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의학석사 학위논문

흉복부대동맥류 수술의 예후 연구

Outcomes of Open Repair of Thoracoabdominal Aortic Aneurysm: 28-Year Experience of a Tertiary Academic Center in Korea

울산대학교 대학원

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김진경

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이 논문을 의학석사학위 논문으로 제출함

2021년 8월

울산대학교 대학원

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김진경의 의학석사학위 논문을 인준함

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Abstract

Background: Open repair remains the gold standard approach in the management of thoracoabdominal aortic aneurysm (TAAA); however, the operative outcomes are still challenged by high operative mortality and disabling complications. Moreover, there is a paucity of studies that systematically reported the operative outcomes of TAAA in Korea.

Methods: The medical records of 290 patients who underwent open repair of TAAA between 1992 and 2020 at a tertiary referral center in Korea were retrospectively reviewed. Determinants of early mortality (within 30-day or in-hospital) and disabling events (death, permanent neurologic complications, and disabling end-organ failure) were analyzed by stepwise multivariable logistic regression models with considerations of baseline clinical variables, operative profiles, and the surgeon factor.

Results: The overall rates of early mortality and disabling complications were 13.1% (n = 38) and 21.4% (n = 62), respectively; the incidence rates were significantly different according to the Crawford extents, with extent II being highest for all of these events followed by extent III. The prevalence of spinal cord deficits was 11.0% (permanent in 7.9%, temporary in 3.1%), and was also the highest in the Crawford extent II (17.0%). In multivariable analyses, age, cardiopulmonary bypass time, and surgeons with a low volume of experience emerged as independent factors significantly associated with early mortality, and disabling complications.

Conclusion: Open repair TAAA carried significant risks of early mortality and disabling complications. Age, cardiopulmonary bypass time, and surgeon factor were significantly associated with early mortality and disabling complications

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Introduction

Despite the development of endovascular therapies for the management of aortic diseases, open surgical repair remains the gold standard approach for treating thoracoabdominal aortic aneurysm (TAAA). This is attributable to the limited efficacy of currently available endovascular devices for the thoracoabdominal aorta in which the complexity of aortic branching vessels such as visceral, renal, and spinal cord feeding arteries hinders effective exclusion of the diseased aorta by endovascular stenting. The operative outcomes of TAAA, however, are still challenged by high rates of operative mortality and disabling complications [1]. Considering that most of the available data on the operative results of open TAAA repairs have been derived by groups of leading experts, they have limited values in estimating the operative outcomes of TAAA in average practice [2, 3]. Moreover, there is also a paucity of studies that systematically reported the outcomes of open TAAA repairs in South Korea. In order to contribute to the body of evidence on this issue, we sought to describe the outcomes of open repair of TAAA and identify the predictors of adverse operative outcomes by analyzing the data from a tertiary referral center in South Korea.

Methods

Study Population and Variables

Using the institutional database of Asan Medical Center (Seoul, Korea), we identified 290 consecutive adult patients who underwent TAAA replacement between September 1992 and December 2020. The extent of thoracoabdominal aortic aneurysms repair was categorized based on the Crawford extent classification [4]. Early death was defined as death occurring within 30 days of surgery or before discharge. Neurologic deficits—both cerebral and spinal—were categorized into disabling and non-disabling, the latter being completely resolved without any residual neurologic symptoms within index hospitalization. Disabling complication was defined as a composite of death, disabling neurologic injuries, and disabling end-organ failures such as the requirement for bowel resection or permanent dialysis that occurred postoperatively. Low cardiac output syndrome (LOCS) was defined as hemodynamic compromise requiring mechanical support such as extracorporeal membrane oxygenation, intra-aortic balloon pump, or ventricular assist device postoperatively. The primary outcomes of interest were mortality and disabling events. The study protocol was approved by the institutional review board (2021-0657), which waived the requirement for informed consent from individual patients considering the retrospective nature of the study design.

