Infected Cardiac Myxoma: an Updated Review

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Abstract

Objective: This study aims to present an updated clinical picture of the infected cardiac myxoma. Revankar & Clark made a systematic review of infected cardiac myxoma based on the literature before 1998. Since then, there has not been any updated information describing its recent changing trends.

Methods: A comprehensive literature search of infected cardiac myxoma was conducted on MEDLINE, Highwire Press and Google between 1998 and 2014.

Results: In comparison with Revankar & Clark’s series, the present series disclosed a significantly decreased overall mortality. It is believed that refinement of the prompt diagnosis and timely management (use of sensitive antibiotics and surgical resection of the infected myxoma) have resulted in better outcomes of such patients.

Conclusion: The present series of infected cardiac myxoma illustrated some aggravated clinical manifestations (relative more occasions of high-grade fever, multiple embolic events and the presence of refractory microorganisms), which should draw enough attention to careful diagnosis and treatment. In general, the prognosis of infected cardiac myxoma is relatively benign and the long-term survival is always promising.

Keywords: Embolism. Infection. Myxoma.

INTRODUCTION

Cardiac myxomas are rare. The classical clinical manifestations of cardiac myxomas can be a triad with constitutional, obstructive and embolic symptoms[1]. The infected cardiac myxoma is a very rare condition with only sporadic cases reported in the literature. In 1998, Revankar & Clark[2] presented a complete literature collection of infected cardiac myxoma with a total of 40 cases, with detailed descriptions of the clinical features of this rare condition. They found no clear distinction between infected and uninfected cardiac myxomas, however, the infected myxomas are associated with more febrile symptoms and a higher risk of embolic events. In order to highlight the recent trends of infected cardiac myxoma, an updated review is made based on a renewed literature collection.

METHODS

A comprehensive literature search was conducted on MEDLINE, Highwire Press and Google between 1998 and 2014. The search terms included “myxoma”, “heart”, “heart valve”, “endocarditis”, “infected”, “bacteremia”, “blood culture” and “sepsis”. Data were extracted from the text, figures and tables, with details of the study population, demographics, onset symptom, duration of disease, risk factor, complication, microorganism, antibiotic use and surgical treatment, timing of surgical operation, follow-up duration and main outcomes including survival, postoperative complication, requirement of further surgical procedure and mortality.
Table 1. Summary of 39 patients with infected cardiac myxoma.

