Review Article

Pelvic Actinomycosis

Alejandra García-García,1 Ninfa Ramírez-Durán,1 Horacio Sandoval-Trujillo,2 and María del Socorro Romero-Figueroa3

1Laboratory of Medical and Environmental Microbiology, Department of Medicine, Autonomous University of the State of Mexico, 50180 Toluca, MEX, Mexico
2Department of Biological Systems, Autonomous Metropolitan University, Xochimilco, 04960 Mexico City, Mexico
3Coordinaci´on Delegacional de Investigaci ´en Salud, México Poniente, Instituto Mexicano del Seguro Social, Toluca, MEX, Mexico

Correspondence should be addressed to María del Socorro Romero-Figueroa; maria.romerof@imss.gob.mx

Received 19 December 2016; Accepted 5 April 2017; Published 8 June 2017

Copyright © 2017 Alejandra García-García et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Introduction. Actinomycosis is a chronic bacterial infection caused by Actinomyces, Gram-positive anaerobic bacteria. Its symptomatology imitates some malignant pelvic tumours, tuberculosis, or nocardiosis, causing abscesses and fistulas. Actinomycoses are opportunistic infections and require normal mucous barriers to be altered. No epidemiological studies have been conducted to determine prevalence or incidence of such infections. Objective. To analyse the clinical cases of pelvic actinomycosis reported worldwide, to update the information about the disease. Methods. A systematic review of worldwide pelvic actinomycosis cases between 1980 and 2014 was performed, utilising the PubMed, Scopus, and Google Scholar databases. The following information was analysed: year, country, type of study, number of cases, use of intrauterine device (IUD), final and initial diagnosis, and method of diagnosis. Results. 63 articles met the search criteria, of which 55 reported clinical cases and 8 reported cross-sectional studies. Conclusions. Pelvic actinomycosis is confusing to diagnose and should be considered in the differential diagnosis of pelvic chronic inflammatory lesions. It is commonly diagnosed through a histological report, obtained after a surgery subsequent to an erroneous initial diagnosis. A bacterial culture in anaerobic medium could be useful for the diagnosis but requires a controlled technique and should be performed using specialised equipment.

1. Introduction

Actinomycosis is a chronic bacterial infection, suppurative and granulomatous in nature, caused by bacteria of the genus Actinomyces [1], a group of Gram-positive anaerobic bacteria that form filamentous microcolonies [2], do not form spores, measure up to 1 μm diameter, and are slow-growing [1]. Actinomycosis is an uncommon condition whose symptomatology imitates some malignant pelvic tumours, tuberculosis, or nocardiosis because it spreads progressively and continuously [3]. This pathology invades tissue layers, causing the formation of abscesses and fistulae. Its diagnosis is difficult, and it results in increased morbimortality. Actinomyces belong to the phylum Actinobacteria and to the order Actinomycetales. Hundreds of Actinomyces species exist, most of which inhabit the soil. Others are associated with plants, which participate in nitrogen fixation, and a few species live in human beings as saprophytic bacteria [2]. It should be highlighted that most Actinomyces spp. are present in microbiota, chiefly inhabiting the oropharynx, gastrointestinal tract, and urogenital tract [3].

Actinomycoses are opportunistic chronic infections [4], as Actinomyces have a low potential for virulence in connection with fimbriae. Therefore, they require normal mucosal barriers to be altered through trauma, surgery, or an infection. In this way, they cross the mucosal membrane or epithelial surface [4–6]. For example, a pulmonary infection can be caused by bronchoaspiration [5, 7], or a pelvic infection can originate from the use of an intrauterine device (IUD), which can injure or perforate the mucosal membrane of the uterus and facilitate infection [3].

Currently, various clinical characteristics of actinomycosis have been described, and the bacterium has been observed in various anatomical sites (e.g., face, bones and articulations,
respiratory tract, urogenital tract, digestive tract, central nervous system, skin, and soft tissue structures). The most frequent clinical form of the disease is cervicofacial actinomycosis, representing approximately 60% of all reported cases, and is associated with odontogenic infection. Other clinical types include thoracic actinomycosis, the third most common type of actinomycosis, which includes pulmonary, bronchial, and laryngeal actinomycosis [3], and abdominal actinomycosis, where the appendix, caecum, and colon are the most common sites of infection. Actinomycosis of the central nervous system is located chiefly in the cerebral abscess. Actinomycosis of the urogenital tract is the second most common clinical form of actinomycosis, and the principal clinical presentation is pelvic actinomycosis [3, 5, 8].

Pelvic actinomycosis can affect any age group, with no preference for occupation or season and is secondary to perforation or fistulation [4]. Other possible causes include bacterial vaginosis, which fosters an anaerobic environment and is associated with other microorganisms [51]; the presence of tumours [66]; and the use of IUDs [3–5]. The possibility of a contagion through oral sex has been considered because these bacteria are part of the oral cavity microbiota [72]. One possible route of dissemination is through IUDs, which fosters the growth of microorganisms through wires that are left in the excervix. In addition, the IUD changes the carbohydrate metabolism in endometrial cells, fostering still more inflammation. Another probable route is the perineum, where the microorganisms could extend from the anus up through the cervicovaginal zone [4].

The most common aetiological agent is Actinomyces israelii [5, 73]. Other reported species include A. naeslundii, A. viscosus, A. odontolyticus, A. pyogenes, A. urogenitalis, and A. turicensis [72, 74, 75].

The symptoms of pelvic actinomycosis associated with the use of an IUD can imitate symptoms of gynaecological malignant tumours, uterine myoma, or adenomyosis when presenting as a genital mass without fever [3]. The infection can disseminate to the uterine tubes and can cause salpingitis and the subsequent destruction of the ovarian parenchyma [4]. Organs such as the bladder, ileocaecal (iliac fossa) and rectosigmoid region, colon, urethra, and extension to the skin have been reportedly affected in various published cases.

The diagnosis of pelvic actinomycosis is obtained using various techniques because culturing Actinomyces spp. presents difficulties and also depends on the skill and access to equipment necessary to perform it.

(a) First, the signs and symptoms of the patients are considered and can point to a possible abdominal infection, vaginitis, abscess, or possible tumour-forming process. The most common symptoms are weight loss, nonspecific abdominal or pelvic pain, breakthrough bleeding or abundant vaginal flow, and, on rare occasions, fever [3, 4, 51].

(b) Upon medical exploration, the affected zone is palpated to detect hard masses, and a gynaecological exam is performed to check for inflammation of the vaginal mucous membrane, yellowish secretion with a bad smell, or some visible damage to the mucous membrane [4, 51].

(c) In laboratory studies, it is possible to identify leucocytosis, erythrocytosis, and high sedimentation rate; high values of C-reactive protein; and tumour marker values within the reference ranges or slightly elevated like Ca 125 (Alpha-fetoprotein), and cancer antigen 15–3 [3, 4, 51].

(d) Diagnostic images, such as computed tomography, magnetic resonance, ultrasound, X-rays, and laparoscopy are helpful, as they can be used to observe the affected zone, such as a tumour-forming mass that can induce either actinomycosis or a carcinogenic process [4, 51, 73].

