythmias occurring during mediastinal manipulation are routinely observed, as well as reported (9, 10), there is a paucity of available literature highlighting the exact incidence and types of arrhythmias.

2. Objectives

Although the occurrence of arrhythmias and hypotension has been duly observed, the aim of our study was to quantify the incidence, predisposing factors, as well as types of arrhythmias.

3. Patients and Methods

From November 2012 to November 2013, 76 patients who had carcinoma of the esophagus were enrolled in this prospective study in Alzahra Hospital. Exclusion criteria were as follows: those with any cardiac dysfunctions, severe pulmonary obstruction or restriction, and patients with electrolyte imbalance or who were on drugs such as steroids, β-blockers, angiotensin converting enzyme inhibitors, calcium channel blockers, and digitalis. Various perioperative conditions were studied, and all the patients selected for the study were stable in terms of cardiac and respiratory functions. A Dutex AS3 was used to monitor ECG, heart rate, blood pressure, oxygen saturation, temperature, CO_2 saturation, and blood gases one half hour before, during, and two hours after the surgery. Other monitoring included urine output and central venous pressure (CVP). Blood pressure and rhythm were recorded continually during mediastinal manipulation. Warming blankets were employed to prevent hypothermia. Anesthesia was maintained with isoflurane and N_2O/O_2 (60:40), and ventilation was controlled with vecuronium, keeping end-tidal carbon dioxide ($ETCO_2$) within normal limits. At the end of the procedure the neuromuscular blockade was reversed with neostigmine and atropine, and patients were transferred to the ICU and monitored carefully. Mediastinal manipulation in all the patients was performed by a single surgeon. The patients were grouped according to having hypotension or arrhythmia, and recorded variables were compared between the two groups. An ANOVA analysis was used to evaluate the correlation of arrhythmia and manipulation time. Chi-square and Fisher exact tests were used for qualitative variables and t-test for quantitative variables.

4. Results

Out of 76 patients with esophagus carcinoma, 13 patients were excluded due to having the risk factors of surgery and non-operative tumors. The mean age of the patients was 61.24 ± 11.48, and 63.04% were male. 28.9% of the patients had more than 20% loss of weight; the mean weight loss was 10.42 + 5.1 kilogram. Mean serum albumin level before the procedure was 3.13 ± 0.68 gr/dl. Mean FEV1 was 2.04 ± 0.42 liters, mean procedure duration was 106.31±17.8 minutes, mean post-operative bleeding was reported to be 506.55 ± 150.68 cc, mean hospitalization period was 12.5 ± 8.11 days, and mean fluid given to the patients was 1.58±.34 liters. Mean systolic and diastolic blood pressure before the surgery were 12.59 ± 0.93 and [illegible] ± 0.78 respectively. In the histopathologic examination, 73.2% were reported to be squamous cell carcinoma (SCC), 26.1% adenocarcinoma, and 1.6% squamous adenocarcinomas. In the pre-manipulation period, five (8.2%) patients had arrhythmias, while 31 (50.8%) had arrhythmias during the manipulation period (P < 0.01). Incidence and type of arrhythmia are shown in Table 1. Mean manipulation time did not show a significant difference according to the type of arrhythmia. Bradycardia and PAC-PVC (Premature Atrial Contracture-Premature Ventricular Contracture) were the most prevalent types of arrhythmia in distal and middle lesions (Table 2). Tumor location, a need for transfusion, pathology of the tumor, presence of arrhythmia before the operation, FEV1 (Forced Expiratory Volume) > 2 liters, and mean volume intake were significantly different between the patients with and without arrhythmia (Table 3). Mortality and complications after the operation were not different between the two groups (P = 1.00). In the first 24 hours of the postoperative period, six patients (9.8%) had arrhythmia, 47.5% had postoperative complications, and 9.8% had 30-day mortality.

In the pre-manipulation period, 8.2% of patients had hypotension, while 57.7% had arrhythmias during the manipulation period (P < 0.01). The mean duration of hypotension was 4.28±1.06 minutes (range: 3 to 7 minutes). Manipulation times, volume loss, mean systolic and diastolic blood pressure before the operation, and FEV1 > 2 liters were statistically significant in occurrence of hypotension (Table 4). Complications after the operation were significantly higher in the hypotension group (P = 0.04).

Table 1. Incidence and Type of Arrhythmia

Arrhythmia	During Manipulation Period	Pre-Manipulation Period	P Value
PAC	9	5	0.1
Bradycardia	5	0	0.05
PAC-PVC	17	0	< 0.01
Total, %	31 (50.8)	5 (8.2)	< 0.01

Table 2. Mean Manipulation Time, Lesion Position, and Type of Arrhythmia

	PAC-PVC	PAC	Bradycardia	P Value
Manipulation Time, min	7.62 ± 1.89	6.55 ± 2.96	5.20 ± 1.09	0.36
Tumor Location, %				
Middle	14 (66.8)	6 (28.4)	1 (4.8)	
Distal	3 (30)	3 (30)	4 (40)	

Table 3. Variables Compared Between two Groups (With and Without Arrhythmia)[a]

Variables	Arrhythmia		P Value
	Yes	No	
Transfusion, %	23.3	10	0.005
Tumor site, %			0.015
Distal	33.3	66.7	
Middle	64.5	35.5	
Pathology, %			0.02
SCC	80	48.4	
Adeno-Carcinoma	20	51.6	
FEV1 > 2, %	35.1	64.9	0.0
Presence of arrhythmia before the manipulation, %	16.7	0	2
Volume intake	1.69	1.47	0.01

[a]Multivariate analysis: FEV1 > 2, tumor site.

