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Hospital incidence, mortality, and gender disparities in patients treated for type A aortic dissections in Switzerland – a secondary data analysis of Swiss DRG statistics

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Summary

AIMS OF THE STUDY: The incidence of type A aortic dissection (TAAD) has increased in several countries in recent decades, but epidemiological data for Switzerland are lacking. Furthermore, there are conflicting data regarding a gender-disparity with higher type A aortic dissection mortality in women. This study analysed sex-specific hospital incidence and in-hospital mortality rates of TAAD in Switzerland.

METHODS: This study is a secondary data analysis of case-related hospital discharge data from the Swiss Federal Statistical Office for 2009–2018. Cases that were hospitalised and surgically treated for type A aortic dissection were included in this analysis. Standardised incidence rates were calculated using the European standard population in 2013. All-cause in-hospital mortality rates were calculated as raw values and standardised for age, sex, and the van Walraven comorbidity score.

RESULTS: A total of 2117 participants were included in this study, of whom 67.1% were male. The age-standardised cumulative hospital incidence for type A aortic dissection treatment was 3.5 per 100,000 (95% CI: 3.3–3.7) for men and 1.7 (1.6–1.8) per 100,000 for women ($p < 0.001$). The incidence rates increased in both sexes during the observed decade. The adjusted mortality rates for treatment of TAAD decreased from 27.6% (26.7–28.5%) in 2009 to 18.5% (17.9–19.1%) in 2018 in women, and they decreased from 19.0% (18.4–19.6%) to 12.3% (11.9–12.7%) in the same period in men. Multivariable logistic regression analysis revealed that female sex was significantly associated with higher mortality, with an odds ratio of 1.39 (1.07–1.79) ($p = 0.012$).

CONCLUSIONS: Hospital incidence rates for the treatment of type A aortic dissection increased in both sexes over the observed decade. The mortality rate was significantly higher in women than it was in men, but it decreased in both sexes. TAAD remains a cardiovascular emergency with a high mortality rate even after emergency surgery.

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Introduction

Aortic dissection is a life-threatening condition caused by an intimal flap separating the aortic lumen into a true lumen and a false lumen. This can cause malperfusion to aortic branches as the dissection extends. The original Stanford classification from 1970 distinguishes type A aortic dissection (TAAD), which involves the ascending aorta, from type B aortic dissection (TBAD), which involves the aorta distal to the left subclavian artery [1]. TAAD and TBAD can distally extend to the iliac and sometimes the femoral arteries. Aortic dissections of the arch without the involvement of the ascending aorta were not reflected by this classification. The European Association for Cardio-Thoracic Surgery and the European Society for Vascular Surgery classifies these pathologies as "non-A-non-B dissections" [2].

While type B aortic dissection can often be treated conservatively by blood pressure control and radiological monitoring of the dissection, type A aortic dissection typically requires urgent cardiac surgery. This is because the dissection can lead to aortic rupture, coronary artery malperfusion, acute aortic valve regurgitation, cardiac tamponade, and stroke [3]. Surgery for type A aortic dissection aims to replace the ascending aorta with a synthetic graft and thereby seal the dissection membrane to restore normal blood flow and prevent rupture. This is typically performed via sternotomy with extracorporeal circulation and hypothermic circulatory arrest to perform an open distal anastomosis. Techniques differ depending on the extent of dissection and the surgeon’s expertise. Although these procedures carry a risk of stroke and bleeding, they are highly effective in preventing death from type A aortic dissection [3].

A secondary analysis of diagnosis-related group (DRG) data on the epidemiology of aortic dissections in Germany revealed relevant information that might help further improve treatment quality [4]. Such longitudinal, nationwide epidemiological data on type A aortic dissection are lacking for Switzerland. Therefore, this study analysed the hospital incidence, treatment details, and all-cause in-hospital mortality of the treatment of type A aortic dissection in Switzerland between 2009 and 2018 using case-related hospital discharge data from the Swiss Federal Statistical Office (SFSO) to gain a better understanding of this pathology in Switzerland.

Materials and methods

This was a secondary data analysis of case-related hospital discharge data from the Swiss Federal Statistical Office. The detailed methodological approach for using this data was described in a previous publication on abdominal aortic aneurysms [5]. In brief, every Swiss facility that treats inpatients is required to report all hospital admissions to the SFSO on an annual basis. Among others, variables include age; sex; up to 50 diagnosis codes; up to 100 procedure codes; information on discharge, including all-cause in-hospital mortality; information on the location before admission and type of admission; information on the insurance class, time to treatment, total length of stay, and length of stay in the intensive care unit (ICU); and duration of ventilation. Diagnoses were recorded according to the 10th revision of the International Classification of Diseases (ICD-10), and procedures were recorded according to the Swiss classification of surgical interventions (CHOP). The current CHOP code list is available online at https://bit.ly/3zYViv6 (last access on 22.11.2023).