(e) In most cases, histological visualisation of biopsy or aspirated samples is employed, where bacilli in the tissue with their typical ramifications, such as in interconnected breasts, are observed. Cervicovaginal cells are collected for Papanicolaou (Pap) staining. In both cases, they are reported as Microorganisms Similar to Actinomyces (MSA) [4, 51]. In many cases, the diagnosis is made a posteriori through a histological examination of samples obtained surgically during laparotomy or laparoscopy, but rarely in a preoperative manner. Histological studies of tissues show inflammatory changes of suppurative and granulomatous nature, connective proliferation, and sulphur granules, which have also been identified in infections caused by Nocardia brasiliensis, Actinomadura madurae, and Staphylococcus aureus. These granules are particles of yellowish colour, which, when viewed by the naked eye, are formed by groups of filamentous Actinomyces surrounded by neutrophils [73].

(f) Two methods exist for completely identifying the causal agent: culture and identification through biochemical tests and identification through sequencing of the 16S rRNA segment, which offers greater precision. Although these methods are very efficient, they are not well reported in the literature due to the conditions under which they must be performed, requiring an anaerobic culture environment and the necessary equipment, which is costly.

The usual treatment for actinomycosis consists of high and prolonged doses of penicillin G (20 million units per day) or amoxicillin for 4 to 6 weeks, followed by penicillin V (4g per day) orally for 6 to 12 months. Clindamycin, tetracycline, and erythromycin are an alternative in cases of allergy to penicillin [4, 5]. In addition to these medicines, it has been observed that Actinomyces is also sensitive to third-generation cephalosporins, ciprofloxacin, trimethoprim-sulfamethoxazole, and rifampicin [4]. However, the elimination of the injured tissue and surgical drainage are necessary measures in some cases [5], and, in these patients, the duration of antimicrobial therapy could be reduced (3 months) [3].

In the review performed by Martinez et al. [74], it is mentioned that there are reports of the presence of Actinomyces in secretions starting from 1877, recorded by Harz. Beecham et
al. found that the first reports of intrauterine actinomycosis related to IUDs appeared in the 1920s [76]. Clinical cases of pelvic actinomycosis have been reported in Africa, Oceania, Asia, Europe, and America. However, as pelvic actinomycosis is an uncommon infection, no epidemiological studies have been conducted to determine its prevalence or incidence.

2. Materials and Methods

We performed this analysis according to the guidelines of the Meta-Analysis of Observational Studies in Epidemiology Group (MOOSE). A systematic review of worldwide cases of pelvic actinomycosis between the years 1980 and 2014 was performed. Studies that described clinical cases of pelvic actinomycosis with a detailed diagnostic method and cross-sectional studies of cases of actinomycosis available in the PubMed, Scopus, and Google Scholar databases were included using the following keywords: Pelvic actinomycosis, Actinomycosis pélvica, “Actinomycosis prevalence”, “Prevalencia de actinomycosis”, “Actinomyces” AND “female genital tract” and combinations of these terms. The use of quotes was avoided when searching for the terms Pelvic actinomycosis and Actinomycosis pélvica in order to increase the search results.

Abstracts of articles identified to be relevant for the objective of this paper were read; studies whose abstract or full text was unavailable were automatically excluded. When an abstract complied with inclusion criteria, the full text was analysed. Case reports that lacked a diagnostic method and a final diagnosis of pelvic actinomycosis were excluded. Studies published in a language that was not English, Spanish, French, or Portuguese were not included. The following information was extracted and analysed from the compiled studies: year, country, type of study, number of cases, prior use of IUD and duration, initial diagnosis, treatment, definitive diagnosis, and method of definitive diagnosis (Figure 1).

3. Results

The search yielded a total of 3852 studies; 3693 were excluded from the title, abstract, and language screening; 96 more were excluded for not being available in full text format and for not meeting the selection criteria when reading the full article. A total of 63 studies including 86 case reports of pelvic actinomycosis, along with 8 cross-sectional studies of reports examining populations for cases of Microorganisms Similar to Actinomyces (MSA), were included for this review (Figure 1).

3.1. Cases of Pelvic Actinomycosis Reported in Africa. From the African continent, 3 articles of clinical cases were found, totalling 8 clinical cases. The majority of patients were IUD users; however in most cases the type of IUD used was not disclosed. The pathology that was first diagnosed in these cases was an ovarian tumour. The method of diagnosis that was utilised to definitively diagnose patients with actinomycosis was histopathological reporting (Table 1). The most common treatments were hysterectomy, laparotomy, and antibiotic therapy. No follow-up data was presented.

3.2. Cases of Pelvic Actinomycosis Reported in Oceania. From Oceania, 1 article was published that included 3 clinical cases with the following ages: 56, 70, and 37 years; two of them were copper IUD users. In the three cases, malignant lesions were initially diagnosed; the final diagnosis was performed postoperatively. Salpingo-oophorectomy along with antibiotic therapy was used in all the cases; patients fully recovered after treatment. (Table 2).
**Table 1:** Publications of cases of pelvic actinomycosis in Africa.

| Definitive diagnosis                                      | Presumptive diagnosis | Definitive method of diagnosis | Previous use of IUD | Treatment and resolution                                      | Number of cases | Reference                  | Age (years) | Reference               |
|----------------------------------------------------------|-----------------------|--------------------------------|---------------------|--------------------------------------------------------------|----------------|---------------------------|--------------|-------------------------|
| Tumour mass formation caused by MSA*                     | Ovarian tumour        | Histopathological report       | Yes (15 years)      | Laparotomy and hysterectomy, ampicillin                      | 1              | 1989, Ben Nasr et al.     | 56           | Tunisia [9]              |
| Pelvic actinomycosis, MSA                                |                       |                                |                     | No date of resolution                                         | 5              | 2008, Chelli et al.       | 39.2 (average) | Tunisia [10]             |
| MSA                                                      | Ovarian tumour        | Histopathological report       | Yes (4)             | Total hysterectomy and bilateral oophorectomy               | 2              | 2010, Abid et al.         | ND           | Tunisia [11]             |

*Total cases 8

*MSA = microorganisms similar to *Actinomyces.*

**ND = not disclosed.
Table 2: Publications of cases of pelvic actinomycosis in Oceania.

| Definitive diagnosis | Presumptive diagnosis | Definitive method of diagnosis | Previous use of IUD | Treatment and resolution | Number of cases | Age (years) | Reference          |
|----------------------|-----------------------|--------------------------------|---------------------|--------------------------|-----------------|-------------|-------------------|
| Actinomyosis organisms Actinomyces sp. | Ovarian cancer Malignant ovarian lesion Ovarian neoplasm | Histopathological report Histopathological report, culture | Yes = 1 Type: copper IUD No = 1 Yes = 1 Type: copper IUD | Total abdominal elective hysterectomy and bilateral salpingo-oophorectomy, penicillin, and amoxicillin Complete recovery Laparotomy and bilateral salpingo-oophorectomy with left ureterolysis, ceftriaxone, and metronidazole Complete recovery Ceftriaxone and Metronidazole, subsequent laparotomy, left salpingo-oophorectomy, penicillin, and amoxicillin Complete recovery | 3 | 56, 70, and 37 | 2014, Wan et al. Australia [12] |

**Total cases** | 3 |
3.3. Cases of Pelvic Actinomycosis Reported in Asia. Fourteen articles of 16 clinical cases came from Asia, the age of the patients ranged between 25 and 86 years, and the average age was 45.6 years (SD 15.5). The majority of patients were IUD users, with a usage time of 1 year to more than 20 years; most of the studies did not specify the type of IUD used. However, cases in nonusers were also reported, despite the well-known relationship between IUD use and pelvic actinomycosis. The most common presumptive diagnostic was malignant lesions, while, in other cases, Crohn's disease and acute peritonitis were also suspected. The most utilised diagnostic method was histological reporting after surgical interventions, which were invasive in most cases, such as hysterectomy and salpingo-oophorectomy along with antibiotic therapy. Most of the patients had a full recovery or at least a significant improvement after follow-up; only a case of renal sequelae was reported. (Table 3).

