Surgical treatment of right-sided active infective endocarditis with or without involvement of the left heart: 20-year single center experience

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Abstract

Objective: The aim of this paper is to review the 20-year experience of surgical treatment of right-sided infective endocarditis at our institution, and in particular to compare the outcome of isolated right-sided endocarditis to right-sided endocarditis with involvement of the left heart. Methods: Between April 1986 and April 2006, 84 operations had to be performed in 79 patients (49 men, median age 43.5 years). There were 72 (85.7%) cases of native and 12 (14.3%) of prosthetic valve endocarditis. In 57 (67.9%) cases, operation was for isolated right-sided endocarditis (RSE) and in 27 (32.1%) cases for combined right and left-sided endocarditis (RLSE). Follow-up was completed in all 91% of survivors. The median follow-up time at 448 patient years was 3.59 years (range 6 months–19.27 years). Results: There was a highly significant difference between the survival rates of patients operated on due to RSE compared to RLSE: the 30-day, 1-, 5-, 10- and 20-year survival rate after RSE operation was 96.2%, 88.4%, 73.5%, 70.4% and 70.4%, respectively, compared to 72.0%, 67.8%, 50.8%, 35.6% and 35.6% after operation for RLSE (p = 0.0093). Patients with RLSE more often underwent emergency operations (p < 0.001), preoperatively were more often on high-dose catecholamines (p < 0.006) and intraoperatively showed more abscess formation (p < 0.001). Freedom from reoperation at 30 days, 1-, 5-, 10- and 20-year was 97.4%, 95.9%, 92.2%, 88.6% and 88.6%, respectively. Risk factors for early mortality were priority of surgery with an odds ratio (OR) of 5.13, age over 40 years (OR 1.04 and 3.24) and left heart involvement (OR 2.54). Conclusions: Our surgical strategy for right-sided infective endocarditis is based on three principles: (1) debridement of the infected area or vegetectomy; (2) valve repair whenever possible, avoiding artificial material; (3) if valve replacement is unavoidable, use of a biological substitute without any artificial material that might become infected. Following these strategies surgery of right-sided infective endocarditis with or without left-side involvement can be performed with good early, mid-term and long-term results. Patients with involvement of the left side showed not only worse preoperative conditions but also a significantly poorer clinical outcome than those with isolated right-sided infective endocarditis.

Keywords: Right-sided endocarditis; Right- and left-sided endocarditis; Surgery; Tricuspid valve reconstruction; Tricuspid valve replacement

1. Introduction

Since the first clinical description in 1855 by Sir William Osler, who presented three Gulstonian Lectures on the topic of malignant endocarditis [1], both the spectrum of causative organisms and the patients affected have changed [2]. New groups at risk of endocarditis have emerged, for example the increasingly aging population with heart valve sclerosis, patients with prosthetic valves, those exposed to nosocomial infections, hemodialysis patients and intravenous drug abusers [3,4].

While left heart endocarditis is reported to have a median incidence of 3.6/100,000 population per year, with an increase in patients over 65 years old to 15.0/100,000 per year and a male to female ratio of 2:1, right-sided infective endocarditis (RSE) represents maximally 5–10% of all cases of endocarditis [5].

These developments and figures reflect our experience of continuing high numbers of patients who have to be operated on for infective endocarditis each year: since April 1986 to April 2006 a total of 1714 operations had to be performed in 1596 endocarditis patients at the Deutsches Herzzentrum Berlin, 80.2% (n = 1375) procedures for native valve endocarditis and 19.8% (n = 339) for prosthetic valve endocarditis. In our patient population, endocarditis affecting the right
heart account for 4.9% of all endocarditis patients operated upon at our institution.

RSE may occur in connection with congenital heart defects, right heart catheterization, alcoholism and sepsis, but, at least in western populations, it is predominantly a disease of intravenous drug abusers [6]. In many cities with large numbers of intravenous drug addicts and homeless people with reduced resistance to infection, RSE caused by *Staphylococcus aureus* is the main form of the disease [7].

Because isolated RSE without left-sided involvement is generally regarded as having a relatively benign prognosis with low in-hospital mortality the primary approach in RSE patients should be conservative. Most patients can be treated medically, with surgery being necessary in only a small minority of cases [8].