Statistical Analysis

Categorical variables are presented as numbers and percentages. Continuous variables are presented as mean ± standard deviation or median with range, as appropriate. For multivariable risk factor analyses, logistic regression models were used to determine the risk factors of early mortality, disabling complications, and spinal cord deficit. All baseline and procedural variables were evaluated in univariable logistic regression models, and those with a P value of .10 or less in univariable analyses were included in the multivariable logistic regression models. Multivariable analyses involved a stepwise backward elimination technique and only the variables with a *P* value of less than .10 were included in the final model.

For variables violating multi-collinearity, we selected a single variable among the conflicting variables based on the highest goodness-of-fit in the logistic model or by the a priori approach. There were 8 surgeons involved in this study, 3 of whom had a surgical volume of > 70 cases and the rest had < 20 cases. We merged the outcomes of low-volume surgeons (< 20 cases) into a single category to investigate the impact of low-volume surgeons on the study outcomes. To analyze the impact of the surgeon factor on each of the outcomes, we first conducted descriptive analyses to determine surgeons (single or in a group) that exhibited significantly different rates of the events. Then, the surgeon factor was entered into multivariable models to test whether it was significantly associated with the outcomes. The odds ratio (OR) and 95% confidence intervals (CIs) were calculated for each parameter. *P* values smaller than .05 were considered statistically significant. R statistical software (version 4.0.5) was used for statistical analyses.

Results

Baseline and Operative Characteristics

The baseline variables are summarized in **Table 1.** Of the 290 patients (mean age, 56.5 ± 14.3 years; female, n=87 [30%]), the most common Crawford extent type was extent II (n=106, 36.6%) followed by extent I (n=93, 32.1%). Underlying aortic pathology was chronic dissection in 150 (51.7%) patients, acute or subacute dissection in 25 (8.6%) patients, and chronic aneurysm without dissection in 110 (37.9%) patients. Half of the patients (n=145) had prior aortic repairs and 12 (4.1%) patients underwent redo-thoracotomy. The mean maximum aortic diameter was 64.2 ± 16.9 mm. Emergent or urgent operations were conducted in 60 (20.7%) patients with aortic dissection or aortic rupture. Cerebrospinal fluid drainage was placed preoperatively in 182 (62.8%) patients. The mean cardiopulmonary bypass time was 155.4 ± 93.4 minutes. Total circulatory arrest (TCA) was used in 96 (33.1%) patients, in whom the mean TCA time was 19.2 ± 17.1 minutes. Intercostal and lumbar arteries reattachment was performed in 105 (36.2%) patients. The operative details are summarized in **Table 2**.

Clinical Outcomes

The rate of early mortality in the overall study population was 13.1% (n=38; **Table 3**), and the rate was the highest in extent II (19.8%) followed by extent III (12.7%), extent V (10.0%), extent I (7.5%); there were no cases of early mortality in the extent IV. Disabling complications occurred in 62 (21.4%) patients, among whom permanent neurologic injuries occurred in 43 (69.3%) patients and bowel resection was performed in 8 (2.8%) patients. Of the 43 patients with permanent neurologic injuries, 23 (7.9%) had permanent spinal cord deficit (SCD) and the rest (n=20, 6.9%) had disabling stroke. In addition to the 23 cases of permanent SCD, there were 9 additional cases of temporary SCDs; as such, a total of 32 (11.0%) patients had SCD. Among 42 (14.5%) patients with cerebral complications, 20 (6.9%) patients had disabling stroke and 1 (0.3%) patient had non-disabling stroke; other cerebral complications included seizure (n=13; 4.5%) and intracranial hemorrhage (n=8; 2.8%). Other major complications included reoperations for bleeding (n=27, 9.3%), new-onset dialysis (n=54, 18.6%), and LCOS (n=25; 8.6%).

