Original Article

Knowledge Management in Cardiac Surgery: The Second Tehran Heart Center Adult Cardiac Surgery Database Report

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Abstract

Background: *The Adult Cardiac Surgery Databank (ACSD) of Tehran Heart Center was established in 2002 with a view to providing clinical prediction rules for outcomes of cardiac procedures, developing risk score systems, and devising clinical guidelines. This is a general analysis of the collected data.*

Methods: *All the patients referred to Tehran Heart Center for any kind of heart surgery between 2002 and 2008 were included, and their demographic, medical, clinical, operative, and postoperative data were gathered. This report presents general information as well as in-hospital mortality rates regarding all the cardiac procedures performed in the above time period.*

Results: *There were 24959 procedures performed: 19663 (78.8%) isolated coronary artery bypass grafting surgeries (CABGs); 1492 (6.0%) isolated valve surgeries; 1437 (5.8%) CABGs concomitant with other procedures; 832 (3.3%) CABGs combined with valve surgeries; 722 (2.9%) valve surgeries concomitant with other procedures; 545 (2.2%) surgeries other than CABG or valve surgery; and 267 (1.1%) CABGs concomitant with valve and other types of surgery. The overall mortality was 205 (1.04%), with the lowest mortality rate (0.47%) in the isolated CABGs and the highest (4.49%) in the CABGs concomitant with valve surgeries and other types of surgery. Meanwhile, the overall mortality rate was higher in the female patients than in the males (1.90% vs. 0.74%, respectively).*

Conclusion: *Isolated CABG was the most prevalent procedure at our center with the lowest mortality rate. However, the overall mortality was more prevalent in our female patients. This database can serve as a platform for the participation of the other countries in the region in the creation of a regional ACSD.*

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Introduction

At the nascent stages of human life, knowledge was spread orally and it was not until more recent evolutionary periods that writing found a foothold in the transmission of knowledge. Printing revolutionized the diffusion of knowledge and terminated the elite's hold on it. The concept of knowledge management, albeit first appearing in the academic world in 1995, dates back to early human societies.[1]

Healthcare knowledge management is a contemporary science, which can be considered as the methods and techniques that help healthcare organizations reduce costs, enhance healthcare quality, lessen medical errors, cope with information overload, bring current research into practice, support decision-making, and boost cooperation and innovation amongst other things. One of the most used methods in healthcare management is based on information technology and databases. Database technology has roots in the late 1950s and 1960s, when computing literature started to make references to data management systems and databases.

The idea of developing a database in cardiac surgery was conceived in 1986, when the Society of Thoracic Surgeons (STS) set up an ad hoc committee to develop a national database for cardiothoracic surgery.[2, 3] In 1989, the committee established the STS National Adult Cardiac Surgery Database.[4, 5] Beginning with 105 participating sites in 1990, the STS increased the number of its collaborating sites to 450 in 1997[6] and to 650 in 1990.[7] In 2011, this database contained more than 4.4 million patient records and represented an estimated 94% of all adult cardiac surgery centers across the U.S. In this way, this database formed one of the largest specialty-specific clinical data registries in the world.

Another major adult cardiac surgery database comes from European countries. The First European Adult Cardiac Surgical Database Report, containing data on 99 hospitals located in 12 countries, was released in 2002. The fourth report, which was published in 2010, contained an analysis of over 1000000 patients from 366 hospitals in 29 countries.[8]

Tehran Heart Center was inaugurated in 2002 as a major dedicated referral center for patients with cardiovascular disorders from all over Iran. The then paucity of data on cardiovascular disorders in Iran, which necessitated recourse to Western countries' databases with their dissimilar ethnic, cultural, and lifestyle backgrounds, prompted us to establish databases at Tehran Heart Center so as to gain a better insight into the current developments in our region. One of these databases is the Adult Cardiac Surgery Databank (ACSD), which was initiated in 2002.[9] The ACSD is based on healthcare knowledge management and pursues the objective of collecting information on such vital issues as workload, mortality rates, postoperative morbidities and complications, and cost-benefit and cost-effectiveness of surgical procedures in conjunction with providing and validating clinical prediction rules for short-term and long-term outcomes of cardiovascular procedures, devising risk score systems for the Iranian population, furnishing materials for formulating clinical guidelines, and imparting guidance to policy-makers in the field of cardiovascular disease.