3.4. Cases of Pelvic Actinomycosis Reported in Europe. Twenty clinical case report articles including 39 cases of pelvic actinomycosis originated from Europe, in which ages ranged from 18 to 65 years; average age was 40 years (SD 10.4). The cases principally included female IUD users, with a usage time ranging from 1.5 to 20 years; copper and multiload IUD were the most reported; however in most studies the type of IUD is not specified. The predominant presumptive diagnosis was malignant lesion; other suspected diagnoses included Crohn's disease, acute appendicitis, endometrial infection, pelvic inflammatory disease, and abscesses. Postoperative histopathological reports were the most common definitive diagnostic methods. Other methods of final diagnosis have been also reported, such as the Pap smear, culture, API 20A biochemical assays, and 16S rRNA sequencing techniques. The most common treatments used were damaged tissue excision, laparotomy, and salpingo-oophorectomy together with antibiotic therapy. The majority of the articles do not have follow-up information, nonetheless studies reporting patient follow-up stated that they fully recovered after treatment, and there is one report of renal sequelae. (Table 4).

3.5. Cases of Pelvic Actinomycosis Reported in America. With regard to America, 16 articles with reports of 20 clinical cases exist. The ages of patients ranged between 18 and 58 years with an average age of 39.6 years (SD 9.9). All patients were IUD users except one case, and the time of device use ranged from 22 months to 33 years. Reported types of IUD include Dalkon Shield and Lippes loop. Tubo-ovarian and pelvic abscesses along with malignant lesions were the conditions in the greatest diagnostic confusion. Similar to the other summaries, the postsurgical histological reports were the most reported definitive diagnostic methods. Other methods were also utilised, such as culture, the 16S rRNA sequencing technique, haematoxylin-eosin staining microscopy (HE), and the IUD smear. Salpingo-oophorectomy and laparotomy along with prolonged antibiotic therapy were the most used therapeutic measures. After treatment most of the patients had a full or significant recovery. (Table 5).

3.6. Cross-Sectional Studies. Eight cross-sectional studies of reports worldwide that examine populations for cases of actinomycosis or MSA were analysed. The prevalence of pelvic actinomycosis was low. Likewise, there is a strong relationship between the use of an IUD and the presence of MSA. In this type of report, the diagnosis methods reviewed were the Pap reports. However, it is important to emphasise that what is reported in these analyses are MSA. Only 3 articles reported actinomycosis as such, and only one report completely identified the causal agent through culture and biochemical assays (Table 6).

4. Discussion

According to the analysis of the articles presented, Europe was the continent on which the greatest number of cases of pelvic actinomycosis was reported, followed by Asia and America. However, it is important to emphasise that this summary of information only gives us an approximation of the real epidemiology of this disease, as the cases presented in this article are only those reported. The youngest cases (18 years) are found in the European and American continents, and the oldest case (86 years) is found in the Asian continent.

Actinomycosis is an invasive infection that frequently imitates malignant processes in various anatomical zones. Pelvic actinomycosis involves one of the regions that is most often a source of diagnostic confusion. In this review, it is evident that, in many of the cases presented, an erroneous clinical diagnosis was made, confusing pelvic actinomycosis mainly with malignant lesions. Other common suspects were tubo-ovarian and pelvic abscesses and Crohn's disease. As such, as described by Kayikcioglu et al. [35] and Moniruddin et al. [77], pelvic actinomycosis should be considered in the differential diagnosis in any chronic inflammatory lesion of the visera located in the pelvic zone to prevent a diagnostic error that could lead to unnecessary invasive treatment.

The diagnosis of pelvic actinomycosis is difficult because it does not produce characteristic disease signs or symptoms. According to what was observed in this analysis, the most utilised diagnostic method in all continents was the histopathological report, which is commonly obtained after a surgical intervention due to an initial diagnostic error. This observation was also made by Purola and Paavonen [78] and more recently by Pérez-López et al. [73]. Other highly reported methods are the Pap test, which is generally reliable, but not unequivocal, as Actinomyces could be confused with similar organisms. Cases in which the causal microorganism is completely identified are few, as are cases identified by culture and biochemical assays. Valour et al. [3] mentioned that cultivating bacteria in anaerobic medium is the cornerstone for diagnosing actinomycosis. However, this method requires a very controlled and precise technique and specific equipment. Identification by sequencing of the 16S rRNA segment is another technique that offers greater precision. Currently other authors such as Demirezen et al. [79] report the effectiveness of using specific primers to identify the most common Actinomyces species from patients' swabs samples; this technique is more accurate and faster than all the previous ones; the disadvantage is the high cost of
### Table 3: Publications of cases of pelvic actinomycosis in Asia.