Multivariable Risk Factor Analysis for Adverse Events

Table 4 summarizes the multivariable risk factor analyses for early mortality. In multivariable analyses, older age (odds ratio [OR], 2.12; 95% confidence interval [CI], 1.49–3.19; P < .001), low-volume surgeons (OR, 5.90; 95% CI, 2.10–17.01; P < .001), and cardiopulmonary bypass time (OR, 1.13; 95% CI, 1.08–1.18; P < .001) emerged as significant independent predictors of early mortality. Similarly, older age (OR, 1.98; 95% CI, 1.52–2.67; P < .001), low-volume surgeons (OR, 2.81; 95% CI, 1.19–6.54; P = .016), and CPB time (OR, 1.07; 95% CI, 1.04–1.11; P < .001) were significantly associated with the risk of disabling complications (**Table 5**).

Discussions

Most of the existing studies on open surgical repair for TAAA have been reported by world-leading experts from high-volume centers, and the surgical techniques and strategies described in those reports have contributed to major advances in the field of TAAA repair [2, 5-8]. However, open repair of TAAA still continues to be challenging and carries a substantial risk of perioperative morbidity and mortality, primarily due to the large extent of surgical trauma, hemorrhagic conditions, and ischemic insults involving the brain, spinal cord, kidneys, and viscera [9, 10]. Yet, there has been a paucity of studies that systematically reported the clinical outcomes of open TAAA repair in South Korea, which led us to describe the outcomes of open repair of TAAA performed at our institution.

The present study analyzed the outcomes of open repair of TAAA performed at a single, high-volume, tertiary academic center in South Korea. Of note, older age, CPB time, and surgeon factor emerged as risk factors for both early mortality and disabling complications. By using systematic multivariable modeling of selecting the highest fitness combined with a priori approach for the comprehensive multivariable analyses, we were able to identify the significant risk factors for operative outcomes. For instance, surgeons with a low-volume of experience (< 20 cases) were shown as a significant independent predictor of mortality and disabling events; notably, the impact of the surgeon factor was stronger than both the Crawford extent and the urgency of the surgery. The contribution of the surgeon factor to the outcomes may be associated with variables such as differences in CPB strategies, needling skills, flexibility to deal with intraoperative events, and overall surgical flows, all of which are difficult to quantify for analyses. Studies in other fields such as valve and coronary surgery have also noted surgeon factor as the predictor of operative outcomes in addition to the effect of the learning curve; however, we believe the present study is unique as there is a lack of such data regarding open repair TAAA [11]. Further studies are required to determine which sub-variables within the surgeon factor specifically act as the culprit for operative risk, which are important because such factors are likely to be one of the few correctable factors. Of note, CPB time, which is significantly affected by the surgeon factor, was found to have its own independent impact on early outcomes even when the Crawford extent was considered in the multivariable model. It is a common expectation that greater surgical extents, which accompany higher surgical risks, inevitably result in longer CPB time (extent II or III vs. extent I, IV, or V); however, the present study revealed that CPB time along with the surgeon factor had a greater impact on early outcomes than the Crawford extent, which should also be studied further in a targeted study [12].

We believe this finding should be validated by a larger dataset because the number of cases that experienced SCD was rather small (n=32) in order to perform robust multivariable modeling. Considering that the sex factor is an important issue in cardiovascular surgery, further studies focusing on this issue in TAAA will also be interesting to the cardiovascular surgical community.

Study Limitations

Limitations of this study include its single-center, retrospective, observational design. Also, as the study data were collected from medical records spanning a 28-year period, there have been significant variations in surgeons, CPB strategies, and surgical volumes during the study period; consequently, these heterogeneity and residual confounding variables might have affected the results of our study despite the use of statistical modeling. Secondly, the numbers of cases experiencing individual components of major adverse events, SCD in particular, were small in order to perform robust multivariable modeling to determine independent risk factors of each outcomes. Finally, as our data rely on the experience from a single high-volume center, the results of the study may have limited generalizability in other settings.

Conclusions

Open repair TAAA carries significant risks of early mortality and disabling complications. Age, CPB time, and surgeon factors were significantly associated with adverse outcomes.