Indications for surgical treatment are better defined for left than for right-sided endocarditis. Uncontrolled sepsis, fever persisting for more than 3 weeks of adequate antibiotic treatment and intractable right heart failure despite appropriate medical treatment, are the most important indications for surgical intervention. Following the European Society for Cardiology (ESC) which 2 years ago published guidelines on the treatment of AIE surgery for RSE is also necessary if tricuspid vegetations are larger than 20 mm after appropriate medical treatment, are the most important indications for surgical intervention. Following the European Society for Cardiology (ESC) which 2 years ago published guidelines on the treatment of AIE surgery for RSE is also necessary if tricuspid vegetations are larger than 20 mm after recurrent pulmonary embolism [9].

The aim of this paper is to review the 20-year experience of surgical treatment of right-sided infective endocarditis at the Deutsches Herzzentrum Berlin, and in particular to compare the outcome of isolated RSE to RSE with involvement of the left heart.

2. Clinical material and methods

2.1. Patient population

Between April 1986 and April 2006, 84 operations had to be performed in 79 patients (49 men, 30 women, median age 43.5 years, mean age 44.3 years, range 12–82 years) due to persisting fever, intractable right heart failure, uncontrollable sepsis or large vegetations. There were 72 (85.7%) cases of native and 12 (14.3%) of prosthetic valve endocarditis (Table 1). In 57 (67.9%) cases operation was for isolated right-sided endocarditis (RSE) and in 27 (32.1%) cases both right and left sides of the heart were operated upon due to combined right- and left-sided endocarditis (RLSE).

In the RSE group, known predisposing factors leading to endocarditis were drug abuses (*n* = 19), pacemaker infection (*n* = 7), right-heart catheterization (*n* = 3), congenital heart defects (*n* = 8), systemic infection (*n* = 6) and dialysis (*n* = 3).

In the RLSE group, 8 out of 27 patients (29.6%) developed right-sided valve involvement before left-sided involvement. Follow-up was completed in all 91% of survivors by telephone contact with the patient, by analysis of standardised mail questionnaires which were sent to the patients, by analyzing the population registry and by contacting peripheral hospitals.

The median follow-up time at 448 patient years was 3.59 years (range 6 months–19.27 years).

An overview of the patient population is given in Table 1.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Patient population (Demographic and clinical characteristics of patients with isolated RSE or combined RLSE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Period (April 1986–April 2006) Isolated RSE Combined RLSE p-value</td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>32</td>
</tr>
<tr>
<td>Women</td>
<td>20</td>
</tr>
<tr>
<td>Total patients</td>
<td>52</td>
</tr>
<tr>
<td>Mean age</td>
<td>38.2 ± 2.44</td>
</tr>
<tr>
<td>Native AIE</td>
<td>49</td>
</tr>
<tr>
<td>Prosthetic AIE</td>
<td>8</td>
</tr>
<tr>
<td>Total cases</td>
<td>57</td>
</tr>
<tr>
<td>IVDU</td>
<td>19</td>
</tr>
<tr>
<td>HIV+</td>
<td>2</td>
</tr>
<tr>
<td>Operation performed as Elective</td>
<td>26</td>
</tr>
<tr>
<td>Urgent</td>
<td>28</td>
</tr>
<tr>
<td>Emergency</td>
<td>3</td>
</tr>
<tr>
<td>Preoperative status Intubation</td>
<td>6</td>
</tr>
<tr>
<td>Septic shock</td>
<td>4</td>
</tr>
<tr>
<td>High-dose catecholamines</td>
<td>2</td>
</tr>
<tr>
<td>Renal insufficiency</td>
<td>14</td>
</tr>
<tr>
<td>Fever</td>
<td>18</td>
</tr>
<tr>
<td>Abscess</td>
<td>–</td>
</tr>
<tr>
<td>Tricuspid</td>
<td>1</td>
</tr>
<tr>
<td>Aortic</td>
<td>6</td>
</tr>
<tr>
<td>Mitral</td>
<td>3</td>
</tr>
<tr>
<td>Microbiological epidemiology Staphylococci</td>
<td>30 (65.2%)</td>
</tr>
<tr>
<td>St. aureus</td>
<td>25</td>
</tr>
<tr>
<td>St. coag. neg</td>
<td>2</td>
</tr>
<tr>
<td>Others</td>
<td>3</td>
</tr>
<tr>
<td>Streptococci</td>
<td>11 (23.9%)</td>
</tr>
<tr>
<td>Str. General</td>
<td>8</td>
</tr>
<tr>
<td>Str. Viridans</td>
<td>3</td>
</tr>
<tr>
<td>Str. β-hämoly</td>
<td>–</td>
</tr>
<tr>
<td>Enterococcus</td>
<td>1 (2.2%)</td>
</tr>
<tr>
<td>Culture negative</td>
<td>4 (8.7%)</td>
</tr>
<tr>
<td>Others</td>
<td>–</td>
</tr>
</tbody>
</table>

RSE: right-sided endocarditis; RLSE: right- and left-sided endocarditis; AIE: active infective endocarditis; IVDU: intravenous drug abuse. Data are absolute values.