Methods

The Tehran Heart Center ACSD was based on the STS questionnaire at the inception. Since then, however, this database has been subjected to many revisions for better adjustment to our requirements and is currently composed of the three distinct components of pre-, intra-, and postoperative data. The input for each component is different: the input for the preoperative component comes from basic, diagnostic, and therapeutic clinical and paraclinical information; the intraoperative component comprises information on intraoperative events; and the input for the postoperative component is derived from the hospital course of patients following cardiac surgery and encompasses physical findings, laboratory tests, co-morbidities, and survival status up until one month after surgery.

The present study recruited all the patients referred to Tehran Heart Center for any kind of heart surgery between 2002 and 2008. Our team of trained physicians prospectively recorded all data that met our five-sheet data-registry-form criteria, from administration to discharge, in a set of 500 variables. Generally, the form is a detailed report of the general demographics of the patient comprising age, sex, insurance coverage, address, and telephone numbers of both the patient and his/her first-degree relative(s) for further follow-up and provides appropriate information on the medical and clinical history of the patient in conjunction with all relevant information on known cardiac disease risk factors that could affect the operation's prognosis and outcome and subsequently the patient's chance of survival. The operative and postoperative data were gathered and recorded from the reports of clinical and paraclinical examinations, intensive care unit (ICU), and cardiac surgery wards. The information was collected via three methods: check-off box; multiple choices; and fill in the blank. Once the ACSD form was filled, a computer operator entered the information into the registry, located in the hospital network.

The validity of the data in the ACSD of Tehran Heart Center is routinely checked by re-abstracting 10% of the entered data and by randomly reentering 5% of the recorded data. By documenting the comparative reliability of the registry versus hospital charts and examining consistency rates, our research team provides guidelines and recommendations for decreasing different types of error so as to improve data collection and entry methods.

All cardiac surgery types can be divided into seven

different groups: isolated coronary artery bypass grafting surgery (CABG); isolated valve surgery; types of surgery other than CABG or valve surgery; CABG combined with valve surgery; CABG concomitant with other types of surgery; valve surgery combined with other types of surgery; and finally CABG concomitant with valve and other kinds of surgery.

This report first presents general information and in-hospital mortality rates regarding all the aforementioned procedures, separately, and thereafter provides more detailed information on the most prevalent procedure type, namely isolated CABG.

The numerical variables are presented as mean ± standard deviation and the categorical variables are summarized by absolute frequency. For the statistical analyses, the Student t-test and chi square were used. All the p values are two-tailed, and a p value ≤ 0.05 was considered statistically significant. For the statistical analyses, the statistical software SPSS version 13.0 for Windows (SPSS Inc., Chicago, IL) was used.

Results

Between January 2002 and December 2008, a total of 24959 heart surgeries were performed at Tehran Heart Center. These procedures consisted of 19663 (78.8%) isolated CABGs, 1492 (6.0%) isolated valve surgeries, 1437 (5.8%) CABGs concomitant with other procedures, 832 (3.3%) CABGs combined with valve surgeries, 722 (2.9%) valve surgeries concomitant with other procedures, 545 (2.2%) surgeries other than CABG or valve surgery, and 267 (1.1%)

CABGs concomitant with valve and other types of surgery.

During this time period, the overall mortality was 205 (1.04%). Table 1 shows the mortality rates in the different types of surgery: the lowest mortality rate (0.47%) was in the isolated CABGs and the highest (4.49%) was in the CABGs concomitant with valve surgeries and other types of surgery. Meanwhile, the overall mortality rate was higher in the females than in the males (1.90% vs. 0.74%, respectively). Table 2 depicts the mean ± standard deviation of the postoperative length of stay (LOS) of the patients in either group.

Isolated CABG accounted for approximately 80% of the all the procedures; accordingly, this report is mostly concentrated on this particular surgical modality. The general characteristics of the patients who underwent isolated CABG are depicted in Table 3. The mean ± standard deviation of the age of the patients in this group was 59.18 ± 15.9 years. The details about the distribution of the isolated CABG patients in the different age groups can be found in Table 4. The overall mortality in the isolated CABG group was 93 out of 19663 (0.47%). The rates of morality in the two sexes and in the different age groups are shown in Table 5: younger patients (< 55 years old) had the lowest mortality rate (0.33%) and those older than 75 years had the highest rate (0.99%).