| Serial N° | Year  | Author          | Sex | Age | Microorganism                                | Diagnostic means | Location of myxoma | Operation | Outcome |
|-----------|-------|-----------------|-----|-----|----------------------------------------------|------------------|--------------------|-----------|---------|
| 1         | 2011  | Adamira F       | F   | 58  | Staphylococcus & Enterococcus faecalis       | TTE, TEE         | LA×2               | Yes       | Survived |
| 2         | 2006  | Awab M          | M   | 58  | Histoplasma capsulatum                       | TTE              | LA                 | Yes       | Survived |
| 3         | 2011  | Belgi Yıldırım M| M   | 47  | Streptococcus viridans                       | TTE              | LA                 | Yes       | Survived |
| 4         | 2010  | Bhanot M        | M   | 54  | Staphylococcus lugdunensis                   | CT, TEE          | LA                 | Yes       | Survived |
| 5         | 2001  | Brazill M       | M   | 52  | Streptococci viridans                       | TTE, TEE         | LA                 | Yes       | Survived |
| 6         | 2007  | Chan M          | M   | 44  | Streptococcus viridans                       | TTE              | RV                 | Yes       | Survived |
| 7         | 2011  | Chang M         | M   | 49  | Streptococcus bovis                         | TTE, TEE         | LA                 | Yes       | Survived |
| 8         | 2001  | Dekkers M       | M   | 40  | Streptococcus mutans                        | TTE, TEE         | LA                 | Yes       | Survived |
| 9         | 2008  | Falasca F       | F   | 63  | Staphylococcus spp                          | TTE              | LA                 | Yes       | Survived |
| 10        | 2013  | Furukawa M      | M   | 62  | Streptococcus agalactiae                    | TTE, TEE         | LA                 | Yes       | Survived |
| 11        | 2005  | García-Quintana F| F | 58  | Streptococcus oralis                        | TTE              | LA                 | Yes       | Survived |
| 12        | 2004  | Gregory M       | M   | 43  | MSSA                                         | TTE (+), TEE (+) | LA                 | Yes       | Survived |
| 13        | 2007  | Guler F         | F   | 12  | MSSA                                         | TTE              | MV (AML)           | Yes       | Survived |
| 14        | 2008  | Janion M        | M   | 67  | MRSA                                         | TTE              | LA                 | Yes       | Survived |
| 15        | 2005  | Juang M         | M   | 42  | G-positive cocci                             | TEE              | LA                 | Yes       | Survived |
| 16        | 2004  | Karachalios M   | M   | 55  | Streptococcus viridans                       | TTE              | LA                 | Yes       | Survived |
| 17        | 2007  | Leone F         | F   | 74  | Enterococcus faecalis                       | TTE              | LA                 | Yes       | Survived |
| 18        | 2013  | Nagata M        | M   | 66  | Streptococcus mitis                         | TEE              | LA                 | Yes       | Survived |
| 19        | 2001  | Oyama M         | M   | 57  | MRSA                                         | TTE              | LA                 | Yes       | Survived |
| 20        | 2004  | Parks M         | M   | 36  | Staphylococcus aureus (oxacillin-resistant) (ORSA) | TTE              | RA                 | Yes       | Survived |
| 21        | 2002  | Prince F        | F   | 12  | Streptococcus viridans                       | TTE              | LA                 | Yes       | Survived |
| 22        | 2001  | Puvaneswary M   | M   | 50  | Streptococcus viridans & Streptococcus salivarius | TTE (+), TEE (+) | RA                 | Yes       | Survived |
| 23        | 2006  | Quigley M       | M   | 55  | Streptococcus mutans                        | TEE              | LA                 | Yes       | Survived |
| 24        | 2005  | Riad M          | M   | 36  | MRSA                                         | TTE              | RA                 | Yes       | Survived |
| 25        | 2010  | Sasaki M        | M   | 69  | Klebsiella pneumoniae                        | TEE              | LA                 | Yes       | Survived |
| 26        | 2010  | Surovcík F      | F   | 59  | Enterococcus faecalis                       | TTE, TEE, CT     | LA                 | Yes       | Survived |
| 27        | 2002  | Tanaka F        | F   | 70  | Enterococcus faecalis                       | TEE              | LA                 | Yes       | Survived |
| 28        | 1999  | Toda M          | M   | 20  | Bacterial colonies                          | TTE              | MV (PML, posterior commissure) | Yes       | Survived |
| 29        | 2009  | Trimeche F      | F   | 46  | MSSA                                         | TTE, TEE         | LA                 | NG        | Died     |
| 30        | 2002  | Uchino F        | F   | 47  | Streptococcus bovis                         | TTE              | LA                 | NG        | Survived |
| 31        | 2006  | Veitch F        | F   | 35  | Staphylococcus aureus                       | TTE, TEE         | MV (AML)           | Yes       | Survived |
| 32        | 2011  | Yoshioka M      | M   | 52  | MSSA                                         | TTE              | LA                 | Yes       | Survived |
| 33        | 2006  | Zechini M       | M   | 55  | Catalase-negative microorganisms (G-positive cocci by staining) | TTE, TEE         | LA                 | NG        | Survived |
| 34        | 2013  | Zwinkels ?       |     |     | Streptococcus (Group C)                    | TTE, cardiac CT angiogram | RA       | Yes       | Survived |