2.2. Operations performed

Of the 57 operations performed due to isolated RSE, there were 51 procedures for isolated tricuspid valve endocarditis with 20 tricuspid valve replacement (*n* = 17 biological prosthesis, *n* = 3 mechanical prosthesis) and 31 tricuspid valve reconstructions following vegetectomy (Fig. 1). Four procedures were performed due to isolated pulmonary valve endocarditis with three cases of pulmonary valve replacement (*n* = 2 homografts, *n* = 1 Shelhigh®) and one pulmonary valve reconstruction following vegetectomy. There were two procedures due to combined tricuspid and pulmonary valve endocarditis with tricuspid and pulmonary valve reconstruction in one case and tricuspid valve reconstruction and pulmonary valve replacement in the other.

An overview of the operations performed for isolated RSE is given in Fig. 1.
The 27 operations performed due to combined RLSE can be classified into three subgroups (Fig. 2):

1. Right- and left-sided valve replacements \((n = 18)\),
2. Right-sided valve reconstruction with left-sided valve replacement \((n = 8)\) and
3. Right- and left-sided valve reconstruction \((n = 1)\).

In the first subgroup, there were 11 tricuspid valve replacements combined with aortic valve \((n = 4)\), mitral valve \((n = 5)\) or aortic and mitral valve replacement \((n = 2)\) and 7 pulmonary valve replacements combined with aortic valve \((n = 4)\), mitral valve \((n = 2)\) or aortic and mitral valve replacement \((n = 1)\).

In the second subgroup, there were 8 tricuspid valve reconstructions combined with aortic valve \((n = 3)\), aortic conduit \((n = 2)\), mitral valve \((n = 1)\) or aortic and mitral valve replacement \((n = 2)\).

In the third subgroup, there was one tricuspid valve reconstruction combined with reconstruction of the mitral valve.

The details of the operations performed for combined RLSE are given in Fig. 2.

2.3. Surgical strategy for active infective endocarditis

Our surgical strategy for active infective endocarditis is based on three principles:

1. Intensive debridement of the infected area or if the infected process is localized on the valve, vegetectomy followed by intensive irrigation with polyvidon–iodine solution of the infected area. Excision of a vegetation alone is limited to patients with well-circumscribed vegetation in an otherwise normal valve.
2. Whenever possible valve repair with homologous or autologous pericardium is attempted avoiding artificial material. Monofilament sutures reinforced with horse pericardium and preserved in polyvidon–iodine solution are used.

Fig. 3a–c shows the operative techniques for tricuspid valve reconstruction: after vegetectomy or excision of the perforated leaflet (Fig. 3a) the defect is closed directly or with a pericardial patch (Fig. 3b). To ensure leaflet coaptation, annuloplasty with pericardium is performed (Fig. 3c).
(3) If valve replacement is unavoidable because of extensive endocarditic destruction of the valve a biological substitute without any artificial material on the surface that might become infected is used, the best option being in our opinion either the homograft, which we used in aortic or pulmonary position or the Shelhigh® bioprosthesis, which is our bioprosthesis of choice for endocarditis over the last 6 years.

2.4. Definition of active infective endocarditis

Active infective endocarditis (IE) was defined on the basis of vegetations or abscess formation shown in the echocardiogram and accompanied by positive blood cultures or intraoperatively harvested valve cultures, on the basis of clinical evidence of persistent sepsis or recurrent septic embolism or on the basis of the intraoperative diagnosis.

2.5. Statistical analysis

Actuarial survival rate and freedom from reoperation was calculated by the Kaplan—Meier method and the log rank test used for statistical evaluation. Risk factors of events during follow-up were identified by univariate logistic regression analysis. Differences between reinfection rate in patients with and without drug abuse were calculated by using Pearson χ²-test. Limitation of the statistical analysis is that due to the low number of events no multivariate analysis could be performed.