Because of personal data protection regulations, no unique identifiers were available for patients, and the exact institution numbers were encoded. Thus, the data do not allow the identification of patients with reinterventions during new hospital admissions.

The analysis of this anonymised dataset did not require ethical approval (waived by the local ethics board: BASEC-Nr. Req-2021-01010). This study is reported in accordance with the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) statement [6]. For legal reasons, the data are not publicly available, but they can be requested directly from the SFSO.

Inclusion and exclusion criteria

The ICD-10 distinguishes between thoracic, thoraco-abdominal, and abdominal aortic dissections. Furthermore, for each anatomical region, it differentiates between ruptured and non-ruptured dissections; thus, the Stanford classification is not directly reflected in the ICD-10 codes. Therefore, only cases with a combination of a corresponding ICD-10 diagnosis code, a CHOP procedure code for aortic replacement, and a CHOP procedure code for extracorporeal circulation were included.

The ICD-10 codes used were I71.00, I71.01, I71.03, I71.04, I71.05, and I71.07, including all ruptured and non-ruptured thoracic- or thoraco-abdominal aortic dissections. The CHOP codes for resection of the thoracic aorta with replacement were 38.45.00, 38.45.10-14, 38.45.19, 38.45.20, and 38.45.29. Of note, the CHOP code for the use of a hybrid prosthesis (38.45.14) has only been available since 2011. A hybrid procedure generally means a surgical graft replacement of the aortic arch with stent-grafting of the descending thoracic aorta using a covered stent, known as the "frozen elephant trunk" procedure [7]. The stent graft in the descending aorta serves as a landing zone for subsequent endovascular graft placements if the thoraco-abdominal aorta requires further treatment. The CHOP codes for extracorporeal circulation were 39.61.00, 39.61.1, 39.61.10-15, 39.61.2, 39.61.21-26, and 39.61.99. The details of the CHOP codes and ICD codes used are available in the supplementary material (see appendix 1).

Statistical analysis

Baseline characteristics and treatment outcomes were stratified by sex. For descriptive analyses, the mean and standard deviation (SD) are reported for continuous variables with approximately normal distributions. For variables with skewed distributions, the median and quartiles (Q1, Q3) are reported. Continuous variables were compared with Student's t-test if they were normally distributed or the Mann-Whitney U test if they had a skewed distribution. For categorical variables, frequencies and percentages are presented. The variables were compared using Pearson's Chi^2 test.

To allow international comparison of the epidemiological data, age-standardised all-cause in-hospital mortality rates were calculated. Age-standardised mortality rates are weighted averages of the age-specific mortality rates per 100,000 persons, where the weight is the proportion of persons in each age group of the standard population. The standard European population from 2013 with 5-year bins was used as a reference to calculate age-standardised cumulative incidence rates for the Swiss population using SFSO data [8–10]. Because the age distribution of the 2009 Swiss population was not available, the 2010 age distribution was used for 2009. Logit Wald 95% confidence intervals (95% CIs) for the directly age-standardised estimates were adjusted as suggested by Altman et al. but on the logit scale [11]. Sex-specific all-cause in-hospital mortality rates were calculated as raw rates and standardised for age, year of treatment, and a sum score of weighted Elixhauser ICD-10 diagnosis groups according to van Walraven [12].

To analyse the association between sex and all-cause in-hospital mortality, a multivariable logistic regression model was built for the overall cohort. The variables sex (factor), age (continuous), type of admission (factor), van Walraven comorbidity score (continuous), insurance class (factor), hospital level (factor), and year of treatment (factor) were included in this model to adjust for potential confounding. Regression coefficients were presented as odds ratios (ORs) with corresponding 95% CIs.

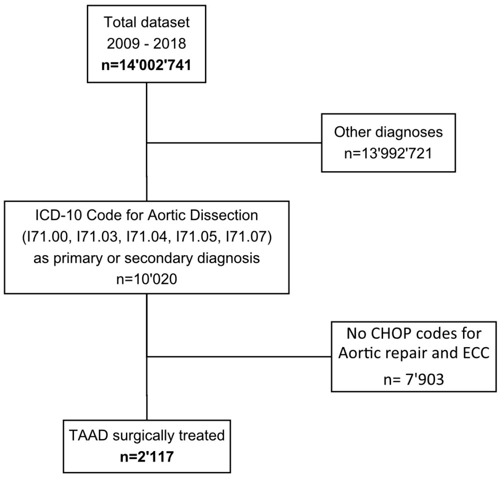
No statistical methods to handle missing data were needed because no missing values were present in any variables of the primary analyses. All analyses were performed with R version 4.2.3 on macOS 12.5.1 [13]. A complete list of all R packages used with version details is available in the supplementary material (see appendix 2). The R code can be shared upon request. All p-values were two-sided with an α-level of 5%.