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Table 1. Preoperative Characteristics

Variables, n (%) or mean± SD	Total n = 290	Extent I n = 93 (32.1)	Extent II n = 106 (36.6)	Extent III n = 63 (21.7)	Extent IV n = 8 (2.8)	Extent V n = 20 (6.9)	*P* value
Age, year	56.5 ± 14.3	61.6 ± 11.5	50.8 ± 14.5	56.2 ± 14.0	50.8 ± 22.0	65.7 ± 8.0	< .001
Female sex, n (%)	87 (30.0)	31 (33.3)	32 (30.2)	13 (20.6)	2 (5.0)	9 (45.0)	.25
BMI, mean ± SD	23.8 ±4.0	24.5±3.9	23.8±4.0	23.1±4.0	20.9±4.2	23.5±3.4	.06
Hypertension, n (%)	205 (70.7)	71 (76.3)	75 (70.8)	36 (57.1)	7 (87.5)	16 (80.0)	.06
Dyslipidemia, n (%)	62 (21.4)	27 (29.0)	19 (17.9)	8 (12.7)	0 (0.0)	8 (40.0)	.011
Diabetes mellitus, n (%)	28 (9.7)	12 (12.9)	10 (9.4)	4 (6.3)	0 (0.0)	2 (10.0)	.60
Aorta pathology							
Rupture or impending rupture, n (%)	31 (10.7)	8 (8.6)	8 (7.5)	9 (14.3)	0 (0.0)	6 (30.0)	.025
Chronic dissection, n (%)	150 (51.7)	47 (50.5)	75 (70.8)	21 (33.3)	5 (62.5)	2 (10.0)	< .001
Acute or Subacute dissection, n (%)	25 (8.6)	10 (10.8)	8 (7.5)	5 (7.9)	0 (0.0)	2 (10.0)	.82

Aneurysm without dissection, n (%)	110 (37.9)	33 (35.5)	22 (20.8)	37 (58.7)	3 (37.5)	15 (75.0)	< .001
Previous aortic intervention							
Prior aortic repair, n (%)	145 (50.0)	42 (45.2)	59 (55.7)	33 (52.4)	5 (62.5)	6 (30.0)	.19
Previous TEVAR, n (%)	11 (3.8)	6 (6.5)	1 (0.9)	2 (3.2)	0 (0.0)	2 (10.0)	.16
Previous PCI, n (%)	19 (6.6)	4 (4.3)	8 (7.5)	4 (6.3)	0 (0.0)	3 (15.0)	.43
Previous CABG, n (%)	11 (3.8)	7 (7.5)	1 (0.9)	3 (4.8)	0 (0.0)	0 (0.0)	.13
Prior myocardial infarction, n (%)	1 (0.3)	1 (1.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	.71
Prior CVA or TIA, n (%)	14 (4.8)	2 (2.2)	7 (6.6)	4 (6.3)	0 (0.0)	1 (5.0)	.57
Marfan syndrome, n (%)	49 (16.9)	5 (5.4)	30 (28.3)	10 (15.9)	4 (50.0)	0 (0.0)	< .001
Peripheral vascular disease, n (%)	6 (2.1)	3 (3.2)	1 (0.9)	2 (3.2)	0 (0.0)	0 (0.0)	.69
Current tobacco use, n (%)	73 (25.2)	21 (22.6)	21 (19.8)	26 (41.3)	1 (12.5)	4 (20.0)	.021
ESRD (on dialysis), n (%)	18 (6.2)	5 (5.4)	5 (4.7)	5 (7.9)	1 (12.5)	2 (10.0)	.76