3. Results

3.1. Demographic and clinical characteristics of patients with isolated RSE or combined RLSE

The demographic and clinical characteristics of patients with isolated RSE or combined RLSE are listed in Table 1.

Comparing the two groups in statistical analysis there were no difference in gender, incidence of native or prosthetic endocarditis or the rate of HIV+ or IVDU patients whereas the group of patients with isolated RSE had a tendency to be younger and showed numerous more injection drug users. In our series, the prevalence of IVDU was 32.9%.

The following statistically significant differences were found:

(1) Patients with combined RLSE more often underwent emergency operations than RSE patients, who were more often operated on electively (p < 0.001).

(2) More patients with combined RLSE preoperatively were on high-dose catecholamines (p < 0.006) with a nonsignificant tendency towards septic shock and renal insufficiency.

(3) Intraoperatively patients with combined RLSE showed abscess formation in the tricuspid (n = 1), aortic (n = 6) and mitral (n = 3) position in contrast to isolated RSE patients, who showed no abscess formation (p < 0.001).

In the isolated RSE group, infection caused by Staphylococci was nearly three times higher than infection caused by Streptococci. Staphylococcal infection occurred in 65.2% of the known cases followed by Streptococci (23.9%), culture-negative (8.6%) and Enterococcal infection (2.1%). In this group, the main infectious agent was St. aureus in 54% of the cases. In comparison, in the combined RLSE group Staphylococcal infection (41.6) was nearly five times higher than infection caused by Streptococci (8.3%) with St. aureus as the main infectious agent in 37.5% of the cases. The second main infectious agents were Enterococci (25%) followed by culture-negative infection (16.6%). Statistical analysis showed a significant difference in the incidence of Enterococcal infection in the combined RLSE group compared with the isolated RSE group (p = 0.002).

3.2. Survival

The survival curves for the whole study population and the comparison between the isolated RSE and the combined RLSE group is given in Fig. 4.

The 30-day, 1-, 5-, 10- and 20-year survival for the whole study population was 88.3%, 81.7%, 66.5%, 59.4% and 49.7%, respectively. We found a highly significant difference between the survival rates of patients who were operated on due to isolated RSE and those who had to be operated on due to combined RLSE: the 30-day, 1-, 5-, 10- and 20-year survival rate after isolated RSE operation was 96.2%, 88.4%, 72.0%, 67.8%, 67.8%, 50.8%, 35.6% and 35.6% after operation for combined RLSE (p = 0.0093). Analysis of the survival curve shows a particularly clear difference between the two groups in the first 30 days and between 1 and 5 years.

Main Causes of early death for the RSE group were septic multiorgan failure (n = 2), myocardial failure (n = 1) and hemorrhagic shock (n = 1), for the combined RLSE group
septic multiorgan failure \( n = 3 \), myocardial failure \( n = 3 \) and cerebral bleeding \( n = 1 \), respectively.

### 3.3. Tricuspid valve replacement versus tricuspid valve reconstruction

There was no significant difference between the survival rates of patients after tricuspid valve replacement compared to those with tricuspid valve reconstruction (Fig. 5): the 30-day, 1-, 5-, 10- and 20-year survival rate after reconstruction was 88.7%, 81.1%, 68.1%, 68.1% and 57.6%, respectively, in comparison to 87.5%, 83.1%, 62.2%, 20.0% and 20.0% after replacement \( (p = 0.43) \). Analysis of the survival curves shows a tendency towards better survival following tricuspid valve reconstruction in comparison to the tricuspid valve replacement group in which there is a sudden drop in the survival curve between 7 and 10 years, however in this time frame there are only seven patients remaining.

### 3.4. Freedom from reoperation due to reinfection

Six patients had to be reoperated upon due to reinfection, two in the isolated RSE and four in the combined RLSE group. Of these patients, only one from the RSE group survived the reoperation the other five died due to septic multiorgan failure in the early postoperative course.

In the isolated RSE group, both patients were drug addicts (one male, 30 years; one female, 24 years) and had tricuspid valve reconstruction. They showed freedom from reoperation after tricuspid valve reconstruction of 3058 and 922 days. Both patients had a reinfection directly related to their iv-drug abuse. In the reoperation, in both cases tricuspid valve replacement was performed with a Shelhigh \(^ \text{\textregistered} \) bioprosthesis. One patient survived, the other had to be re-reoperated upon due to thrombosis of the valve caused by endocarditis and died in septic multiorgan failure on the 16th pod.