Results

From 01.01.2009 to 31.12.2018, 10,020 individuals were hospitalised with ruptured or non-ruptured thoracic or thoraco-abdominal aortic dissections as the primary or secondary diagnosis. Cases without surgical treatment of the aortic dissection involving the use of extracorporeal circulation were excluded (n = 7903). A total of 2117 individuals were surgically treated for aortic dissection with the use of extracorporeal circulation and included in this study (figure 1).

Table 1 summarises the baseline characteristics of the study cohort stratified by sex. Males accounted for 67.1% of patients, and the overall median age was 65 years (Q1 to Q3: 55–73). Females were significantly older than males, with a median age of 71 (61–77) years versus 62 (53–71) years, p <0.001. Females had significantly more diagnoses of cerebrovascular disease and arterial hypertension (p = 0.010). The other comorbidities were similar between men and women. The van Walraven Score steadily increased from 2009 to 2018 in both sexes (figure 2).

Figure 1: Patient flow. The total dataset contained all hospitalisations in the Swiss population from 2009 to 2018. ICD = International Classification of Diseases (version 10); CHOP = Swiss medical procedural classification; ECC = extracorporeal circulation; TAAD = type A aortic dissection.



Epidemiology

The overall age-standardised hospital incidence rates for type A aortic dissection treatment was 3.5 per 100,000 (95% CI: 3.3–3.7) in men and 1.7 per 100,000 (1.6–1.8) in women (p <0.001). The incidence rates increased in both sexes during the observed decade; for men, the incidence increased from 2.9 (2.4–3.5) per 100,000 in 2009 to 3.9 (3.4–4.6) per 100,000 in 2018, and for women, the incidence increased from 1.4 (1.1–1.9) per 100,000 in 2009 to 2.0 (1.6–2.4) per 100,000 in 2018 (figure 3).

Treatment specifications

Table 2 summarises the treatment specifications of the study cohort stratified by sex. The vast majority of the 2117 cases with type A aortic dissection were treated at major hospitals. These included university hospitals (76.6%) and major non-university hospitals (17.1%). The remaining 6.3% of cases (133 patients) were treated at small hospitals, including specialty clinics. In 38 of the

Table 1:
Baseline characteristics. Continuous variables are presented as medians and quartiles (Q1 to Q3). Counts are presented with percentages in parentheses. Definitions of the comorbidities are available in the supplementary material (appendix).

	Male	**Female**	**Total**	
Variable	**n = 1420**	**n = 697**	**n = 2117**	**p-value**
Age, years	62 (53–71)	71 (61–77)	65 (55–73)	<0.001
van Walraven score	13 (3–19)	13 (3–20)	13 (3–19)	0.257
Coronary artery disease	318 (22.4)	142 (20.4)	460 (21.7)	0.289
Chronic heart failure	210 (14.8)	125 (17.9)	335 (15.8)	0.062
Cerebrovascular disease	268 (18.9)	165 (23.7)	433 (20.5)	0.010
Arterial hypertension	712 (50.1)	391 (56.1)	1103 (52.1)	0.010
Chronic pulmonary disease	126 (8.9)	77 (11.0)	203 (9.6)	0.110
Diabetes mellitus	62 (4.4)	42 (6.0)	104 (4.9)	0.097
Chronic kidney disease	211 (14.9)	96 (13.8)	307 (14.5)	0.505
Cancer	13 (0.9)	7 (1.0)	20 (0.9)	0.843
Obesity	52 (3.7)	29 (4.2)	81 (3.8)	0.574
Connective tissue disease	22 (1.5)	18 (2.6)	40 (1.9)	0.101
Location before admission				0.898
– Acute care hospital	694 (48.9)	332 (47.6)	1026 (48.5)	
– Home	688 (48.5)	344 (49.4)	1032 (48.7)	
– Nursing home	5 (0.4)	2 (0.3)	7 (0.3)	
– Other	33 (2.3)	19 (2.7)	52 (2.5)	
Year				0.995
– 2009	108 (7.6)	52 (7.5)	160 (7.6)	
– 2010	120 (8.5)	60 (8.6)	180 (8.5)	
– 2011	120 (8.5)	57 (8.2)	177 (8.4)	
– 2012	138 (9.7)	64 (9.2)	202 (9.5)	
– 2013	150 (10.6)	83 (11.9)	233 (11.0)	
– 2014	158 (11.1)	79 (11.3)	237 (11.2)	
– 2015	150 (10.6)	68 (9.8)	218 (10.3)	
– 2016	151 (10.6)	80 (11.5)	231 (10.9)	
– 2017	157 (11.1)	74 (10.6)	231 (10.9)	
– 2018	168 (11.8)	80 (11.5)	248 (11.7)	

2117 cases (1.8%), a hybrid procedure was performed to treat the TAAD.