| Definitive diagnosis                                             | Presumptive diagnosis                        | Definitive method of diagnosis | Previous use of IUD | Treatment and resolution                                                                 | Number of cases | Age (years) | Reference          | Country        |
|-----------------------------------------------------------------|----------------------------------------------|-------------------------------|---------------------|----------------------------------------------------------------------------------------|----------------|--------------|--------------------|----------------|
| Actinomycotic abscesses (sulphur granules)                       | Sigmoid colon cancer and tumour in left ovary | Histopathological report      | Yes (1 year)        | Segmented resection of the sigmoid colon, elimination of the left distal ureter, the left ovary and Fallopian tube, ampicillin, and amoxicillin Complete recovery | 1              | 36           | 1995, Kim et al.  | South Korea [13]|
| MSA*                                                            | Crohn's disease or ovarian cancer or pelvic abscess associated with the IUD | Histopathological report of the ovary | Yes (14 years) Type: ND | Laparotomy, total hysterectomy, bilateral salpingo-oophorectomy, and anterior resection No date of resolution | 1              | 45           | 2009, Lim et al.  | Korea [14]     |
| MSA                                                            | Tumour in the appendix                       | Histopathological report ND   | ND                  | Drainage, penicillin, and amoxicillin Complete recovery                                | 1              | 50           | 2010, Lee et al.  | South Korea [15]|
| Pelvic actinomycosis (A. israelii)                              | ND                                           | Sonography-guided transvaginal needle aspiration | Yes (4 years Type: multiload copper IUD) | Incomplete tumourectomy, ileal resection, partial cystectomy, colostomy and bilateral ureterocutaneostomy, and penicillin Significant improvement | 1              | 38           | 1996, Antebay et al. | Israel [16]   |
| Actinomyces, pelvic actinomycosis                               | Peritoneal carcinomatosis                     | Schiff and Grocott-Gomori acid tests | Yes (10 years Type: ND) | Amoxicillin, and penicillin, and colostomy and anterior resection Significant improvement | 1              | 43           | 1999, Maeda et al. | Japan [17]    |
| Pelvic actinomycosis                                            | Pelvic actinomycosis                         | Cervical Papanicolaou         | Yes (21 years Type: ND) | Ampicillin Almost complete recovery                                                   | 1              | 51           | 2007, Nozawa et al. | Japan [18]    |
| Pelvic actinomycosis                                            | Ovarian malignancy                           | Gomori methenamine staining histopathology | No                   | Hysterectomy with bilateral salpingo-oophorectomy No date of resolution  | 1              | 74           | 2012, Ikeda and Kato | Japan [19]    |
| Definitive diagnosis                  | Presumptive diagnosis | Definitive method of diagnosis | Previous use of IUD | Treatment and resolution                                      | Number of cases | Age (years) | Reference                          |
|--------------------------------------|-----------------------|--------------------------------|---------------------|----------------------------------------------------------------|----------------|-------------|-----------------------------------|
| Puncture pyometra caused by *Actinomyces* | Puncture pyometra    | Microscopic examination, Gram staining of the uterus and intraperitoneal pus, and culture | No                  | Emergency abdominal hysterectomy and bilateral salpingo-oophorectomy, cefmetazole, and meropenem No date of resolution | 1              | 86          | 2013, Hagiya Japan [20]          |
| Inflammation caused by MSA           | Acute peritonitis due to perforated visera | Histopathological report of the abdominal wall | Yes (20 years) Type: ND | Laparotomy, resection, and penicillin Complete recovery | 1              | 50          | 2008, Devendra and Chen Singapore [21] |
| MSA                                  | Pelvic actinomycosis  | Papanicolaou, cervical culture and culture of IUD (without being able to be isolated), and histopathological report | Yes (15 years) Type: ND | Laparotomy, amoxicillin, and penicillin Significant recovery | 1              | 40          | 2010, Fu and Tasi Taiwan [22]     |
| MSA, *Actinomyces* spp.              | Ovarian cancer        | Histopathological report and culture of purulent material | No                  | Laparotomy, hysterectomy, penicillin, and streptomycin Complete recovery | 3              | 25, 31, and 35 | 2010, Munja et al. India [23]     |
| Endometrial actinomycosis            | ND                    | Histopathological report of endometrial samples | No                  | Augmentin and amoxicillin No date of resolution | 1              | 52          | 2012, Sharma et al. India [24]    |
| Ovarian actinomycosis                | Ovarian cancer        | Histopathological report        | No                  | Laparoscopy, hysterectomy with salpingo-oophorectomy, and penicillin Total recovery | 1              | 39          | 2013, Vijaya et al. India [25]    |
| Pelvic actinomycosis, *Actinomyces*  | Ovarian cancer        | Histopathological report        | No                  | Total hysterectomy with bilateral salpingo-oophorectomy No date of resolution | 1              | 35          | 2013, Chalageri et al. India [26] |

| Total cases                          |                       |                               |                     |                                                               | 16             |             |                                   |

* MSA = microorganisms similar to *Actinomyces*.  
** ND = not disclosed.
| Definitive diagnosis | Presumptive diagnosis | Definitive method of diagnosis | Previous use of IUD | Treatment and resolution | Number of cases | Reference |
|----------------------|----------------------|--------------------------------|---------------------|--------------------------|----------------|-----------|
| *Actinomyces*        | Crohn's disease      | Histopathological report of purulent material | Yes (20 months) Type: ND** | Laparotomy, penicillin, and fusidic acid Complete recovery | 1 19 | 1985, Spickett and Kipping England [27] |
| MSA*                 | Ovarian cancer with metastasis | Histopathological report | Yes (4 years) Type: ND | Total abdominal hysterectomy and bilateral salpingo-oophorectomy, and penicillin No date of resolution | 1 37 | 1997, Kirova et al. France [28] |
| *Actinomyces israelii* | ND                  | Papanicolaou                  | Yes (15 years) Type: copper IUD | Amoxicillin/clavulanic acid and ofloxacin Complete recovery | 1 57 | 2013, Rajanarison et al. France [29] |
| MSA                  | Inflammation caused by *Actinomyces* | ND Histopathological report | Yes (19 and 7 years) Type: ND | Laparotomy, preoperative biopsy, resection of the tumour, resection of the necrosed tissues and partial cystectomy, hysterectomy, bilateral salpingo-oophorectomy, penicillin, and amoxicillin Complete recovery | 2 48 and 52 | 2000, Pérez García et al. Spain [31] |
| MSA                  | Malignant tumour formation | Histopathological report | ND | Laparotomy, resection of the central part of the epiploon and tumour formation, penicillin, and amoxicillin Significant improvement | 1 30 | 2009, García Martínez et al. Spain [32] |
| MSA                  | ND                   | Histological cervicovaginal observation and histopathological report | Yes Type: ND | Laparotomy, penicillin, and amoxicillin Complete recovery | 2 33 and 35 | 2003, Bergenhenegouwen et al. Holland [33] |
| *Actinomyces*        | ND                   | Aspirate study                | Yes Type: ND | Penicillin, bacampicillin Complete recovery | 1 45 | 2005, Lely and Van Es Holland [34] |
| MSA                  | ND                   | Histopathological report      | Yes (4–9 years) Type: copper IUD | Penicillin, bacampicillin Complete recovery | 5 32, 35, 44, 44, and 52 | 2005, Kayikcioglu et al. Turkey [35] |
| Definitive diagnosis                                      | Presumptive diagnosis | Definitive method of diagnosis | Previous use of IUD | Treatment and resolution                                                                 | Number of cases | Age (years) | Reference                      |
|----------------------------------------------------------|----------------------|--------------------------------|---------------------|------------------------------------------------------------------------------------------|-----------------|-------------|--------------------------------|
| Actinomycosis, MSA                                       | Tumour formation or  | Histopathological report of   | Yes = 2 (15 and 6   | Subbactam-ampicillin, penicillin and ceftriaxone, laparotomy, drainage of abscesses      | 3               | 32, 45, and 55| 2009, Onal et al. Turkey [36]  |
|                                                          | abscess in ovary     | the ovary                     | years)              | salpingo-oophorectomy, and hysterectomy                                                   |                 |             |                                |
|                                                          |                      |                                | No = 1              | Complete recovery                                                                         |                 |             |                                |
|                                                          |                      |                                | Type: ND            |                                                                                          |                 |             |                                |
| MSA                                                      | ND                   | Histopathological report       | Yes (8 years)       | Extraction of a mass in the internal walls of the abdomen, penicillin                     | 1               | 48         | 2010, Carkman et al. Turkey [37]|
|                                                          |                      |                                | Type: multiload     | Complete recovery                                                                         |                 |             |                                |
|                                                          |                      |                                | copper IUD          |                                                                                          |                 |             |                                |
| Damage in the organs adjacent to the irregular mass, MSA | ND                   | Histopathological report       | Yes (16 years)      | Laparotomy, total abdominal hysterectomy, bilateral salpingo-oophorectomy, and penicillin| 1               | 48         | 2000, Yegüez et al. Turkey [38]|
|                                                          |                      |                                | Type: ND            | Complete recovery                                                                         |                 |             |                                |
| Actinomycosis                                            | Pelvic inflammatory  | Histopathological report       | Yes (12 years)      | Laparotomy, hysterectomy, bilateral salpingo-oophorectomy, appendectomy, lower anterior| 1               | 44         | 2012, Yilmaz et al. Turkey [39]|
|                                                          | disease, rectal      |                                | Type: copper IUD    | resection, Hartmann colostomy, penicillin, and amoxicillin                               |                 |             |                                |
|                                                          | tumour               |                                |                     | Complete recovery                                                                         |                 |             |                                |
| Actinomycosis                                            | Necropsy             | Yes (20 years)                 | Death due to sepsis | 1                                                                                       | 1               | 49         | 2007, Grabiec et al. Poland [40]|
| MSA                                                      | Acute appendicitis,  | Histopathological report       | No                  | Laparotomy, right ileocolic resection with anastomosis of the ileotransverse colon, and  | 1               | 46         | 2008, Pitot et al. Belgium [41]|
|                                                          | fistulisation in     |                                |                     | amoxicillin                                                                             |                 |             |                                |
|                                                          | abdominal wall       |                                |                     | No date of resolution                                                                    |                 |             |                                |
| Actinomyces spp.                                         | Carcinoma            | Purulent material culture,     | Yes (3 years)       | Right hemicolectomy, antibiotic therapy                                                  | 1               | 35         | 2009, Čolović et al. Serbia [42]|
|                                                          |                      | histopathological report       | Type: ND            | Complete recovery                                                                         |                 |             |                                |
| MSA, pseudoactinomycotic radiate granules                | Endometrial infection, histopathological report | Yes | 5 endometrial biopsies and 1 piece of hysterectomy | 6 | 2009, Boyle and McClellagge North Ireland [43] | |
|                                                          |                      | Histopathological report       | Type: ND            | No date of resolution                                                                    |                 |             |                                |
| Definitive diagnosis | Presumptive diagnosis | Definitive method of diagnosis | Previous use of IUD | Treatment and resolution | Number of cases | Age (years) | Reference |
|----------------------|-----------------------|-------------------------------|---------------------|--------------------------|----------------|------------|-----------|
| *Actinomyces*        | Muscular neoplasia     | Postsurgical histopathological report of samples from the abdominal wall abscess | Yes Type: ND | Laparotomy, adhesiolysis, complete excision of the mass with extensive damage to the anterior abdominal wall, and antibiotic therapy | 1 | 47 | 2010, Acquaro et al. Italy [44] |
| Anogenital actinomycosis, *Actinomyces turicensis* | Perianal abscesses, pilonidal cyst, and gas gangrene | API 20A biochemical assays and 16S rRNA sequencing technique | ND | ND | 7 | 18, 18, 28, 23, 28, 33, and 65 | 2010, Chudáčková et al. Czech Republic [45] |
| *Actinomyces*        | Tumoural process in pelvis | Histopathological report | Yes Type: multiload copper IUD | Cystoscopy, penicillin, and Duomox | 1 | 42 | 2012, Maxová et al. Czech Republic [46] |