In the combined RLSE group, there were three male (one drug addict) and one female patient, who was drug addict. Two of them showed early (17 and 123 days) and two of them late reinfection (190 and 454 days) after either aortic or mitral valve and tricuspid valve replacement due to endocarditis. Two of these patients were operated on externally and were referred to our institution in decompensated status for ultima ratio therapy. One of these patients had been operated on three times before and developed recurrence of endocarditis after Ross operation.

![Fig. 4. Survival curves for the whole study population and comparison between the isolated RSE and combined RLSE group. RSE: right-sided endocarditis; RLSE: right and left-sided endocarditis.](image-url)

![Fig. 5. Survival for tricuspid valve reconstruction versus replacement.](image-url)
Freedom from reoperation at 30 days, 1-, 5-, 10- and 20-year was 97.4%, 95.9%, 92.2%, 88.6% and 88.6%, respectively (Fig. 6).

Comparing the reinfection rate subject to drug abuse we found a highly significant difference towards IVDU ($p < 0.0001$; Pearson $\chi^2$-test), but the low number of patients has to be taken into consideration.

### 3.5. Risk factors for early mortality

The risk factors for early mortality in the univariate logistic regression analysis are given in Table 2. Statistically significant risk factors for early mortality were priority of surgery with a odds ratio of 5.13, age and age over 40 years (OR 1.04 and 3.24) and involvement of the left side of the heart (OR 2.54). Patients developing abscess formation showed a nonsignificant trend ($p = 0.09$) towards higher mortality with odds ratio of 2.33. Tricuspid valve reconstruction versus replacement (OR 1.7), gender, injection drug abuses and *Staphylococcus* infection (OR 0.81) had no statistically significant influence on early mortality.

![Fig. 6. Freedom from reoperation due to reinfection.](image)

### Table 2

<table>
<thead>
<tr>
<th>Risk factors for early mortality in the univariate logistic regression analysis</th>
<th>Odds ratio</th>
<th>95% CI</th>
<th>$p$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priority of surgery (elective-urgent-emergency)</td>
<td>5.13</td>
<td>1.77–15.03</td>
<td><strong>0.003</strong></td>
</tr>
<tr>
<td>Age 40 years</td>
<td>3.24</td>
<td>1.52–6.89</td>
<td><strong>0.009</strong></td>
</tr>
<tr>
<td>Age</td>
<td>1.04</td>
<td>1.02–1.06</td>
<td><strong>0.001</strong></td>
</tr>
<tr>
<td>Involvement of left heart</td>
<td>2.54</td>
<td>1.23–5.28</td>
<td><strong>0.012</strong></td>
</tr>
<tr>
<td>Abscess</td>
<td>2.33</td>
<td>0.88–6.18</td>
<td>0.09</td>
</tr>
<tr>
<td>Tricuspid valve reconstruction versus replacement</td>
<td>1.70</td>
<td>0.79–3.67</td>
<td>0.174</td>
</tr>
<tr>
<td>Gender</td>
<td>1.32</td>
<td>0.61–2.85</td>
<td>0.477</td>
</tr>
<tr>
<td><em>S. aureus</em></td>
<td>0.81</td>
<td>0.39–1.69</td>
<td>0.57</td>
</tr>
</tbody>
</table>