Females required red blood cell transfusions more frequently than males (p <0.001). The total length of stay in the ICU was 68 hours (29–158), whereas the total length of hospital stay was 12 days (9–19). Both durations were similar in men and women. However, 16.7% of all patients were transferred to another acute care hospital after surgical treatment. The data reflect only the time until discharge from the hospital where the surgical treatment was performed, and therefore, they do not reflect the total length of stay until discharge from any subsequent inpatient treatments.

Treatment outcomes

The raw all-cause in-hospital mortality rate for surgically treated type A aortic dissection was 15.2% (95% CI: 13.7–16.8%). The raw all-cause in-hospital mortality rates were lower in men (13.0% [11.4–14.9%]) than in women (19.7% [16.9–22.8%]), as shown in table 3.

The adjusted all-cause in-hospital mortality rates for type A aortic dissection treatment decreased from 19.0% (95% CI: 18.4–19.6%) in 2009 to 12.3% (11.9–12.7%) in 2018 in men and from 27.6% (26.7–28.5%) in 2009 to 18.5% (17.9–19.1%) in 2018 in women, see figure 4. These decreases were not statistically significant for men (p = 0.082) or women (p = 0.081). However, mortality was significantly lower in 2014–2016 compared with the reference year 2009. These findings are also reflected in figure

Figure 2: Comorbidities (van Walraven score). Comorbidities are summarised using a sum score of weighted Elixhauser ICD-10 diagnosis groups according to van Walraven [12]. The score is calculated from grouped ICD-10 diagnoses per patient and weighted on the basis of the association of each category and mortality. The boxplots are stratified by sex. The whisker extends from the hinge to the largest and the smallest value, no greater than 1.5 × the inter-quartile range. Outlying points are not plotted to increase readability.

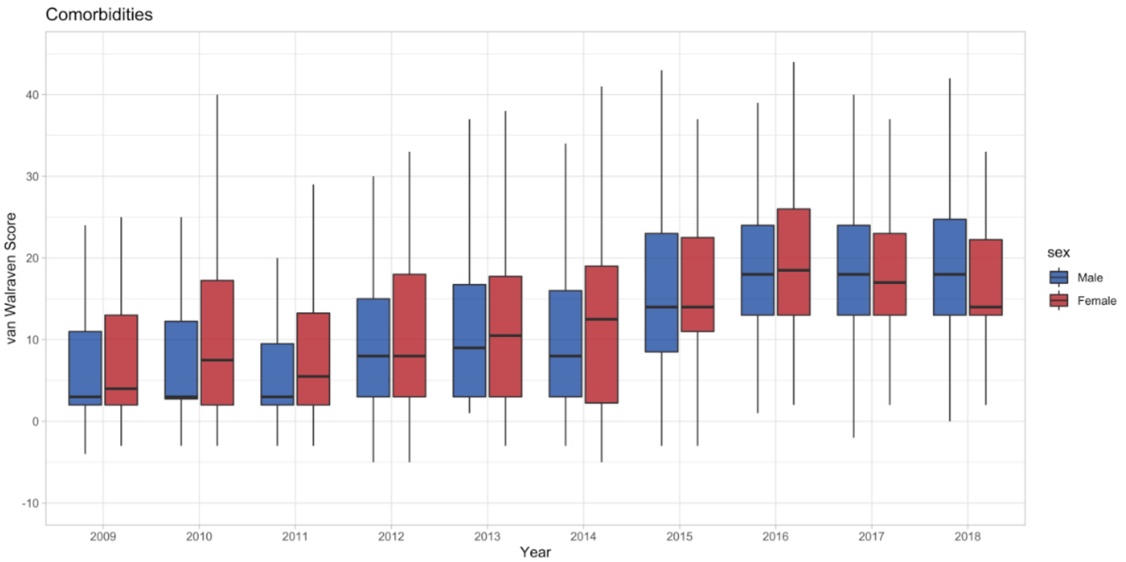
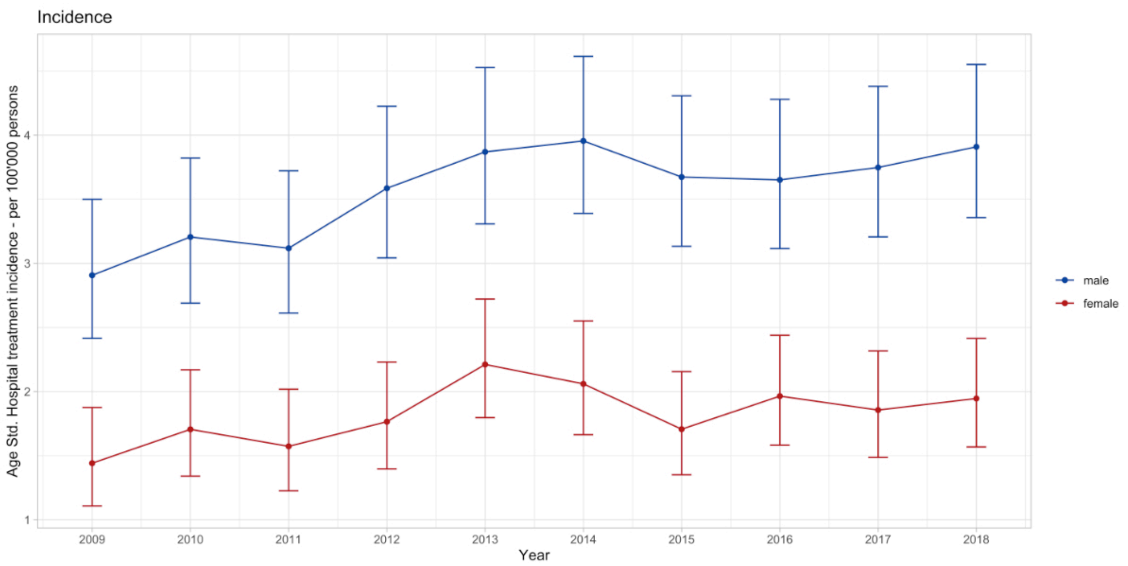