**Total cases** 39

* MSA = microorganisms similar to *Actinomyces*.
** ND = not disclosed.
## Table 5: Publications of cases of pelvic actinomycosis in America.

| Definitive diagnosis | Presumptive diagnosis | Definitive method of diagnosis | Previous use of IUD | Treatment and resolution | Number of cases | Reference |
|----------------------|-----------------------|--------------------------------|---------------------|--------------------------|----------------|-----------|
| **Actinomyces israelii** | Tubo-ovarian abscess | Histopathological report and culture | Yes (4 years) Type: Dalkon Shield IUD | Laparotomy, hysterectomy, bilateral salpingo-oophorectomy, and penicillin Complete resolution | 1 | 1980, McLeod et al. United States [47] |
| **Actinomycotic tubo-ovarian abscess** | Tubo-ovarian abscess or malignant tumour | Histopathological report | Yes Type: ND** | Antibiotic therapy, tumourectomy, and right salpingo-oophorectomy No date of resolution | 1 | 1982, Kelly and Aaron United States [48] |
| **A. naeslundii** | Pelvic abscess | Microscopic observation of the IUD and culture | Yes (10 years) Type: Dalkon Shield IUD | Antibiotic therapy hysterectomy, bilateral salpingo-oophorectomy Complete recovery | 1 | 1985, Bonnez et al. United States [49] |
| Sulphur granules; **Actinomyces israelii**; actinomycotic pelvic abscess secondary to IUD involving the bladder, sigmoid colon, left ureter, liver, and superior abdominal wall | ND | Histopathological report and culture | Yes (15 years) Type: Lippes loop IUD | Percutaneous drainage and prolonged antibiotic therapy No date of resolution | 1 | 1996, Hochsztein et al. United States [50] |
| **Actinomycotic granules, tubo-ovarian abscess** | Abdominal tumour secondary to colon cancer | Laparotomy | Yes Type: copper IUD | Laparotomy, en bloc resection that included compromised abdominal wall, right hemicolecction, hysterectomy, bilateral salpingo-oophorectomy, partial sigmoidecction, and penicillin Complete recovery | 1 | 1999, Mesa-Castillo et al. Colombia [51] |
| **MSA** | ND | Histopathological report | Yes (9 and 3 years) Type: ND | Laparotomy, hysterectomy, oophorectomy, penicillin, and amoxicillin Significant improvement | 2 | 2006, Urbina et al. Colombia [52] |
| **Actinomyces sp.** | Bilateral cystic teratoma | Histopathological report | No | Laparotomy, bilateral salpingo-oophorectomy, and penicillin Significant improvement | 1 | 2001, Burlando et al. Argentina [53] |
| Definitive diagnosis                                      | Presumptive diagnosis | Definitive method of diagnosis          | Previous use of IUD | Treatment and resolution                                      | Number of cases | Reference          |
|----------------------------------------------------------|-----------------------|----------------------------------------|---------------------|---------------------------------------------------------------|----------------|--------------------|
| Tubo-ovarian actinomycosis, MSA                         | Tumour formation      | Histopathological report of the ovary  | Yes (8 years)       | Oophorectomy, right salpingectomy, and amoxicillin             | 1              | 2005, Vispo et al.  |
|                                                          |                       |                                        | Type: ND            | No date of resolution                                          |               | Argentina [54]      |
| Actinomycosis, MSA                                      | Vesical tumour        | Histopathological report               | Yes (33 years)      | Penicillin                                                    | 1              | 2003, Alegria et al.|
|                                                          |                       |                                        | Type: ND            | Progressive improvement                                        |               | Chile [55]          |
| Pelvic actinomycosis, sulphur granules                  | Pelvic or neoplastic  | IUD swab                               | Yes (27 years)      | Penicillin and amoxicillin                                    | 1              | 2013, Daniels et al.|
|                                                          | actinomycosis of the  |                                        | Type: Lippes loop   | Significant improvement                                        |               | Chile [56]          |
|                                                          | colon or ovary        |                                        | IUD                  |                                                               |               |                    |
| MSA                                                      | ND                    | Histopathological report of the right  | Yes (22 years)      | Laparotomy to drain purulent material, hysterecory with       | 1              | 2004,                |
|                                                          |                       | ovary                                  | Type: ND            | bilateral salpingo-oophorectomy, and penicillin                |               | López-Cervantes et  |
|                                                          |                       |                                        |                     | Significant improvement                                        |               | al México [57]      |
| MSA Actinomycotic granuloma                             | Uterine myomatosis    | Histopathological report               | Yes (10, 10, and 4  | Laparotomy, hysterecory, salpingo-oophorectomy, and penicillin| 3              | 2005,                |
|                                                          |                       |                                        | years)              | Significant improvement                                        |               | Olivera-Reynada et  |
|                                                          |                       |                                        | Type: ND            |                                                               |               | al México [58]      |
| Coinfection by *Neisseria gonorrhoeae* and *Actinomyces*| ND                    | Culture of UID and vaginal exudate     | Yes (22 months)     | Surgical excision of the appendix, bilateral salpingectomy    | 1              | 2013, Eiros-Bouza et|
| *naeslundii*                                             |                       |                                        | Type: copper IUD    | No date of resolution                                          |               | al Mexico [59]      |
| Urachal actinomycosis, “sulphur granules”               | Carcinoma             | Histopathological report               | ND                  | Partial cystectomy                                            | 1              | 2013, Alfonso et al.|
|                                                          |                       |                                        |                     | Complete recovery                                              |               | Mexico [60]         |
| *Actinomyces* spp.                                      |                       |                                        |                     |                                                               |               |                    |
|                                                          |                       |                                        |                     | Laparotomy, cefotaxime, metronidazole, and penicillin         | 1              | 2004, Mejía et al.  |
|                                                          |                       |                                        |                     | Gradual recovery                                              |               | Mexico [61]         |
| *Actinomyces urogenitalis*                              | ND                    | Microscopic observation of the IUD,    | Yes                  | Oral amoxicillin                                              | 1              | 2006, Elsayed et    |
|                                                          |                       | sequencing of the 16S rRNA gene        | Type: ND            | Complete recovery                                              |               | al Canada [62]      |
| Ovarian actinomycosis                                   | Left tubo-ovarian     | Haematoxylin-eosin (HE) staining       | No                   | Exploratory laparotomy, unilateral oophorectomy, and penicillin| 1              | 2013, Bes et al.    |
|                                                          | abscess               | microscopy                             |                     | Complete recovery                                              |               | Brazil [63]         |