to be continued
Risk factors

Recent dental problem 3 (7.7) 9 (22) 3.4 0.115
Dental surgery 1
Reconstructive dental procedures; coronary catheterization and angioplasty 2 years earlier 1
Dental decay 1
Recent infection 4 (10.3) 4 (10) 0.0 1.000
Achilles tendon infection 2
Urinary tract infection 1
Cellulitis, web-space abscess of hand 1
Invasive procedure 4 (10.3) 2 (5) 0.8 0.432
Umbilical hernia repair 1
Amputation above knee for intractable osteomyelitis 1
Multiple surgery, closed trauma of the left knee 1
Acupuncture for weight reduction 1
Immunocompromised condition 5 (12.8) 3 (7.5) 0.6 0.481
Intravenous drug use, hepatitis C infection 2
Diabetes mellitus 1
Breast cancer (surgery, radiotherapy, chemotherapy), pharyngitis 1
Traveled to Mexico 3 months before, patent fossa ovalis 1

Total 16 (41.0) 18 (45) 0.1 0.821

Clinical features

The onset symptoms and signs of the 37 patients (2 patients’ symptoms were not reported) with infected cardiac myxoma were listed in Table 3. Fever was the most common symptom accounting for 97.3% of all cases. The fever nature was persistent in 2 (5.6%), recurrent in 1 (2.8%), intermittent in 1 (2.8%) and with a fever of unknown origin in 3 (8.3%) patients. In general, constitutional symptoms were more frequent than obstructive or neurological symptoms. The duration of symptoms before admission was 1.6±1.7 (range, 0.1-6; median, 1) months (n=21).
Laboratory findings showed that leukocyte count was elevated in 20 patients (76.9%) and normal in 6 (23.1%) patients ($x^2=15.1, P=0.000$) with a quantitative result of $15.7\pm7.3$ (range, 4.9-33.6; median, 15.2) ×10^9/L ($n=26$). Hemoglobin was reduced indicating a mild anemia in 13 (92.9%) patients and normal in 1 (7.1%) patient ($x^2=20.6, P=0.000$) with a quantitative result of $10.4\pm1.3$ (range, 9-13.7; median, 10.8) g/dL ($n=14$). Erythrocyte sedimentation rate and C-reactive protein were elevated in all studied cases: erythrocyte sedimentation rate was $83.3\pm28.4$ (range, 37-124; median, 83) mm/h ($n=15$) and C-reactive protein was $15.8\pm10.5$ (range, 3-39.9; median, 13.2) mg/dL ($n=17$). Microscopic hematuria was present in 2 (5.4%) patients.