Figure 3: Incidence of type A aortic dissection. Age-standardised incidence rates stratified by sex and presented with 95% confidence intervals for each year.



4, in which the smoothed adjusted survival curves for both sexes drop slightly in these years.

Figure 5 presents the results of the regression analysis of all-cause in-hospital mortality. Female sex was significantly associated with higher mortality (OR: 1.39, 95% CI: 1.07–1.79, p = 0.012). Transfer from another acute care hospital was associated with a decreased mortality (OR: 0.72 [0.56–0.93], p = 0.012). Likewise, private insurance class was associated with decreased mortality (OR: 0.60 [0.43–0.81], p = 0.001.

Table 3 shows other relevant diagnoses during the hospital stay, including myocardial infarction, stroke, paraplegia, acute mesenteric ischemia, renal failure, and limb ischemia. The rates of these complications did not differ between men and women.

Discussion

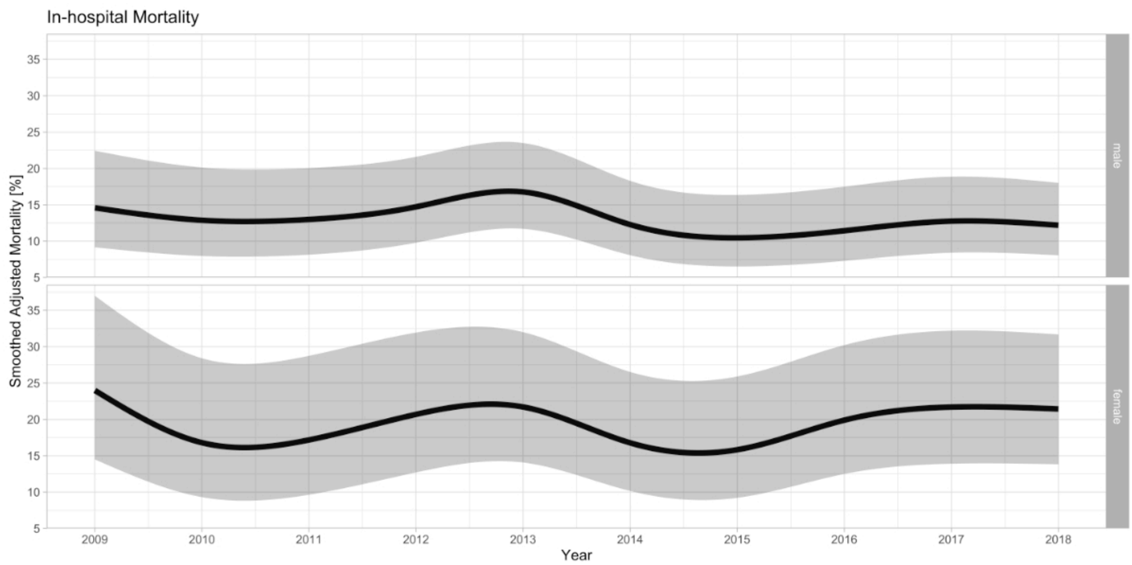
This is the first study to demonstrate the nationwide hospital incidence of type A aortic dissection treatment in Switzerland. We used case-related hospital discharge data to estimate the actual incidence and treatment outcomes of patients treated for type A aortic dissection.

Table 2:
Treatment specifications. Continuous variables are presented by median and quartiles (Q1 to Q3). Counts are presented with percentages in parentheses.