| Total cases                                              | 20                    |                                        |                     |                                                               |               |                    |

* MSA = microorganisms similar to *Actinomyces*.
** ND = not disclosed.
Table 6: Publications of cross-sectional studies of pelvic actinomycosis.

| Sample size | Period          | Age            | Diagnosis          | Diagnosis method | Previous use of IUD | Important findings                                                                 | Reference                  |
|-------------|-----------------|----------------|-------------------|------------------|---------------------|------------------------------------------------------------------------------------|----------------------------|
| 121,193     | March 1977–November 1979 | 21–51          | MSA∗               | Papanicolaou     | Yes = 11,952        | 202 cases with MSA∗, 2 patients were not IUD users                                 | 1980, Fry et al. South Africa [64] |
| 2290        | ND**            | 17–76          | MSA                | Papanicolaou     | Yes (prolonged use) | 19 out of 2290 were diagnosed with MSA Statistically significant correlation of the presence of MSA with *Trichomonas vaginalis*, *cocci*, *lactobacilli*, pseudoeosinophils, endocervical cells, and polymorphs | 2005, Demirezen et al. Turkey [65] |
| ND          | January 1994–January 2010 | 6–75           | Actinomycosis      | TAC first and later histological report with finding of MSA | Yes = 2              | 23 cases of abdominal pelvic actinomycosis were identified: 18 women: 5 had ovarian and pelvic masses, 2 in the uterus; as an important risk factor, 2 patients used IUDs | 2011, Sung et al. Korea [66] |
| 293         | March 1978–March 1979 | ND             | MSA                | Papanicolaou sample observations | Yes = 128 plastic IUDs and 167 copper IUDs Oral contraceptives = 300 | 40 women with IUDs had increased prevalence of MSA, 2 who used copper and none who used oral contraceptives | 1980, Duguid et al. England [67] |
| 468         | Comparative study with 4 sample groups | ND             | 33 ± 7.7           | MSA              | Papanicolaou samples | Cases without IUD (group 0: 128) 2 to 35 months IUD use (group 1: 121); 36 to 71 months (group 2: 112); more than 72 months (group 3: 107) | MSA was found in 2 cases from group 2 and in 7 patients from group 3 MSA was 3.68 times more likely with greater use | 1999, Garrido et al. Colombia [68] |
| 1774        | January 1996–January 2001 | 22–51          | Actinomycosis      | Papanicolaou samples | Yes = 671 oral contraceptive methods = 343 Other contraceptive methods = 32 No contraceptive use = 728 | Actinomycosis in 13 patients with IUDs and in 2 without contraceptive methods | 2002, Torres et al. Chile [69] |
| 22          | 24–58           | Genital actinomycosis | Biopsy results   | Yes = 18 (3–19 years) | Actinomycosis in 14 patients with IUDs, of which 2 had no symptoms of infection; species: *Actinomyces israelii*, *Actinomyces naeslundii*, and *Actinomyces odontolyticus* | 2003, Madrid et al. Chile [70] |
| 200         | ND             | 25–50          | Actinomyces        | Vaginal secretion culture, Gram stain, Papanicolaou, API 20A biochemical assays | Yes = 106 (3–10 years) No = 94 | Actinomycosis in 14 patients with IUDs, of which 2 had no symptoms of infection; species: *Actinomyces israelii*, *Actinomyces naeslundii*, and *Actinomyces odontolyticus* | 2002, Cano Ramos et al. Mexico [71] |

* MSA = microorganisms similar to *Actinomyces*.
** ND = not disclosed.
reagents and the use of special equipment. However, because of the nature of the pathology, there is no early diagnosis, because, as has already been mentioned, the presence of symptoms occurs in advanced stages of the disease.

According to the observed reports, we conclude that the presentation of symptoms in pelvic actinomycosis is observed in an advanced period of the pathology, which does not include attack to the general state of health or fever, which is oriented towards an infectious pathology. The manifestations found are occupational masses in the pelvic-abdominal cavity that force the surgical procedures to be performed, and the diagnosis is made up to the time of the histopathological study.

Pelvic actinomycosis is considered to be a rare and unusual disease, although the use of IUDs can promote its appearance. In the articles analysed, the greatest number of patients diagnosed with pelvic actinomycosis on all continents was IUD users, and the periods of use varied widely, from one year to long periods, such as 33 years. However, cases occurred mainly in users that wore IUDs for prolonged periods. Thus, based on experience and observation, it is recommended that IUDs be changed periodically to limit the occurrence of this condition. Some authors, such as Valour et al. [3], recommend changing the IUD every 5 years at a minimum, and others, such as Hernández et al. [4], recommend changes every 3 years. It should be emphasised that those cases in which patients were not IUD users were identified more recently. This observation could suggest that, despite the information that is available regarding the relationship between this condition and IUD use, the aetiology of pelvic actinomycosis could be due to other factors.