Table 6 demonstrates the body mass index (BMI) of the patients in the isolated CABG group according to sex. The BMI was divided into the five different sub-groups of less than 20 Kg/m^2 (underweight), 20-24.9 Kg/m^2 (normal), 25-29.9 Kg/m^2 (overweight), 30-34.9 Kg/m^2 (obese), and equal to or more than 35 Kg/m^2 (very obese).

Table 1. Mortality rate in different procedures and different genders

	Male				Female				Total			
	Alive	Dead	All	MR (%)	Alive	Dead	All	MR (%)	Alive	Dead	All	MR (%)
CABG	14559	59	14618	0.4	5011	34	5045	0.67	19570	93	19663	0.47
Valve	1277	10	1287	0.77	187	19	206	9.2	1464	29	1493	1.94
Other	242	8	250	3.2	293	2	295	0.67	535	10	545	1.83
CABG + Valve	535	15	550	2.7	269	13	282	4.6	804	28	832	3.36
CABG + Other	1071	8	1079	0.74	343	14	357	3.9	1414	22	1436	1.5
Valve + Other	370	5	375	1.3	342	6	348	1.7	712	11	723	1.5
CABG + Valve + Others	167	4	171	2.33	88	8	96	8.33	255	12	267	4.49

CABG, Coronary artery bypass grafting; MR, Mortality rate

Table 2. Postoperative length of stay (days) in different types of surgeries[*]

	Male	Female	Total
CABG	7.54±6.2	8.71±6.02	7.88±6.86
Valve	12.22±7.54	13.88±14.44	13.11±11.77
Other	8.20±5.62	8.06±5.38	8.13±5.49
CABG + Valve	13.24±7.99	16.39±12.27	14.29±9.74
CABG + Other	8.92±6.90	10.73±11.69	9.37±8.36
Valve + Other	11.40±7.05	12.69±9.23	12.02±8.19
CABG + Valve + Other	15.30±13.75	15.92±10.13	15.52±12.54

[*]Data are presented as mean±SD
CABG, Coronary artery bypass grafting

Table 3. General characteristic of isolated CABG group*

	Male	Female	Total
Age (y)	58.59±14.64	60.89±18.96	59.18 ±15.90
BMI (Kg/m²)	26.68±3.7	28.83±4.6	27.24±4.09
HLP	9024 (45.89)	3819 (19.42)	12843 (65.31)
DM	3912 (19.89)	2413 (12.27)	6325 (32.16)
HTN	6843 (34.80)	3475 (17.67)	10318 (52.47)
Family History	5232 (26.60)	2147 (10.91)	7379 (37.52)
Smoking	6932 (35.25)	430 (2.18)	7362 (37.44)
Number of Grafts			
1	220 (1.11)	96 (0.48)	316 (1.60)
2	1188 (6.04)	536 (2.72)	1724 (8.76)
3	4653 (23.66)	1889 (9.60)	6542 (33.27)
4	6385 (32.47)	2060 (10.47)	8445 (42.94)
≥ 4	2105 (10.70)	443 (2.25)	2548 (12.95)

*Data are presented as mean±SD or n (%)
CABG, Coronary artery bypass grafting; BMI, Body mass index; HLP, Hyperlipidemia, DM, Diabetes mellitus; HTN, Hypertension

Table 4. Performed isolated CABG in different age categories*

	Male (n=14618)	Female (n=5045)	Total (n=19663)
< 55 (y)	5273 (36.07)	1253 (24.83)	6526 (33.19)
≥ 55 - < 60 (y)	2540 (17.37)	899 (17.81)	3439 (17.48)
≥ 60 - < 65 (y)	2697 (18.44)	1193 (23.64)	3890 (19.78)
≥ 65 - < 70 (y)	1949 (13.33)	885 (17.54)	2834 (14.41)
≥ 70 - < 75 (y)	1535 (10.50)	633 (12.54)	2168 (11.02)
≥ 75 (y)	624 (4.26)	182 (3.60)	806 (4.09)