### Table 3. Onset symptoms and signs of the patients with infected cardiac myxoma.

| Feature                        | Present | Revankar & Clark’s | $x^2$ | $P$ value |
|--------------------------------|---------|--------------------|-------|-----------|
| **Symptom**                    |         |                    |       |           |
| Fever                          | 36 (97.3) | 37 (92)            | 0.9   | 0.616     |
| Embolic events                 | 10 (27.0) | 5 (12)             | 2.6   | 0.151     |
| Weight loss                    | 9 (24.3) | 13 (32)            | 0.6   | 0.460     |
| Dyspnea                        | 8 (21.6)  | 3 (8)              | 3.1   | 0.106     |
| Fatigue                        | 8 (21.6)  | 11 (28)            | 0.4   | 0.605     |
| Neurologic symptoms            | 7 (18.9)  | 8 (20)             | 0.0   | 1.000     |
| Malaise                        | 6 (16.2)  | 11 (28)            | 1.4   | 0.279     |
| Rigor/shivers/chills           | 6 (16.2)  | 11 (28)            | 1.4   | 0.279     |
| Night sweat                    | 5 (13.5)  | 11 (28)            | 2.3   | 0.165     |
| Weakness                       | 3 (8.1)   | 5 (12)             | 0.4   | 0.713     |
| Abdominal pain                 | 3 (8.1)   | 3 (8)              | 0.0   | 1.000     |
| Anorexia                       | 3 (8.1)   |                    | 3.4   | 0.106     |
| Edemas                         | 3 (8.1)   |                    | 3.4   | 0.106     |
| Chest pain/distress            | 2 (5.4)   |                    | 2.2   | 0.228     |
| Cough                          | 2 (5.4)   | 4 (10)             | 0.6   | 0.676     |
| Nausea/vomiting                | 2 (5.4)   | 1 (2)              | 0.4   | 0.605     |
| Headache                       | 1 (2.7)   | 4 (10)             | 1.7   | 0.360     |
| Arm pain                       | 1 (2.7)   |                    | 1.1   | 0.481     |
| Arthralgia                     | 1 (2.7)   | 6 (15)             | 3.5   | 0.110     |
| Diarrhea                       | 1 (2.7)   | 3 (8)              | 0.9   | 0.616     |
| Hemoptysis                     | 1 (2.7)   |                    | 1.1   | 0.481     |
| Jaundice                       | 1 (2.7)   |                    | 1.1   | 0.481     |
| Lethargy                       | 1 (2.7)   |                    | 1.1   | 0.481     |
| Back pain                      | 1 (2.7)   |                    | 1.1   | 0.481     |
| Myalgias                       | 1 (2.7)   |                    | 1.1   | 0.481     |
| Palpitation                    | 1 (2.7)   |                    | 1.1   | 0.481     |
| Septic shock                   | 1 (2.7)   |                    | 1.1   | 0.481     |
| **Sign**                       |         |                    |       |           |
| Temperature (ºC)               |         |                    |       |           |
| <37.8                          | 5/28 (17.9) | 3/32 (9)           | 0.9   | 0.454     |
| 37.8-38.9                      | 9/28 (32.1) | 19/32 (59)         | 4.5   | 0.042     |
| >38.9                          | 14/28 (50) | 10/32 (31)         | 2.2   | 0.189     |
| Heart murmur                   | 18 (48.6) | 26 (65)            | 2.1   | 0.172     |
| Loud $S_1$                     | 3 (8.1)   | 14 (35)            | 8.1   | 0.006     |
| Extra heart sound              |          | 9 (22)             | 9.4   | 0.002     |
| “Tumor plop”                   | 2 (5)    |                    | 1.9   | 0.494     |
| Splenomegaly                   | 3 (8)    |                    | 2.9   | 0.241     |
| Skin lesions                   | 3 (8.1)  | 6 (15)             | 0.9   | 0.484     |
| Neurological deficits          | 2 (5.4)  | 3 (8)              | 0.1   | 1.000     |
Microorganisms

All 39 patients had microbiological evidence confirmed by one or more investigations including blood culture, culture of resected myxoma, histopathological inspection for bacteria or confirmation by polymerase chain reaction. Blood culture for microbiological isolation was positive in 37, negative in 1 and unstated in 1. Cultures of resected myxoma tissues were done in 15 patients: 9 (60%) were positive and 6 (40%) were negative. Histopathological studies of the resected myxomas were performed in 30 patients. They were histopathologically inspected for bacteria in 14 patients: 13 (92.9%) were positive and 1 (7.1%) was negative. The 41 bacteria of 39 patients were summarized in Table 4.

Histopathology showed inflammatory cell infiltrate in 11 (36.7%), necrosis in 4 (13.3%) and micro-/focal abscesses in 2 (6.7%) patients, respectively.

Complications

There were 12 patients in whom complications developed. Of these, embolic events in 10 (8 were multiple sites or multiple organs), sepsis in 4 (one was septic shock), disseminated intravascular coagulation in 3 and lung abscess in 1. The embolic events were shown in Table 5. In comparison, 18 patients of Revankar & Clark’s series developed embolic events and only one of them were multisites (80% (8/10) vs. 5.6% (1/18), \( x^2=16.3, P=0.000 \)).