Chronic lung disease, n (%)	16 (5.5)	7 (7.5)	4 (3.8)	2 (3.2)	0 (0.0)	3 (15.0)	.21
GFR, mL/min/1.73m^2	75.9 ± 32.8	72.5 ± 27.6	78.1 ± 31.4	78.8 ± 39.7	71.9 ± 40.5	72.1 ± 35.8	.68
Blood hemoglobin level, g/dL	12.5 ±1.8	12.7 ± 2.0	12.6 ± 1.7	12.2 ± 1.7	12.1 ± 2.0	12.1 ±1.8	.42
Symptomatic, n (%)	126 (43.4)	37 (39.8)	49 (46.2)	30 (47.6)	3 (37.5)	7 (35.0)	.74
Maximum aortic diameter, mm	64.2 ± 16.9	65.4 ± 19.0	63.2 ± 16.8	65.6 ± 13.0	58.0 ± 14.7	62.2 ± 19.1	.64
Operator							.005
1	91 (31.4)	28 (30.1)	34 (32.1)	12 (19.0)	3 (37.5)	14 (70.0)	
2	72 (24.8)	19 (20.4)	32 (30.2)	21 (33.3)	0 (0.0)	0 (0.0)	
3	87 (30.0)	34 (36.6)	26 (24.5)	19 (30.2)	4 (50.0)	4 (20.0)	
4*	40 (13.8)	12 (12.9)	14 (13.2)	11 (17.5)	1 (12.5)	2 (10.0)	

BMI, body mass index; TEVAR, thoracic endovascular aneurysm repair; PCI, percutaneous coronary intervention; CABG, coronary artery bypass grafting; CVA, cerebrovascular accident; TIA, transient ischemic attack; ESRD, end-stage renal disease; GFR, glomerular filtration rate.

*Operator 4 refers to operators who had case volumes of less than 20 (range, 1–18)

Table 2. Operative Details

Variables, n (%) or mean ± SD	Total n = 290	Extent I n = 93 (32.1)	Extent II n = 106 (36.6)	Extent III n = 63 (21.7)	Extent IV n = 8 (2.8)	Extent V n = 20 (6.9)	*P* value
Urgent or emergency, n (%)	60 (20.7)	19 (20.4)	19(17.9)	14 (22.2)	1 (12.5)	7 (35.0)	.49
CPB time, min	155.4 ± 93.4	145.1 ± 73.9	239.8 ± 107.4	176.5 ± 114.0	128.5 ± 93.4	87.2 ± 78.3	< .001
Total circulatory arrest, n (%)	96 (33.1)	28 (32.6)	56 (54.4)	10 (18.2)	0 (0.0)	2 (10.0)	< .001
Total circulatory arrest time, min	19.2 ± 17.1	19.1 ± 11.2	23.8 ± 25.9	28.4 ± 29.3	0.0 ± 0.0	5.5 ± 2.1	.47
Aortic repair details							
Redo thoracotomy, n (%)	12 (4.1)	0 (0.0)	3 (2.8)	6(9.5)	2 (25.0)	1 (5.0)	.001
Clamping proximal to LSCA, n (%)	19 (6.6)	11 (12.0)	8 (7.5)	0 (0.0)	0 (0.0)	0 (0.0)	.028
Extraction of TEVAR, n (%)	8 (2.8)	5 (5.4)	0 (0.0)	2 (3.2)	0 (0.0)	1 (5.0)	.20
Reverse elephant trunk, n (%)	13 (4.5)	5 (5.4)	8 (7.5)	0 (0.0)	0 (0.0)	0 (0.0)	.15
Completion elephant trunk, n (%)	7 (2.4)	3 (3.2)	4 (3.8)	0 (0.0)	0 (0.0)	0 (0.0)	.50

ICA/LA reattachment, n (%)	105 (36.2)	28 (30.1)	57 (53.8)	14 (22.2)	2 (25.0)	4 (20.0)	< .001
Bi-iliac artery reconstruction, n (%)	36 (12.4)	1 (1.1)	19 (17.9)	16 (25.4)	0 (0.0)	0 (0.0)	< .001
Splenectomy, n (%)	6 (2.1)	2 (2.2)	2 (1.9)	2 (3.2)	0 (0.0)	0 (0.0)	.91
Operative adjuncts							
Cerebrospinal fluid drainage, n (%)	182 (62.8)	57 (61.3)	74 (69.8)	40 (63.5)	6 (75.0)	5 (25.0)	.005

CPB, cardiopulmonary bypass; TCA, total circulatory arrest; LSCA, left subclavian artery; TEVAR, thoracic endovascular aneurysm repair; ICA, intercostal artery; LA, lumbar artery.