	Male	**Female**	**Total**	
Variable	**n = 1420**	**n = 697**	**n = 2117**	**p-value**
Type of hospital				0.356
– University hospital	1096 (77.2)	525 (75.3)	1621 (76.6)	
– Major hospital	232 (16.3)	131 (18.8)	363 (17.2)	
– Other	92 (6.5)	41 (5.9)	133 (6.3)	
Treatment				0.116
– Open repair	1390 (97.9)	689 (98.9)	2079 (98.2)	
– Hybrid repair	30 (2.1)	8 (1.1)	38 (1.8)	
Packed red blood cells				<0.001
– 0	602 (42.4)	212 (30.4)	814 (38.5)	
– 1–5	433 (30.5)	252 (36.2)	685 (32.4)	
– >5	385 (27.1)	233 (33.4)	618 (29.2)	
Fresh frozen plasma				0.445
– 0	1222 (86.1)	613 (87.9)	1835 (86.7)	
– 1–5	103 (7.3)	46 (6.6)	149 (7.0)	
– >5	95 (6.7)	38 (5.5)	133 (6.3)	
Platelet transfusion				0.539
– 0	1291 (90.9)	643 (92.3)	1934 (91.4)	
– 1–5	104 (7.3)	42 (6.0)	146 (6.9)	
– >5	25 (1.8)	12 (1.7)	37 (1.7)	
Length of stay ICU, h	64.5 (27–157)	78 (32–165)	68 (29–158)	0.143
Length of stay, d	12 (9–19)	13 (9–20)	12 (9–19)	0.654

ICU = intensive care unit; h = hours; d = days.

Figure 4: Smoothed and adjusted all-cause in-hospital mortality of patients treated for type A aortic dissection. Smoothed adjusted all-cause in-hospital mortality rates of patients surgically treated for type A aortic dissection stratified by sex with the corresponding 95% confidence interval. The mortality rates were adjusted for age, year of treatment, and the Elixhauser comorbidity score.



The epidemiological metrics are comparable to international data [4, 14]. The overall incidence of TAAD might be approximately twice as high because the prehospital death rate is estimated to be approximately 50%, and TAAD has been identified as one of the leading causes of out-of-hospital death [15, 16]. The excellent prehospital care in Switzerland, including the broad availability of helicopter emergency medical services and short travel distances, may result in a lower prehospital death rate [17].

In line with previous publications, we observed an increase in the incidence of type A aortic dissection treatment during the observed decade [4, 15, 18]. This increase might be attributable to the demographic change in Switzerland (i.e., the ageing population); the broader availability and use of computed tomography in emergency departments, presumably leading to an increased detection rate; and/or a decrease in the rate of older adults turning down treatment.

Furthermore, the rate of hybrid procedures (i.e., procedures using a hybrid prosthesis, specifically the frozen elephant trunk procedure) gradually increased after 2011, when the first two procedures were coded. Since then, the proportion steadily increased to 4.4% of cases (11 of 248 cases) in 2018.

Gender-specific outcomes

This study identified a difference in treatment outcomes between men and women. The multivariable regression

Figure 5: Multivariable logistic regression model of all-cause in-hospital mortality. A total of 2117 cases with type A aortic dissection and 322 hospital deaths were recorded in the Swiss Federal Statistical Office between 2009 and 2018. Data are presented as odds ratios with corresponding 95% confidence intervals. For continuous variables (i.e., age in years and van Walraven score), odds ratios are given per one-unit increase in the variable.