Treatment

Thirty-eight of 39 patients received a surgical treatment of infected cardiac myxoma and the reason that only patient did not undergo any surgical procedure was due to rapid deterioration leading to death. Of the 38 surgical operations, 30 were isolated cardiac myxoma resections, 5 were cardiac

Table 4. Pathogens of infective cardiac myxoma.

| Pathogens                      | Present | Revankar & Clark’s | \( x^2 \) | P value |
|--------------------------------|---------|--------------------|----------|---------|
| Streptococci                   | 17 (41.5) | 20 (50) | 0.6 | 0.507 |
| Streptococcus viridans         | 7       | 7      |       |        |
| Streptococcus mutans           | 2       | 2      |       |        |
| Streptococcus bovis            | 2       | 2      |       |        |
| Streptococcus mitis            | 2       | 2      |       |        |
| Streptococcus (Group C)        | 1       | 1      |       |        |
| Streptococcus agalactiae       | 1       | 1      |       |        |
| Streptococcus oralis           | 1       | 1      |       |        |
| Streptococcus salivarius       | 1       | 1      |       |        |
| Staphylococci                  | 12 (29.3) | 7 (18) | 1.6 | 0.295 |
| MSSA                           | 4       | 4      |       |        |
| MRSA                           | 3       | 3      |       |        |
| Staphylococcus aureus          | 2 (1 was oxacillin-resistant (ORSA)) | 1        |       |        |
| Staphylococcus lugdunensis     | 1       | 1      |       |        |
| Staphylococcus spp             | 1       | 1      |       |        |
| Staphylococcus (species not given) | 1       | 1      |       |        |
| Enterococcus faecalis          | 4 (9.8) | 2 (5)  | 0.7 | 0.675 |
| Gram-negative bacilli          | 2 (4.9) | 3 (8)  | 0.2 | 0.675 |
| Klebsiella pneumoniae          | 2       | 2      |       |        |
| Gram-negative cocci            | 1 (2.4) | 1 (2.4) | 1.0 | 1.000 |
| Neisseria lactamica            | 1       | 1      |       |        |
| Fungus                         | 1 (2.4) | 3 (8)  | 1.1 | 0.359 |
| Histoplasma capsulatum         | 1       | 1      |       |        |
| Actinomyce                     | 1 (2.4) | 1 (2.4) | 1.0 | 1.000 |
| Actinobacillus actinomycetemcomitans | 1       | 1      |       |        |
| Unknown                        | 3 (7.3) | 3 (8)  | 0.0 | 1.000 |
| Bacterial colonies             | 1       | 1      |       |        |
| Gram-positive cocci            | 2       | 2      |       |        |
myxoma resection with concurrent cardiac surgical procedures (mitral valve replacement in 2, and mitral valve replacement + coronary artery bypass grafting, mitral valve replacement + embolectomy of the left anterior descending coronary artery + coronary artery bypass grafting, and pulmonary valve replacement in 1 patient each) and 3 with staged peripheral operations (3rd toe of right foot amputation & right femoropopliteal bypass; right common iliac artery thrombectomy and embolectomy of the left common and external iliac and right deep femoral arteries in 1 patient each).

The timing for surgical operation was reported in 26 patients, 4 of them were operated on an urgent basis and 22 had a delay of 18±13.5 (range, 3-42; median, 14) days (n=21) after admission for the purpose of sufficient preoperative antibiotic treatment and stabilization of patients’ conditions. Preoperative antibiotic treatment was described in 26 patients. The frequently used antibiotics included vancomycin (7 patients), penicillin (4 patients) and ampicillin (3 patients). Sometimes, they were used along with gentamicin (80 mg every 8 h). Other antibiotics were imipenem, meropenem, peperacillin, trimethoprim/sulfamethoxazole, oxicillin, ampicillin, nafcillin, teicoplanin, azitromicine, ceftriaxone, cindamycin and amoxicillin–clavulanic acid.

The duration of preoperative antibiotic use was 22.3±13.4 (range, 7-42; median, 18) days (n=12). Postoperative antibiotic regimens included vancomycin (500 mg every 6 h), ceftazidime (2 g every 8 h) and netilmicin (150 mg every 12 h) followed by ceftepime (1 g every 12 h) plus teicoplanin (400 mg daily), nafcillin (2 g intravenously every 6 h) and gentamicin and antifungal drugs with a therapeutic course of 31.2±5.1 (range, 27-42; median, 28) days (n=9).