Table 4. Variables Compared Between two Groups (With and Without Hypotension)[a]

Variables	Hypotension		P Value
	Yes	No	
Volume Loss	541.17	462.96	0.04
Mean Systolic Pressure	12.91	12.18	0.002
Mean Diastolic Pressure	8.58	8.00	0.03
FEV1> 2, %	43.2	56.8	0.015
Manipulation Time, %	7.64	5.70	0.001
Re operation, %	28.2	14.8	0.04

[a]Multivariate analysis: manipulation time, mean syst ssure.

5. Discussion

In our study, out of 61 patients onl ve had rhythmias (PAC) in the pre-manipulation perio hile 31 patients had arrhythmias during t ipulation period (P < 0.01). During manipulation, ine ts had PAC, five bradycardia and 17 nts h AC-PVC. All the patients with PAC before th sur ry ha t after the manipulation as well. In the co se dy, in distal esophageal lesions brad rhyth as were common, while in middle lesions nd PVC e common. The incidence of arrhythmias in iddle (66.7%) esophageal lesions was more th in distal (%) lesions, indicating tumors located oser the heart are more prone to cause arrhythmias. iddle ophageal lesions are mostly SCC in origin wit y effect on arrhythmias. The incidence of intraoperat arrhythmias in our study was the same as that study by Malhotra et al. (65%) (11). In our study, about 23.3% of the patients with arrhythmias and 10% without arrhythmias had blood transfusions that were statistically significant (P < 0.005), indicating prolonged manipulation in patients with bleeding. Duration of manipulation and surgery in both groups did not have any statistical difference (71%). The demographic data and various hemodynamic variables had no effects on arrhythmias.

The location (mid-esophageal) and the type of tumor (SCC) were the predisposing factors for the arrhythmias with significant correlation. In spite of this, the type of pathology in the distal esophageal lesions had no significant correlation with the arrhythmias.

About 35.1% of the patients with intraoperative arrhythmias and 64.9% without arrhythmias had FEV1 > 2, which was a significant correlation, indicating that patients with good pulmonary function had better outcomes than patients with FEV1 < 2. Also, 66.7% of patients with intraoperative arrhythmias and 45.2% without arrhythmias had hypotension, which was not statistically significant (P = 0.009), indicating no correlation between arrhythmias and hypotension. This result is the same as that in the study done by Malhotra (11).

Hypoxia, hypercarbia, and electrolyte disturbances as the causes of arrhythmia were ruled out, because they did not occur in any of the patients. Moreover, the patients with any coexisting cardiopulmonary disease were excluded from our study. Therefore, the arrhythmias and hypotension were exclusively due to mediastinal manipulation (11).

Hypotension was defined as a decrease of systolic blood pressure by 20% from the baseline (11). Hypotension occurred in 8.2% of the patients in the pre-manipulation period and in 55.7% of the patients during manipulation. The duration of manipulation in patients with hypotension was 7.64 ± 2.42 minutes, compared with 5.7 ± 1.87 minutes in patients without hypotension, which was a significant correlation ($P < 0.001$). There was a linear relationship between the duration of mediastinal manipulation and the degree of hypotension with return of blood pressure to normal after withdrawal of hands from the mediastinum. The systolic and diastolic blood pressure in patients with hypotension was higher, also the amount of bleeding in patients with hypotension (541.17 mL ± 172.53) was higher than those without hypotension (462.96 mL ± 105), indicating a significant correlation. This means that maintaining blood pressure below normal before the manipulation was effective in decreasing bleeding and hypotension during the manipulation. The amount of bleeding in our study (506 - 557 cc) was less, compared with those by Orringer (12), and Rao (13) with689 ccand 729 cc, respectively. In another study by Orringer (4), the amount of blood lost was 368 cc, which is less than in our research. This difference may be due to the fact that 90% of our patients were in stage III cancer.

Ritchie and his colleagues (14) reported arrhythmi in 60% of patients given prevention measures by ing digitalis as prophylaxis. Amar (7) reported 13% s ravet tricular tachydysrhythmias (SVT) after the ma lation, which increased the duration of ICU and ospit stay. Patti et al. (8) reported 32% of atrial arrhy as contro by digitalis and verapamil. Atkins (15) repor bout 13.7% cardiac arrhythmias after esoph omy, wh is the fourth common complication a er pneumonia and anastomotic leakage. In our study, y 10.16% f the patients had atrial fibrillation and PVC-PA e fi was controlled by digitalis and the sec out any intervention.

We therefore conclude at transhiatal esophagectomy, the inc nce o hythmias and hypotension is significant urin med tinal manipulation. The incidence of hyth may be minimized by constant monito g of als, as well as limiting the duration of med nal ma lation. However, the incidence of postoper e arrhythmias was not significant.

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Footnote

Authors' Contribution: Study concept and design: Mojtaba Ahmadinejad and Mozaffar Hashemi; acquisition of data: AbbasTabatabai; analysis and interpretation of data: Shahram Keykha, drafting the manuscript: Zabih lah Taleshi and Koorosh Ahmadi.

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