*Data are presented as n (%)
CABG, Coronary artery bypass grafting

Table 5. Mortality rate in isolated CABG group according to gender

	Male				Female				Total			
	alive	dead	all	MR (%)	Alive	dead	all	MR (%)	Alive	Dead	All	MR (%)
< 55 (y)	5261	12	5273	0.22	1243	10	1253	0.79	6504	22	6526	0.33
≥ 55 - < 60 (y)	2526	14	2540	0.55	893	6	899	0.66	3419	20	3493	0.58
≥ 60 - < 65 (y)	2689	8	2697	0.29	1186	7	1193	0.58	3875	15	3890	0.38
≥ 65 - < 70 (y)	1939	10	1949	0.51	879	6	885	0.67	2818	16	2834	0.6
≥ 70 - < 75 (y)	1526	9	1535	0.58	630	3	633	0.47	2156	12	2168	0.55
≥ 75 (y)	618	6	624	0.96	180	2	182	1.09	798	8	806	0.99

CABG, Coronary artery bypass grafting; MR, Mortality rate

Table 6. Body mass index (BMI) subgroups in isolated coronary artery bypass grafting group*

BMI	Male	Female	Total
< 20 (kg/m²)	350 (2.4)	73 (1.5)	423 (2.2)
≥ 20 - < 25 (kg/m²)	4665 (32.0)	976 (19.4)	5641 (28.8)
≥ 25 - < 30 (kg/m²)	7020 (48.2)	2116 (42.1)	9136 (46.7)
≥ 30 - < 35 (kg/m²)	2187 (15.0)	1337 (26.6)	3524 (18.0)
≥ 35 (kg/m²)	337 (2.3)	520 (10.4)	857 (4.4)

*Data are presented as n (%)

Discussion

The first Tehran Heart Center ACSD report was published in 2008[9] and since has been drawn upon as a reference by a large number of studies.[10-16] Tehran Heart Center, a major referral cardiac hospital in Iran, boasted more than 520000 outpatient visits, 50000 coronary angiographies, 9000 percutaneous coronary interventions (PCI), 500 electrophysiological studies, and 1000 pacemaker and implantable cardioverter defibrillator (ICD) implantations

between the years 2001 and 2008.

Most of the current knowledge in the field of cardiac surgery comes from the Western world. Although many aspects of cardiac diseases and their respective treatment modalities are the same throughout the world, differences in ethnic, cultural, and lifestyle backgrounds between peoples can give rise to different risks of developing cardiac disease and perhaps different therapeutic approaches. A large database of this kind would be a great help in managing knowledge in the field of cardiac surgery in the Iranian population. Indeed, the cardiac surgery studies hitherto conducted with the aid of the ACSD have already played a significant role in developing guidelines and helping physicians and surgeons opt for optimal treatment modalities. Be that as it may, the ACSD could also prove invaluable in other ways as well.

Our data show that the majority of the procedures performed at Tehran Heart Center were isolated CABGs. This pattern chimes in with that reported in the U.S. and in some European countries[6, 17] but is in contrast with that reported elsewhere in Europe and in China.[8, 18] For instance, in Spain about 30% and in China 34% of the total procedures are isolated CABGs and it seems that valvular problems are more prevalent in China and in some European countries than in Iran or in the U.S.[19] According to the Fourth European Association for Cardio-Thoracic Surgery Adult Cardiac Surgery Database Report, isolated CABG, with an overall proportion of 56.8% in the database, ranged from 29.7% to 79.6% across the countries involved. It seems that for the larger European countries, there is a trend towards a decreasing proportion of CABG along with an increase in valve surgery.[18]

With respect to overall mortality rates, we found the highest rates in the patients who underwent CABG concomitant with valve surgery and other types of cardiac surgery. This trend is almost the same as what has been found in the U.S and Europe.[17, 18] Nevertheless, compared to the European countries, the overall mortality rates in our patients were considerably low. For instance, while the mortality rates of our isolated CABGs, isolated valve surgeries, and CABGs combined with valve surgeries were 0.47%, 1.94%, and 3.36%, respectively, the overall mortality rates in the European countries are 2.2% for isolated CABGs, 3.7% for isolated valve surgeries, and 6.2% for CABGs combined with valve sugery.[18] Certain factors, including the age of the patients, should, however, be taken into consideration when interpreting these findings. Our patients had a lower mean age than that of their European counterparts, so it follows logically that the mortality rate in the former should be lower. Also of note is the higher mortality rate in our female patients in any group of cardiac surgery; this trend has been observed by many other studies.[19]

Looking specifically at the mortality rates in the different age categories of the isolated CABG group shows that our low rates, by comparison with those reported by the majority of similar studies, seem reasonably expected. The mean ± SD of age in our patients in the isolated CABG group was 59.18 ± 15.9 years and 33.19% of these patients were less than 55 years of age. According to the European report, only Armenian patients were a few years younger than our patients (mean age = 58 years), while the average age of the patients from countries such as Germany and Belgium was 67 years.[17] Therefore, our patients were significantly younger and finding lesser mortality rates amongst them is more probable. For instance, even though the mortality rate in our patients who were older than 75 years was 0.99%, this rate for those who were younger than 55 years was only 0.33%.