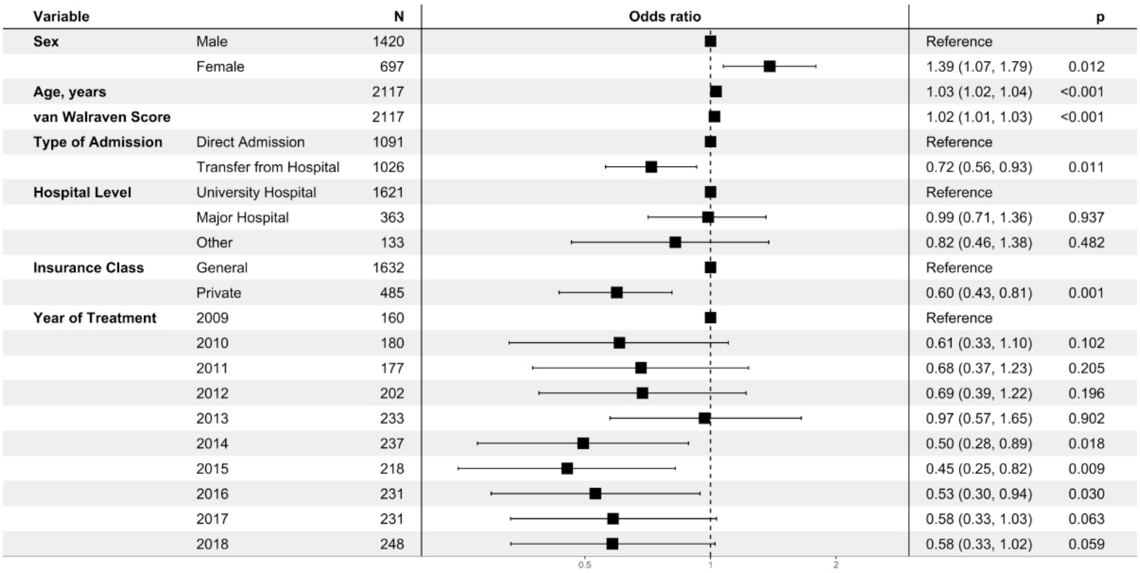


Table 3:
Hospital treatment outcomes. These are unadjusted raw counts presented with percentages in parentheses. All comparisons are descriptive and unadjusted. The variable "destination after discharge" does not include deceased patients; the percentage was calculated for the overall cohort.

	Male	**Female**	**Total**	
Variable	**n = 1420**	**n = 697**	**n = 2117**	**p-value**
Myocardial infarction	64 (4.5)	33 (4.7)	97 (4.6)	0.814
Acute stroke	50 (3.5)	37 (5.3)	87 (4.1)	0.052
Acute paraplegia	34 (2.4)	13 (1.9)	47 (2.2)	0.437
Acute mesenteric ischemia	61 (4.3)	33 (4.7)	94 (4.4)	0.645
Large bowel resection	14 (1.0)	13 (1.9)	27 (1.3)	0.090
Small bowel resection	10 (0.7)	7 (1.0)	17 (0.8)	0.467
Acute renal failure	55 (3.9)	24 (3.4)	79 (3.7)	0.624
Dialysis (cvvHD)	147 (10.4)	83 (11.9)	230 (10.9)	0.280
Acute limb ischemia	76 (5.4)	45 (6.5)	121 (5.7)	0.304
Lower leg fasciotomy	25 (1.8)	6 (0.9)	31 (1.5)	0.105
Major amputation	2 (0.1)	0 (0.0)	2 (0.1)	0.322
Destination after discharge				<0.001
– Home	267 (18.8)	82 (11.8)	349 (16.5)	
– Nursing home	6 (0.4)	6 (0.9)	12 (0.6)	
– Other	21 (1.5)	7 (1.0)	28 (1.3)	
– Rehabilitation	711 (50.1)	341 (48.9)	1052 (49.7)	
– Acute care hospital	230 (16.2)	124 (17.8)	354 (16.7)	
All-cause raw in-hospital mortality	185 (13.0)	137 (19.7)	322 (15.2)	<0.001

cvvHD = continuous veno-venous haemodialysis.

model showed that female sex was associated with a significantly higher mortality rate (OR: 1.39). An international registry-based study comprising data from 58 large referral centres in 13 countries also reported a higher mortality in females [19]. They found higher rates of organ malperfusion, shock, and altered consciousness for women compared to men. A possible explanation for this difference is that aortic dissection presents later in women than in men in Switzerland. Table 3 shows that the rate of malperfusion for several organ systems (i.e., the brain, heart, intestines, and limbs) was higher in women. However, none of the observed differences reached statistical significance. Interestingly, a cohort study conducted at the Sakakibara Heart Institute in Japan reported that the time from the onset of symptoms to operation was similar in both sexes, and mortality did not differ between sexes in their cohort [20].

By contrast, other studies have shown no differences in survival between sexes: A recently published study on gender-specific outcomes in type A aortic dissection analysed German registry data and found no difference in mortality between men and women [21]. Furthermore, a comparable analysis of German DRG statistics reported a tendency towards higher all-cause in-hospital mortality in women, but the difference in mortality between men and women was not significant [4]. Neither of these studies reported the time from the onset of symptoms to operation. Thus, it remains unclear why the adjusted mortality rates were higher in women than in men in Switzerland.

In line with all the studies discussed above, women were, on average, significantly older than men at the time of type A aortic dissection [4, 19, 21]. In our study, the age difference was 9 years. This was included in the regression model, but further adjustments for functional capacity parameters were not possible with these administrative data. In addition to possible confounding from unmeasured variables such as time-delay for treatment, gender-specific factors might lead to higher mortality.

Gender-specific differences in treatment outcomes have been described for the treatment of ruptured abdominal aortic aneurysms [5, 22]. A systematic review in this field showed that women treated for abdominal aortic aneurysms had higher rates of transfusion and pulmonary and bowel complications compared with men [22]. The authors concluded that these factors might be causes for the observed outcome disparities and could thus be targets for quality improvement. In the present study, women had significantly higher transfusion rates than men. This could be due to higher peri-interventional blood loss or more post-procedural bleeding complications. Further exploratory studies are needed to confirm and elucidate these findings.