Table 3. Early Outcomes

Variables, n (%) or mean ± SD	Total n = 290	Extent I n = 93 (32.1)	Extent II n = 106 (36.6)	Extent III n = 63 (21.7)	Extent IV n = 8 (2.8)	Extent V n = 20 (6.9)	*P* value
Operative mortality	38 (13.1)	7 (7.5)	21 (19.8)	8 (12.7)	0 (0.0)	2 (10.0)	.09
Cerebral complication (composite)	42 (14.5)	16 (17.2)	18 (17.0)	6 (9.5)	2 (25.0)	0 (0.0)	.17
Intracranial hemorrhage, n (%)	8 (2.8)	2 (2.2)	2 (1.9)	4 (4.8)	0 (0.0)	0 (0.0)	.74
Seizure, n (%)	13 (4.5)	8 (7.5)	5 (5.4)	0 (0.0)	0 (0.0)	0 (0.0)	.15
Non-disabling stroke, n (%)	1 (0.3)	1 (1.1)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	.71
Disabling stroke, n (%)	20 (6.9)	5 (4.7)	11 (11.8)	2 (3.2)	2 (25.0)	0 (0.0)	.024
Spinal cord deficit (composite)	32 (11.0)	6 (6.5)	18 (17.0)	7 (11.1)	1 (12.5)	0 (0.0)	.08
Permanent SCD	23 (7.9)	6 (6.5)	13 (12.3)	4 (6.3)	0 (0.0)	0 (0.0)	.23
Permanent paraplegia, n (%)	19 (7.0)	4 (5.4)	11 (9.4)	4 (6.3)	0 (0.0)	0 (0.0)	.46
Permanent paraparesis, n (%)	4 (1.4)	2 (2.2)	2 (1.9)	0 (0.0)	0 (0.0)	0 (0.0)	.76
Temporary SCD	9 (3.1)	0 (0.0)	5 (4.7)	3 (4.8)	1 (1.3)	0 (0.0)	.11
Temporary paraplegia, n (%)	6 (2.0)	0 (0.0)	4 (3.8)	2 (3.2)	0 (0.0)	0 (0.0)	.35

Temporary paraparesis, n (%)	3 (1.0)	0 (0.0)	1 (0.9)	1 (1.6)	1 (12.5)	0 (0.0)	.020
Gastrointestinal complication (composite)	12 (4.1)	2 (2.2)	3 (2.8)	6 (9.5)	0 (0.0)	1 (5.0)	.17
Gastrointestinal ischemia, n (%)	4 (1.0)	0 (0.0)	1 (0.9)	3 (4.8)	0 (0.0)	0 (0.0)	.92
Gastrointestinal resection, n (%)	8 (2.8)	2 (2.2)	2 (1.9)	3 (4.8)	0 (0.0)	1 (5.0)	.74
Bleeding requiring reoperation, n (%)	27 (9.3)	4 (4.3)	18 (17.0)	3 (4.8)	0 (0.0)	2 (10.0)	.014
New dialysis, n (%)	54 (18.6)	15 (16.1)	28 (26.4)	10 (15.9)	0 (0.0)	1 (5.0)	.06
Low cardiac output syndrome, n (%)	25 (8.6)	3 (3.2)	16 (15.1)	4 (6.3)	0 (0.0)	2 (10.0)	.036
Multiple organ failure, n (%)	17 (5.9)	2 (2.2)	11 (10.4)	3 (4.8)	0 (0.0)	1 (5.0)	.14
Surgical wound revision, n (%)	30 (10.3)	5 (5.4)	16 (15.1)	7 (11.1)	1 (12.5)	1 (5.0)	.22
Pneumonia, n (%)	51 (17.6)	16 (17.2)	23 (21.7)	9 (14.3)	1 (12.5)	2 (10.0)	.62
Drainage of pericardial effusion, n (%)	14 (4.8)	2 (2.2)	10 (9.4)	2 (3.2)	0 (0.0)	0 (0.0)	.09
Tracheostomy, n (%)	55 (19.0)	13 (14.0)	30 (28.3)	11 (17.5)	0 (0.0)	1 (5.0)	.017
Reintubation, n (%)	52 (17.9)	14 (15.7)	26 (28.3)	10 (18.5)	1 (12.5)	1 (5.0)	.09
Ventilator support > 48 hours, n (%)	116 (40.0)	31 (33.3)	63 (59.4)	20 (31.7)	1 (12.5)	1 (5.0)	< .001
Vocal cord paralysis, n (%)	34 (11.7)	19 (20.4)	11 (10.4)	4 (6.3)	0 (0.0)	0 (0.0)	.014