As regards the postoperative LOS in our isolated CABG patients, we found no considerable difference between our data and those of most other reports. For instance, the mean ± SD of the LOS was 7.88 ± 6.86 days in our series and 7 days (ranging from 4.5 days up to 11 days between countries) in the European countries.[18] Although the LOS in Iranians is slightly more than what we see in European patients, it is important to consider the age of patients. Since the mean age of the Iranian patients is less than that of their European counterparts, we expect an earlier discharge from the hospital. Nonetheless, that was not the case and more research is required to seek practical solutions for decreasing the LOS in Iranian patients.

There are many other issues for which a database can prove useful and there are a great number of variables on which further work is needed. However, the aim of this paper was to present a perspective view of the ACSD of Tehran Heart Center. More detailed data are provided in the Tehran Heart Center Second Cardiac Surgical Database Report, which was released in 2011. There are some limitations in this report, first and foremost amongst which is the absence of any information on the follow-up of the surgical patients. Over the past few years, Tehran Heart Center has developed a Follow-Up Clinic for patients undergoing any kind of cardiac surgery. This clinic was established as another means of knowledge management in the field of cardiac surgery; a combination of the data from the Follow-Up Clinic and the current data in the existing literature can offer a great deal of information on the outcome of the performed procedures and positively impact the health of patients candidated for cardiac surgery in the future. Furthermore, it is hoped that our cardiac surgeons will compare the information with that available internationally to make sounder judgment on their performance and elevate the quality of treatment which they offer to patients, which is the salient aim of knowledge management.

Conclusion

The term "knowledge management", albeit an old concept, was first introduced into academia in recent years. The term "healthcare knowledge management" is even a younger concept and is deemed a "should do" issue. Cardiac surgery is an integral, yet costly, component of healthcare. Databases can play a significant role in knowledge management in this field. Nonetheless, despite the availability of large cardiac surgery databases around the world, coping with the ethnic, cultural, and lifestyle characteristics of Iranian patients requires the establishment of such a database in the country. Tehran Heart Center is the pioneer of adult cardiac databases in Iran; and to the best of our knowledge, in the Middle East. A database of this kind needs to be "light on its feet" in responding to regional needs. To that end, it is vital that an alliance be forged between cardiac centers in Iran and those in the region with the aim of developing a comprehensive national and regional database à la the ones already established in the U.S. and Europe.