Outcomes

During a follow-up period of 11.1±14.5 (0.1-58; median, 8.5) months (n=16), 37 (92.6%) patients survived and 2 (7.4%) died. Of the 37 survived patients, 35 (94.6%) were event-free and 2 (5.4%) were complicated with ruptured saccular abdominal aortic aneurysm with renal infarct and septic emboli requiring aortoiliac bypass in one patient, and increased cerebral hematoma requiring craniotomy in another. One patient died of rupture of a right lung abscess 3 weeks after admission and the other died of disseminated intravascular coagulation on postoperative day 10. The overall mortality was 5.1% and the operative mortality was 2.6%, with a significantly reduced overall mortality in comparison with that of the patient series of Revankar & Clark (overall mortality: 5.1% vs. 21%, $x^2=4.0$, $P=0.047$; operative mortality: 3% vs. 2.6%, $x^2=1.4$, $P=0.239$). The overall survival rate was 92.6% (Figure 1). The survival rates of the surgical and non-surgical patients were 96.2% and 0%, respectively (Figure 2).
DISCUSSION

In 1998, Revankar & Clark defined infected cardiac myxoma in three levels based on clinical and pathological findings of the myxoma:

Definite infected cardiac myxoma
1. Documented myxoma by pathology and
2a. Microorganisms seen on pathology or
2b. Positive blood cultures and inflammation on pathology.

Probable infected cardiac myxoma
1. Documented myxoma by pathology and
2. Positive blood cultures or inflammation on pathology.

Possible infected cardiac myxoma
1. Characteristic appearance by transthoracic or transesophageal echocardiography and
2. Positive blood cultures.

Using these criteria, the three-level infected cardiac myxoma accounted for 85%, 12.5% and 2.5% respectively as reported by Revankar & Clark, and 87.2%, 10.3% and 2.6% in the present series.

The diagnosis of infected cardiac myxoma can be a challenge. The time interval from symptom onset to establishment of the diagnosis varied from 0 to 126 (median, 4) months. Pathogens can be evidenced by blood culture, culture or staining of resected myxoma, and occasionally confirmation by polymerase chain reaction is helpful. The transthoracic or transesophageal echocardiography is a reliable means for the detection of a cardiac myxoma. Only in patients with rapid deterioration leading to sudden death was the diagnosis of a cardiac myxoma established by autopsy.

Comparisons between the two series revealed that the present series were characterized by few occasions of moderate-grade fever (while more occasions of high-grade fever in spite of lack of a statistical significance) and abnormal heart sound, but more uncommon microorganisms and more severe complications -- multiple embolic events. Other clinical features of the two patient series did not differ from each other. The somehow aggravated situations may contribute to the presence of refractory microorganisms, such as Gram-negative bacteria, fungus and actinomyce.

In conclusion, the present series of infected cardiac myxoma illustrated somehow aggravated clinical manifestations (relative more occasions of high-grade fever, multiple embolic events and the presence of refractory microorganisms), which should draw sufficient attention to be careful in the diagnosis and treatment. In general, the prognosis of infected cardiac myxoma is relative benign and now the long term survival is always promising.