Like all review studies, the main limitation of the study was the lack of data reported, another limitation was that not all articles were open access, and there were not enough subscriptions to the respective journals to access them.

During the first reports of this disease, greater numbers of cases were observed in developed countries, but, presently, reports of cases in developing countries and regions such as the Middle East, Southwest Asia, or Latin America are more common. This change could be because, in the first decades of its observation, this condition and its aetiology were unknown and prevention was difficult. However, with the advance of technology, preventative measures directed at high-risk populations in developed countries began to be applied, as opposed to developing countries, where no such actions were taken.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

References

[1] S. Khodavaisy, E. Zibafar, S. J. Hashemi, H. Narenji, and R. Daie Ghavzini, “Actinomycosis in iran: short narrative review article,” Iranian Journal of Public Health, vol. 43, no. 5, pp. 556–560, 2014.

[2] M. T. Madigan, J. M. Martinko, and P. J. Brock, Biología de los Microorganismos, Pearson, Madrid, Spain, 12 edition, 2009.

[3] F. Valour, A. Sénéchal, C. Dupieux et al., “Actinomycosis: etiology, clinical features, diagnosis, treatment, and management,” Infection and Drug Resistance, vol. 7, pp. 183–197, 2014.

[4] J. A. S. Hernández, N. A. M. Carrillo, F. Chilaca, and J. A. R. Tapia, “Uso del DIU asociado a la infección secundaria por actinomycetes en tracto genital femenino,” Revista Española de Patología, vol. 37, pp. 383–390, 2004.

[5] G. F. Brooks, J. S. Bute, and S. A. Morse, Bacilos Gram-positivos No Formadores de Esporas: Corynebacterium, Propionibacterium, Listeria, Erysipelothrix, Actinomyces y Especies Relacionadas, Manual Moderno, México, 2005.

[6] S. R. Paniagua and S. Victoria–Ortega, Estudio Comparativo del Aislamiento y Tipificación del Género Actinomyces Entre Placa de Fosas y Fisuras y Placa Interproximal en Pacientes Que Concurren a la Cátedra de Práctica Clínica Preventiva I de la F.O.U.N.E. - Informe de Avance, Resumen M-060, Comunicaciones Científicas y Tecnológicas, Argentina, South America, 2006.

[7] B. L. Peregrino, L. R. Vázquez, T. Caballero, V. M. Gil, and R. E. Flores, “Actinomicosis pulmonar simulando un tumor mediastinal en un niño de 11 años,” Enfermedades Infecciosas y Microbiología, vol. 28, p. 121, 2008.

[8] R. C. Read, “Nocardiosis and actinomycosis,” Medicine, vol. 33, no. 5, pp. 114-115, 2005.

[9] R. Ben Nasr, M. Ben Othman, and M. Cammoun, “Pseudotumoral pelvic actinomycosis in a woman who had been using an IUD for 15 years,” Tunisie Medicale, vol. 67, no. 8-9, pp. 563–565, 1989.

[10] D. Chelli, A. Hassini, F. Aloui et al., “Pelvic actinomycosis in Tunisia: five cases,” Cahiers Sante, vol. 18, no. 2, pp. 77–82, 2008.

[11] M. Abid, M. Ben Amar, Z. Damak et al., “Intrauterine device and pelvic tumor: Two case reports of pelvic actinomycosis with pseudotumor from tropical zones,” Medecine Tropicale, vol. 70, no. 3, pp. 285–287, 2010.

[12] K. M. Wan, Y. J. J. Rhou, T. T. Berges, N. Campbell, and J. Carter, “Pelvic actinomycosis mimicking ovarian cancer: a report of 3 cases and review of the literature,” Austin Journal of Obstetric and Gynecology, vol. 1, no. 3, p. 3, 2014.

[13] J. C. Kim, M. K. Cho, J. W. Yook, G. Y. Chee, and I. C. Lee, “Extensive colonic stricture due to pelvic actinomycosis,” Journal of Korean Medical Science, vol. 10, no. 2, pp. 142–146, 1995.

[14] S. Lim, D. H. Jeong, and K. B. Lee, “Pelvic actinomycosis with unilateral hydrourephrosis and a rectal fistula mimicking an ovarian malignancy,” Journal Women’s Medicine, vol. 2, pp. 158–161, 2009.

[15] S.-Y. Lee, H.-J. Kwon, J.-H. Cho et al., “Actinomycosis of the appendix mimicking appendiceal tumor: a case report,” World Journal of Gastroenterology, vol. 16, no. 3, pp. 395–397, 2010.

[16] E. Y. Antebey, G. Rahav, J. Hanoch et al., “Ultrasound-Guided Transvaginal aspiration in the management of actinomyces pelvic abscess,” Infectious Diseases in Obstetrics and Gynecology, vol. 4, no. 5, pp. 298–300, 1996.

[17] H. Maeda, Y. Shichiri, H. Kinoshita et al., “Urinary undiversion for pelvic actinomycosis: a long-term follow up,” International Journal of Urology, vol. 6, no. 2, pp. 111–113, 1999.

[18] H. Nozawa, Y. Yamada, Y. Muto, S. Arita, and K. Aisaka, “Pelvic actinomycosis presenting with a large abscess and bowel stenosis with marked response to conservative treatment: a case report,” Journal of Medical Case Reports, vol. 1, article 141, 2007.
[19] S.-I. Ikeda and T. Kato, “A case of pelvic actinomycosis unrelated to an intrauterine device,” *Japanese Journal of Clinical Oncology*, vol. 42, no. 3, Article ID hys015, pp. 237-238, 2012.

[20] H. Hagiya, “Pyometra perforation caused by actinomycosis without intrauterine device involvement,” *Case Reports in Obstetrics and Gynecology*, vol. 2013, Article ID 658902, 2 pages, 2013.

[21] K. Devendra and C. M. Chen, “Pelvic actinomycosis masquerading as an acute abdomen from a small bowel perforation,” *Singapore Medical Journal*, vol. 49, no. 2, pp. 158-159, 2008.

[22] P.-K. Fu and C.-A. Tsai, “Management of patients with huge pelvic actinomycosis complicated with hydrenephrosis: a case report,” *Journal of Microbiology, Immunology and Infection*, vol. 43, no. 5, pp. 442–446, 2010.

[23] K. Munjal, S. Nandedkar, V. Subedar, and S. Jain, “Tubo-ovarian actinomycosis mimicking as ovarian malignancy: Report of three cases,” *Indian Journal of Pathology and Microbiology*, vol. 53, no. 4, pp. 870-871, 2010.

[24] S. Sharma, M. Valiathan, L. Rao, and M. V. Pai, “Endometrial actinomycosis in post menopausal female in the absence of an intrauterine contraceptive device: a rare cause of bleeding per vaginum,” *Journal of Clinical and Diagnostic Research*, vol. 6, no. 6, pp. 1062-1063, 2012.

[25] C. Vijaya, A. Shetty, and V. Geethamani, “Isolated ovarian actinomycosis—a diagnosis often overlooked,” *Sri Lanka Journal of Obstetrics and Gynecology*, vol. 35, no. 1, pp. 37-39, 2013.