Mortality

Mortality rates tended to decline in the observed decade, but type A aortic dissection remains a fatal cardiovascular emergency. In addition to the discussed association between gender and all-cause in-hospital mortality, age, van Walraven comorbidity Score, interhospital transfer, and insurance class were significantly associated with mortality in the multivariable regression model. For each decade of increasing age, the probability of in-hospital mortality increased (OR: 1.34). This observed association seems plausible and has been previously reported [4].

The association between comorbidity scores obtained from administrative data (i.e., the Elixhauser score or the van Walraven score) and all-cause in-hospital mortality has been reported previously and was confirmed in this study. The inclusion of this score is an attempt to adjust for comorbidities. However, in several populations, these scores increased over time; this may be due to an increase in documentation and coding of comorbidities rather than an actual increase in comorbidities [4, 5, 23, 24]. Thus, its value as an estimation of the disease burden is questionable.

The regression analysis also revealed an association between the type of admission and all-cause in-hospital mortality. Patients transferred from other acute care hospitals had lower mortality than patients who directly presented at the treating institution. A similar picture was recently presented for the treatment of ruptured abdominal aortic aneurysm in Switzerland [25]. Several factors must be considered when interpreting these findings. First, the turndown rate might be different in hospitals that do not surgically treat type A aortic dissection compared with those that do. This might lead to systematic differences between referred patients and patients who were directly admitted and treated. Second, the transfer of patients with cardiovascular emergencies between hospitals could lead to an increase in mortality and a selection of patients who are more haemodynamically stable and actually reach the hospital for surgical treatment [26]. In Switzerland, the transfer of patients with cardiovascular emergencies between hospitals is generally fast, and no deaths were observed in an analysis of data from the largest helicopter emergency medical service provider [17]. However, data on haemodynamic parameters are not available in these datasets, nor is information on deaths during interhospital transfers.

The regression analysis also showed that private insurance was associated with a lower mortality rate than nonprivate insurance (OR: 0.60). The authors hypothesise that insurance class is a surrogate parameter for better socioeconomic status and thus a better risk profile rather than an indicator of different treatment for this cohort. Similar results have been shown for abdominal aortic aneurysm treatment in Switzerland [25]. Another explanation for this finding could be the fact that patients with relevant comorbidities are less likely to be accepted by private insurance. However, none of these interpretations can be verified.

Limitations

This analysis has several limitations. The data are not clinical but administrative. The main strengths and limitations of statutorily collected routine data are well-known [23]. For aortic dissections, the ICD coding does not directly allow differentiation between type A and type B Stanford dissections. The combination of ICD coding and procedural coding allows the identification of cases surgically treated with type A aortic dissection. Nevertheless, the proportion of palliative treatment of type A aortic dissection cannot be estimated, as these cases cannot be distinguished from conservatively treated type B aortic dissection. In addition, some cases with complicated type B aortic dissection in this cohort may have been surgically treated with extracorporeal circulation.

For this specific analysis, the main advantage compared with registry data is the presumably complete coverage of the Swiss population. The main limitations are as follows:

First, the risk of bias due to coding errors cannot be ruled out. For hard outcomes, such as all-cause in-hospital mortality, the risk is presumably low.

Second, the data allow non-independent observations of patients treated twice for the same ICD code, which leads to double counting and distorts the incidence rates. The proportion of patients remains unknown but is likely to be negligible.

Third, comparison of mortality rates with international data is limited because adjustments were only possible for age, gender, and the van Walraven comorbidity index; these adjustments neither reflect the cardiovascular risk profile nor the functional capacity of the treated individuals.

Fourth, the data do not allow a distinction to be made between persons with permanent residence in Switzerland and persons with non-permanent residence (e.g., travellers, tourists, etc.). Therefore, the actual incidence rates for permanent residents of Switzerland may be slightly different.

Implications for research and practice

This study revealed an unexplained gender difference in type A aortic dissection treatment outcomes in Switzerland, with higher mortality in women. This finding should be further investigated using clinical data to explore, identify, and ultimately address possible deficiencies in the treatment of women with type A aortic dissection.

Conclusion

Hospital incidence rates for the treatment of type A aortic dissection increased in both sexes over the observed decade. The adjusted all-cause in-hospital mortality rates decreased in both sexes, but the mortality rate was significantly higher in women than in men. This unexplained gender difference in type A aortic dissection treatment outcomes warrants further exploration. Women received more blood products, possibly indicating an increased risk of bleeding complications in this population.

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Potential competing interests

All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. No potential conflict of interest related to the content of this manuscript was disclosed.

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Appendices

Appendix 1: CHOP codes and ICD codes used.

Appendix 2: Complete list of all R packages used with version details.

The appendices are available for download as separate files at https://doi.org/10.57187/s.3499.