REFERENCES

1. Nath MP, Singh B, Chakrabarty A. Left atrial myxoma presenting as stroke: case report & review of literature. Indian Anaesth Forum [Accessed March 23, 2014]. Available at: http://www.theiaforum.org
2. Revankar SG, Clark RA. Infected cardiac myxoma. Case report and literature review. Medicine (Baltimore). 1998;77(5):337-44.
3. Adamira M, Justik P, Ulman J, Brezina A, Mirejovsky T, Trnkova M. Two sporadic infected cardiac myxomas in 1 patient. Tex Heart Inst J. 2011;38(2):191-3.
4. Awab A, Hamadani M, Sud B, Voskuhl GW. Infected atrial myxoma. Med J Aust. 2006;185(6):332.
5. Belgi Yıldırım A, Er A, Küçük M, Özbilim G. Infected giant left atrial myxoma: an unusual phenomenon. Anadolu Kardiyol Derg. 2011;11(1):83-5.
6. Bhanot N, Sahud AG, Bhat S, Lane S, Manyam H, Chan-Tomkins NH. Fever of unknown origin: a case of cardiac myxoma infected with Staphylococcus lugdunensis. South Med J. 2010;103(7):697-700.
7. Brazil P L. Infected cardiac myxoma: an unusual phenomenon. Can Oper Room Nurs J. 2001;19(3):20-1.
8. Chan V, Veinot JP, Hynes M, Lapiere H, Ruel M. Infected right ventricular myxoma and pulmonary valve endocarditis. J Thorac Cardiovasc Surg. 2007;134(1):248-9.
9. Chang JH, Kim JY, Yoon JW, Seol MD, Won DJ, Cho WH, et al. A case of infected left atrial myxoma with concomitant mitral valve endocarditis. Korean Circ J. 2011;41(10):618-21.
10. Dekkers P, Elbers HR, Marschius WJ, Jaarsma W. Infected left atrial myxoma. J Am Soc Echocardiogr. 2001;14(6):644-5.
11. Falasca K, Ucciferri C, Mancino P, Di Girolamo A, Vecchiet J. Infected atrial myxoma: a rare cause of fever. Infez Med. 2008;16(1):40-2.
12. Furukawa A, Kishi S, Aoki J. Large infected atrial myxoma with vegetations. Rev Esp Cardiol. 2013;66(4):310.
13. García-Quintana A, Martín-Lorenzo P, Suárez de Lezo J, Díaz-Escofet M, Llorens R, Medina A. Infected left atrial myxoma. Rev Esp Cardiol. 2005;58(11):1358-60.
14. Gregory SA, O’Byrne WT 3rd, Fan P. Infected cardiac myxoma. Echocardiography. 2004;21(1):65-7.
15. Gulen N, Ozkara C, Kaya Y, Saglam E. Ruptured abdominal aortic aneurysm after resection of an infected cardiac myxoma. Tex Heart Inst J. 2007;34(2):233-5.
16. Janion M, Sielski J, Ciuraszkiewicz K. Sepsis complicating giant cardiac myxoma. Am J Emerg Med. 2008;26(3):387.e3-4.
17. Juang SE, Lai HC, Lan YC, Liu TJ, Lai HC. Left atrial infective endocarditis with giant vegetation without involvement of the mitral valve: case report of transesophageal echocardiography in diagnosis. Acta Anaesthesiol Taiwan. 2005;43(3):165-7.
18. Karachalios G, Bablekos G, Karachalou L, Zoganas I, Charalabopoulos A, Charalabopoulos K. Left atrial myxoma prolapsing into the left ventricle. Case report and review of the literature. Chemotherapy. 2004;50(6):297-301.
19. Leone S, dell’aquila G, Giglio S, Magliocco M, Maio P, Ngoiro FS, et al. Infected atrial myxoma: case report and literature review. Infez Med. 2007;15(4):256-61.
20. Nagata T, Totsugawa T, Katayama K, Kuinose M, Yoshitaka H, Uesugi T. Infected cardiac myxoma. J Card Surg. 2013;28(6):682-4.
21. Oyama H, Nakayama M, Ikeda A, Maeda M, Miyahara T, Inoue S, et al. A case of cardiac myxoma with multiple brain hemorrhage. No Shinkei Geka. 2001;29(6):533-7.