Disabling complications, n (%)*	62 (21.4)	15 (16.1)	32 (30.2)	13 (20.6)	0 (0.0)	2 (10.0)	.038

ARF, acute renal failure; SCD, spinal cord deficit**. ***Disabling complications include operative mortality, disabling stroke, permanent spinal cord deficits and gastrointestinal resection.

Table 4. Final Multivariable Logistic Regression Model for Early Mortality

	OR	95% CI	*P* value
Age (by 10-year increment)	2.12	1.49–3.19	< .001
Surgeon factor*	5.90	2.10–17.01	< .001
CPB time (by 10 min increment)	1.13	1.08–1.18	< .001

OR, odds ratio; CI, confidence interval; CPB, cardiopulmonary bypass.

*Low-volume operators vs. other operators.

Table 5. Final Multivariable Logistic Regression Model for Disabling Complications

	OR	95% CI	*P* value
Age (by 10-year increment)	1.98	1.52–2.67	< .001
Surgeon factor*	2.81	1.19–6.54	.016
CPB time (by 10 min increment)	1.07	1.04–1.11	< .001

OR, odds ratio; CI, confidence interval; CPB, cardiopulmonary bypass.

*Low-volume operators vs. other operators

국문요약

배경 : 수술적 인조혈관 치환술은 흉복부대동맥류의 표준 치료로 자리잡고 있으나, 수술에 따른 사망률 및 신경학적 사망률이 여전히 높게 보고되고 있다. 하지만 이러한 흉복부대동맥의 수술에 대한 임상 결과에 대한 연구는 외국 의료기관의 경험에 기반을 둔 것들로, 이 수술에 대한 한국에서의 임상 결과의 체계적인 연구는 부족한 상황이다.

방법 : １９９２년부터 ２０２０년까지 서울아산병원 흉부외과에서 흉복부대동맥류 수술을 받은 ２９０명을 대상으로 후향적 연구를 진행하였다. 조기 사망률 (수술 후 ３０일 이내 혹은 입원기간 내) 과 주요 비가역적 합병증 (사망, 영구적 신경학적 손상, 그리고 장기부전) 을 다변량 로지스틱 회귀 모델을 사용하여 분석하였다.

결과 : 조기 사망률은 13.1% (n = 38), 비가역적 합병증은 21.4% (n = 62)의 결과를 나타냈다. 발생률은 흉복부대동맥의 Crawford 분류에 따라 유의하게 다른 결과를 보여주었고, 특히 Crawford II형이 가장 높은 사망률과 합병증 발생률을 보였다. 척추 손상의 발생률은 11.0% 이었으며 이 중 영구적 손상은 ７．９％, 일시적 손상은 ３．１％으로 나타났으며, 이 또한 Crawford II형에서 １７.０％로 가장 높게 나타났다. 다변량 분석에서, 나이, 심폐 우회 시간, 그리고 적은 경험의 집도의가 조기 사망과 합병증의 중요한 요인으로 분석되었다.

결론 : 흉복부대동맥류 수술은 조기 사망률과 합병증의 상당한 위험을 수반한다. 이는 나이, 심폐 우회 시간, 그리고 집도의에 영향을 받는 것으로 분석되었다.