Acknowledgment

References

1. Ghani SR. Knowledge management: tools and techniques. DESIDOC J Lib Inf Technol 2009;29:33-38.
2. Kouchoukos NT, Ebert PA, Grover FL, Lindesmith GG. Report of the Ad Hoc Committee on Risk Factors for Coronary Artery Bypass Surgery. Ann Thorac Surg 1988;45:348-349.
3. Clark RE. It is time for a national cardiothoracic surgical data base. Ann Thorac Surg 1989;48:755-756.
4. Edwards FH. Evolution of the Society of Thoracic Surgeons National Cardiac Surgery Database. J Invasive Cardiol 1998;10:485-488.
5. Shahian DM, Blackstone EH, Edwards FH, Grover FL, Grunkemeier GL, Naftel DC, Nashef SA, Nugent WC, Peterson ED; STS workforce on evidence-based surgery. Cardiac surgery risk models: a position article. Ann Thorac Surg 2004;78:1868-1877.
6. Ferguson TB, Jr, Dziuban SW, Jr, Edwards FH, Eiken MC, Shroyer AL, Pairolero PC, Anderson RP, Grover FL. The STS National Database: current changes and challenges for the new millennium. Committee to Establish a National Database in Cardiothoracic Surgery, The Society of Thoracic Surgeons. Ann Thorac Surg 2000;69:680-691.
7. Shahian DM, O'Brien SM, Filardo G, Ferraris VA, Haan CK, Rich JB, Normand SL, DeLong ER, Shewan CM, Dokholyan RS, Peterson ED, Edwards FH, Anderson RP; Society of Thoracic Surgeons Quality Measurement Task Force. The Society of Thoracic Surgeons 2008 cardiac surgery risk models: part 1--coronary artery bypass grafting surgery. Ann Thorac Surg 2009;88:S2-22.
8. Bridgewater B, Gummert J, Kinsman R, Walton P. Isolated CABG. In: Bridgewater B, Gummert J, Kinsman R, Walton P, eds. Towards Global Benchmarking: the Fourth EACTS Adult Cardiac Surgical Database Report. 4th. Oxfordshire: Dendrite Clinical Systems Ltd; 2010. p. 70-159.
9. Karimi AA, Ahmadi SH, Davoodi S, Marzban M, Movahedi N, Abbasi K, Salehi Omran A, Shirzad M, Sadeghian S, Abbasi SH, Lotfi-Tokaldany M, Soleymanzuleh M, Fehri A, Sheikh Fathollahi M. First database report on cardiothoracic surgery in Tehran Heart Center. Iranian J Publ Health 2008;37:1-8.
10. Karimi A, Ahmadi H, Davoodi S, Movahedi N, Marzban M, Abbasi K, Omran AS, Sadeghian S, Yazdanifard P, Abbasi SH, Fallah N. Factors affecting postoperative morbidity and mortality in isolated coronary artery bypass graft surgery. Surg Today 2008;38:890-898.
11. Davoodi S, Karimi A, Ahmadi SH, Marzban M, Movahhedi N, Abbasi K, Omran AS, Shirzad M, Sheikhvatan M, Abbasi SH. Coronary artery bypass grafting in patients with low ejection fraction: the effect of intra-aortic balloon pump insertion on early outcome. Indian J Med Sci 2008;62:314-322.
12. Anvari MS, Boroumand MA, karimi A, Alidoosti M, Yazdanifard P, Shirzad M, Abbasi SH, Soleymani A. Aortic and mitral valve atherosclerosis: predictive factors and associations with coronary atherosclerosis using Gensini score. Arch Med Res 2009;40:124-127.
13. Ahmadi H, Karimi A, Davoodi S, Movahedi N, Marzban M, Abbasi K, Salehi Omran A, Shirzad M, Abbasi SH, Tazik M. Determinant factors of renal failure after coronary artery bypass grafting with on-pump technique. Med Princ Pract 2009;18:300-304.
14. Marzban M, Karimi A, Ahmadi H, Davoodi S, Abbasi K, Movahedi N, Salehiomran A, Abbasi SH, Kawoosi Y, Yazdanifard P. Early outcomes of double-vessel coronary endarterectomy in comparison with single-vessel coronary endarterectomy. Tex Heart Inst J 2008;35:119-124.
15. Abbasi K, Fadaei Araghi M, Zafarghandi M, Karimi A, Ahmadi H, Marzban M, Movahedi N, Abbasi SH, Moshtaghi N. Concomitant carotid endarterectomy and coronary artery bypass grafting versus staged carotid stenting followed by coronary artery bypass grafting. J Cardiovasc Surg (Torino) 2008;49:285-288.
16. Kassaian SE, Alidoosti M, Saleh DK, Zeinali AM, Salarifar M, Sahraian AM, Shirani S, Kazazi EH, Darvish S, Marzban M, Abbasi SH, Massumi A. Risk factors for major complications due to delay in surgery in staged carotid stenting and coronary bypass graft surgery. EuroIntervention 2007;3:60-66.
17. Ahmadi H, Karimi A, Davoodi S, Marzban M, Movahedi N, Abbasi K, Omran AS, Sadeghian S, Abbasi SH, Yazdanifard P, Ardabili MS. 24-hour in-hospital mortality predictions in coronary artery bypass grafting patients. Arch Med Res 2007;38:417-423.
18. Grover FL. The Society of Thoracic Surgeons National Database: current status and future directions. Ann Thorac Surg 1999;68:367-373.
19. Ben Bridgewatera, Robin Kinsmanb, Peter Waltonb, Jan Gummertc, A. Pieter Kappeteind. The 4th European Association for Cardio-Thoracic Surgery adult cardiac surgery database report. Interact Cardiovasc Thorac Surg 2011;12:4-5.
20. Abbasi SH, Ponce de Leon A, Kassaian SE, Karimi AA, Sundin Ö, Soares J, Macassa G. Gender differences in the risk of coronary artery disease in Iran. Iranian J Publ Health 2012;41:36-47.