22. Parks JD, Thangathurai D, Farhoormand L, Riad MG. Infected atrial myxoma presenting with septic shock. [Accessed March 30, 2014]. Available at: http://www.usc.edu/schools/medicine/departments/anesthesiology/assets/WARC2004/parks1.pdf
23. Prince JM, Larsen R, Janner D. Infected cardiac myxoma. Pediatr Infect Dis J. 2002;21(2):177-8.
24. Pumpanswary M, Thomson D. Magnetic resonance imaging features of an infected right atrial myxoma. Australas Radiol. 2001;45(4):501-3.
25. Quigley RL, Meursing DF, Rossman MI. Left atrial myxoma and mitral valve endocarditis—a cause and effect: a case report. Heart Surg Forum. 2006;9(1):E486-7.
26. Riad MG, Parks JD, Murphy PB, Thangathurai D. Infected atrial myxoma presenting with septic shock. J Cardiothorac Vasc Anesth. 2005;19(4):508-11.
27. Sasaki A, Baba T. Infected left atrial myxoma: report of a case. Kyobu Geka. 2010;63(11):1009-11.
28. Surovcik R, Jevovy P, Feuereisl R, Fric P, Pavlovic J, Stetrba D. Infected myxoma as a cause of acute infective endocarditis. Vnitr Lek. 2010;56(2):154-6.
29. Tanaka M, Kawaihito K, Adachi H, Yamaguchi A, Ino T. Infected left atrial myxoma with mitral valve endocarditis. Jpn J Thorac Cardiovasc Surg. 2002;50(3):137-9.
30. Toda R, Moriyama Y, Shiotai K, Toyohira H, Taira A. Myxoma of mitral valve associated with infective endocarditis. Jpn J Thorac Cardiovasc Surg. 1999;47(6):285-7.
31. Trimche B, Bouraoui H, Garbba R, Mahdhaui A, Ben Rhomdane M, Ernez-Hajri S, et al. Systemic embolism and septic shock complicated left atrial myxoma: case report. Case Rep Med. 2009. [Accessed March 30, 2014]. Available at: http://www.hindawi.com/journals/crin/2009/306375/abs/
32. Uchino K, Mochida Y, Ebina T, Tobe M, Kobayashi S, Yano Y, et al. Infected left atrial myxoma. Intern Med. 2002;41(11):957-60.
33. Veitch AM, Manghat NE, Kakani NK, Lewis CT, Ring NJ. Systemic septic embolisation secondary to an atrial myxoma in a young woman. Emerg Radiol. 2006;12(3):137-9.
34. Yoshioka D, Takahashi T, Ishizaka T, Higuchi T. Successful surgical resection of infected left atrial myxoma in a case complicated with disseminated intravascular coagulation and multiple cerebral infarctions: case report. J Cardiothorac Surg. 2011;6:68.
35. Zechini B, Cipriani P, Papadopoulou S, Di Nucci G, Petrucca A, Teggi A. Endocarditis caused by Lactococcus lactis subsp. lactis in a patient with atrial myxoma: a case report. Diagn Microbiol Infect Dis. 2006;56(3):325-8.
36. Zwinkels RL, van der Sar-van der Brugge S, Sleeswijk Visser SJ. An unexpected cause of sepsis in a patient with dental decay. Rare example of an infected right atrial calcified myxoma, with extensive calcified pulmonary emboli. Acute Med. 2013;12(1):34, 59-61.
37. Bernstein JM, Leasure W, Buel A. Getting to the heart of the matter. Skinmed. 2007;6(6):290-2.
38. Liu YL, Liu XH, Cai KH. Cardiac valve myxomas with infected endocarditis in the youngerly. Zhonghua Bing Li Xue Za Zhi. 2005;34(10):695-6.
39. Marshall C, McDonald M. Recurrent subacute bacterial endocarditis as a presentation of left atrial myxoma. Aust N Z J Med. 1998;28(3):350.
40. Pinede L, Duhat P, Loire R. Clinical presentation of left atrial cardiac myxoma. A series of 112 consecutive cases. Medicine (Baltimore). 2001;80(3):159-72.
41. Despott E, Cachia MJ. An unusual cause of shortness of breath and fever. Malta Med J. 2005;17(1):36-8.