To our knowledge, our study presents for the first time in literature 20-year results in a group of high-risk patients with isolated right-sided endocarditis, compared to patients with right and left-sided involvement. It is shown that surgical treatment of right-sided active infective endocarditis (IE) with or without involvement of the left heart can be performed with good early, mid-term, and long-term results. RSE patients with involvement of the left side showed not only worse preoperative condition but also a significantly poorer clinical outcome than those with isolated right-sided IE. In our study patients with RLSE preoperatively tended towards septic shock and renal insufficiency and significantly more of them were on high-dose catecholamines (22.2% vs 3.8%) compared to patients with RSE. Additionally, they more often had to undergo emergency operations due to worsening conditions (40.7%, vs 5.7%). Each of these factors increases the clinical variability and complexity of IE and could be a possible explanation for the different outcomes between the groups. It is noteworthy, that in the hospital period may not be an appropriate time frame to evaluate the mortality rate and clinical outcome of surgery in IE and that the benefit may be seen in the long-term follow-up [10]. Additionally, we found in our series that 29.6% of these patients intraoperatively showed abscess formation primarily in aortic and followed by mitral and tricuspid position with a nonsignificant trend towards higher mortality, whereas no abscess was found in the isolated RSE group. These results are consistent with the known increase in morbidity and mortality of left-sided endocarditis as compared to right IE, and the increase of mortality in IE complicated by abscess formation [12]. However, it has to be mentioned that this factor did not achieve statistical significance in our study, probably due to insufficient sample size. For the risk stratification in our study it has to be taken into consideration that our hospital is a referral surgical center receiving patients who have already been treated medically externally and sometimes coming too late for an operation as ultima ratio therapy. We found priority of surgery, age, and involvement of the left heart to be independent risk factors for early mortality and this not only reflects the aggressive nature of the disease but also shows that a large number of patients are referred too late for operation. These results accord with data from the Euro heart survey published in 2005 [13–15].

In our opinion, three basic principles are important for the successful surgical treatment of IE, in addition to appropriate valve selection and prompt operation. (1) Aggressive and extensive debridement to prevent further access of the infection to the circulation or, if the infection is localized on the valve, vegetectomy can be performed. (2) The correction of defects that have developed, such as fistulas or abscess cavities, with homologous or autologous pericardial patches. (3) Whenever possible valve repair with homologous or autologous pericardium is attempted, avoiding artificial material. Especially for tricuspid valve reconstruction we always perform annuloplasty reinforced with pericardium to ensure leaflet coaptation. If valve replacement is necessary we avoid the use of mechanical prostheses and use as little foreign material as possible in the infected area. Following these principles, we found in this series satisfactory long-
term results regarding freedom from reoperation due to reinfection, as already published [16—18]. The third point is a matter of controversial discussion in the literature. In the study by Moon et al. [19] of patients with native and prosthetic endocarditis, published in 2001, the operative mortality, the survival rate, and the rate of freedom from reoperation were independent of whether a mechanical or a biological valve was implanted.

Although the majority of cases of tricuspid valve endocarditis can be treated conservatively with antibiotic therapy [8], if surgery is necessary several surgical options with the goal of eradication of the infection and hemodynamic correction are discussed in the literature [3]. The surgical options for endocarditis of the tricuspid valve include vegetectomy and repair, replacement or excision. Excision has the advantage that it can be performed quickly in the beating heart in patients with severe sepsis who may be unable to tolerate prolonged periods of cardiopulmonary bypass, although the complication of right-sided heart failure can be deleterious [20]. Tricuspid valve replacement is a matter of controversy, with regard to hemodynamics, long-term prognosis, valve choice and reinfection of the implanted prosthesis [22,23]. Vegetectomy and tricuspid valve reconstruction enable eradication of the infection without implantation of prosthetic material and are a suitable treatment for tricuspid valve endocarditis with well circumscribed vegetations or localized infection of the valve, reducing the incidence of right-sided failure and improving the long-term functional status compared to valve excision. The published studies concord with the results in our series which indeed showed a tendency towards better survival following tricuspid valve reconstruction although this was not statistically significant compared to the tricuspid replacement group [21].

St. aureus infective endocarditis (IE) is associated with high morbidity and mortality and a more severe prognosis compared with IE caused by other pathogens [24]. In a prospective study from Finland published this year, in which right-sided endocarditis was observed in 60% of IVDU patients whereas 93% of nonaddicts had left-sided involvement, St. aureus in IVDU patients was associated with a high complication rate but there was no difference in early mortality between the groups and injection drug abuse was not significantly associated with mortality [25]. These results concord with our series in which 33% of patients (n = 26) were drug addicts with 73% of them (n = 19) having isolated RSE and 27% (n = 7) having left-sided involvement, which is similar to the figures given in other published series of IVDU patients [4,6]. The distribution of isolates find in our study was consistent with that found in the literature. The group of patients with isolated RSE had a tendency to be younger and included numerous many more injection drug users. In both groups, St. aureus was the main infectious agent of endocarditis but injection drug abuse and Staphylococcus infection had no statistically significant influence on early mortality after surgery, as reported previously [7].

4.1. Study limitations

The present study is retrospective. Clinical endpoints such as exercise capacity and echocardiographic hemodynamic control could not be assessed. There is a natural bias in the clinical assessment of the patient groups. Despite these limitations the present study represents a unique attempt to collect and analyze a single-center experience in the surgical treatment of isolated RSE or combined RSE over a period of 20 years.

5. Conclusions

Surgical treatment of right-sided active infective endocarditis with or without involvement of the left heart can be performed with good early, mid-term and long-term results whereas patients with involvement of the left side showed not only worse preoperative condition but also a significantly poorer clinical outcome than those with isolated right-sided IE.

In our experience, by following the surgical strategy of minimizing foreign material in the infected field the clinical results achieved, in particular the reinfection rate, are very good.

Analysis of the survival curves and risk factors for early mortality not only reflects the aggressive nature of the disease but also shows that a large number of patients seem to be referred too late for operation.

The clinical variability and complexity of IE makes standardization and comparison of patients difficult and also leads to the necessity of individualized, patient-tailored assessment and therapy.

Acknowledgements

We thank Mrs S. Kosky for her great help with data acquisition, Mrs A. Benhennour for bibliographic assistance, Mrs K. Weber for her photographic work, Mrs J. Stein for her statistical work and Mrs A. Gale for her editorial assistance.

References


Dr P. Kolh (Liege, Belgium): I would like to ask you two short questions. The first one is, if I remember correctly, you showed us that about a third of the patients had endocarditis from IV drug abuse. Do you have information about the other causes of endocarditis, I mean, what was more common? And second, if you have any insight on hemodynamic data in the short or late hemodynamic period after reconstruction?

Dr Musci: We have no data for the IV drug abuse patients. I can only say that these patients are high-risk patients and very difficult to follow-up.

Dr Kolh: The question was the other etiology besides IV drug abuse for endocarditis.

Dr Musci: 60–70% of them had right-sided catheter cannulation infection and 20% of patients had hospital acquired infection. So it was like the predisposing factor slide which I showed you.

And the second question, the hemodynamic data, is still being researched.

Dr K. Kie (Puchon, South Korea): How many cases of rhythm disturbance were there in the postoperative course in your cohort, and second is, do you think there is any relationship between surgical aggressiveness and post-operative rhythm disturbance?

Dr Musci: I didn’t catch your first question. I’m sorry.

Dr Yie: The first question is how many cases of rhythm disturbances occurred in your cohort?

Dr Musci: There were about 10% of patients who had disturbances, not more, and postoperatively we did a study about how many patients had sinus rhythm. It was over 90%.

The second question?

Dr Yie: The second question is do you think there is any relationship between the surgical aggressiveness and the postoperative rhythm disturbances?

Dr Musci: If you have a large abscess formation and you have to be very aggressive and you have to remove a great deal of tissue, you will have a lot of disturbances. But you have to be aggressive in this surgery. You can’t leave any residual defects. So you have to take into account that you will have some disturbance, yes. It depends if you have abscess formation or if you have only endocarditis of the leaflet.

Dr G. Economopoulos (Athens, Greece): I have actually two questions for you. The first question is the drug abusers. It is a problem that we have seen in all big cities. And my question to you is, I think you should follow them more stringently. If you have a drug abuser whose likelihood of dropping the habit is very, very small, would you consider going in and putting an artificial valve in him, because personally I have seen a lot of them coming back with recurrent prosthetic valve endocarditis in worse shape than the first time.

The second question goes to, if you have a combined mitral and tricuspid valve endocarditis in a young patient and you do everything that you possibly could to save the mitral valve but despite that you have to replace it now, would you still put a prosthetic mitral valve, a mechanical valve having a biological valve in the tricuspid position or the type of valve that you are going to put in the mitral position will affect the decision about the type of tricuspid valve replacement?

Dr Musci: At our institution we have a clear position on these two questions. The first one, we would operate on every patient and we would perform tricuspid reconstruction if possible. If not possible, we only would use a biological substitute, no prosthetic. We don’t use any prosthetic valves right now in our institution for any kind of endocarditis.

The second one, if we have to perform mitral valve replacement, we would also try to reconstruct if possible. If not, we would only use a biological substitute. We don’t use any prosthetic substitutes for endocarditis.

Dr G. Knyshev (Kiev, Ukraine): How many patients do you have as a drug addict with diseases of the tricuspid valve, because in our institute last year it is more and more patients with tricuspid diseases, it is that addicted patient.

Dr Musci: I have only this small series I can show you, with about 30% of IV drug abusers.