[26] A. Chalageri, A. Gupta, M. Vijayanand, and G. Srinivas, “Bilateral ovarian actinomycosis masquerading as ovarian malignancy; without any history of intra-uterine contraceptive device,” *Indian Journal of Pathology and Microbiology*, vol. 53, no. 4, pp. 870-871, 2010.

[27] G. P. Spickett and R. A. Kipping, “Pelvic actinomycosis presenting with rectal stricture,” *Journal of the Royal Society of Medicine*, vol. 78, no. 8, pp. 674-675, 1985.

[28] Y. M. Kirova, F. Feuilhade, M. A. Belda-Lefrère, and J. P. Le Bourgeois, “Intrauterine device - associated pelvic actinomycosis: a rare disease mimicking advanced ovarian cancer: a case report,” *European Journal of Gynaecological Oncology*, vol. 18, no. 6, pp. 502-503, 1997.

[29] J. J. C. Rajaonarison, D. M. A. Randriambololona, H. D. Ranoharison, C. Bohec, and P. G. Randaoharison, “Un nouveau cas d'actinomyces pelvienne infiltrante,” *Revue Tropicale de Chirurgie*, vol. 7, pp. 12–14, 2013.

[30] A.-S. Tholozan, J. J. Terzibachian, A. Bourtembourg et al., “Secondary psosas actinomycosis: a complication of an intrauterine contraceptive device,” *Gynecologie Obstetrique Fertilite*, vol. 41, no. 3, pp. 190–192, 2013.

[31] M. Pérez García, A. Rodríguez Alonso, A. Núñez López et al., “Actinomycosis abdominopélvica con afectación del aparato urinario, secundaria a infección ginecológica por dispositivo intrauterino,” *Actas Urológicas Españolas*, vol. 24, no. 2, pp. 197–201, 2000.

[32] M. T. García Martínez, L. E. M. Amado, M. Carreña Delgado, and N. A. Barreiro, “Masa abdominal secundaria a infección por actinomícosis,” *Revista Panamericana de Infectología*, vol. 11, no. 3, pp. 42–44, 2009.

[33] L. A. Bergenheengouwen, H. H. De Haan, E. S. Sjibrandij, and P. H. P. Groeneveld, “Unavoidable surgical intervention in two women with severe actinomycosis during IUD use,” *Nederlands Tijdschrift voor Geneeskunde*, vol. 147, no. 48, pp. 2382–2385, 2003.
in the presence of an intrauterine device,” *Journal of Clinical Microbiology*, vol. 21, no. 2, pp. 273–275, 1985.

[50] J. G. Hochstein, M. Koenigsberg, and D. A. Green, “US case of the day. Actinomycotic pelvic abscess secondary to an IUD with involvement of the bladder, sigmoid colon, left ureter, liver, and upper abdominal wall,” *RadioGraphics*, vol. 16, no. 3, pp. 713–716, 1996.

[51] R. Mesa-Castillo, V. P. Cataño-Garcia, and A. Miranda-Montalvo, “Actinomycosis abdominal causa de exéresis intraabdominal sin diagnóstico previo,” *Revista Colombiana de Cirugía*, vol. 14, no. 2, pp. 118–121, 1999.

[52] S. Urbina, H. Ruiz, and S. Parejas, “Pelvic actinomyces infection: report of two cases occurred in the Hospital of San José,” *Infectious Diseases in Obstetrics and Gynecology*, vol. 2006, Article ID 69020, 2006.

[53] S. C. Burlando, L. A. Paz, L. G. De Feo, G. Benchetrit, D. Rimoldi, and S. C. Predari, “Ovarian abscess due to Actinomyces sp. in absence of an intrauterine contraceptive device,” *Medicina*, vol. 61, no. 5, pp. 577–580, 2001.

[54] N. Vispo, G. Cassanello, P. Capellino, and M. N. Gargiulo, “Actinomicosis tubo-ovárica pseudo-tumoral,” *Revista del Hospital Privado de Comunidad*, vol. 9, no. 1, pp. 23–25, 2005.

[55] B. J. Alegria, M. M. P. González, C. M. Galleguillos, P. C. Whittle, and S. C. Franco, “Revision de infeccion pelvicana por actinomicosis: presentacion de un caso clinico,” *Revista Chilena de Radiología*, vol. 9, no. 4, pp. 196–200, 2003.

[56] S. P. Daniels, A. E. Correa, and F. C. Goity, “Actinomicosis pelviana: caso clinico,” *Revista Chilena de Obstetricia y Ginecologia*, vol. 78, no. 1, pp. 48–50, 2013.

[57] G. López-Cervantes, C. Montoya-Mejía, and F. J. Vega-Ruiz, “Tumoración pélvica secundaria a actinomicosis reporte de una Caso,” *Boletín Clínico del Hospital Infantil del Estado de Sonora*, vol. 21, no. 1, p. 115, 2004.

[58] A. Olivera-Reynada, M. A. Calzada-Ramos, X. Espinoza-Guerrero, C. Molotla-Xolalpa, and P. D. J. Cervantes-Miramontes, “Abdominal actinomycosis: report of three cases,” *Cirugía y Cirujanos*, vol. 73, no. 1, pp. 47–50, 2005.

[59] J. M. Eiros-Bouza, M. D. González, E. Martín-Medrano, and M. Garcia-Yuste, “Co-infection with Neisseria gonorrhoeae and Actinomyces naeslundii,” *Revista de Ginecología y Obstetricia de México*, vol. 81, no. 11, pp. 665–673, 2013.

[60] D. S. G. Alfonsco, M. M. M. Esther, G. R. Marco, and M. M. Helga, “Urachal actinomycosis: differential diagnosis of a tumor,” *Revista Mexicana de Urología*, vol. 73, no. 1, pp. 54–58, 2013.

[61] Y. R. Mejia, M. Hernández, Z. Martínez, and A. Carrera, “Actinomycosis tuboovárica,” *Revista de Ginecología y Obstetricia de México*, vol. 72, pp. 162–165, 2004.

[62] S. Elsayed, A. George, and K. Zhang, “Intrauterine contraceptive device-associated pelvic actinomycosis caused by Actinomyces urogenitalis,” *Anaerobe*, vol. 12, no. 2, pp. 67–70, 2006.

[63] T. M. Bes, G. J. Morgan, E. D. B. C. Bicca et al., “Actinomycose ovariana en paciente no usuária de dispositivo intrauterino,” *Associação Medica Do Rio Grande Do Sul*, vol. 57, no. 2, pp. 143–145, 2013.

[64] R. Fry, A. M. Linder, and M. M. Bull, “Actinomycete-like organisms in cervicovaginal smears,” *South African Medical Journal*, vol. 57, no. 25, pp. 1041–1043, 1980.

[65] Ş. Demirezen, D. Kaya, and M. S. Beksaç, “Cytologic findings in pap smears with Actinomyces-like organisms,” *Acta Cytologica*, vol. 49, no. 3, pp. 257–261, 2005.

[66] H. Y. Sung, I. S. Lee, S. I. Kim et al., “Clinical features of abdominal actinomycosis: a 15-year experience of a single institute,” *Journal of Korean Medical Science*, vol. 26, no. 7, pp. 932–937, 2011.

[67] H. L. D. Duguid, D. Parratt, and R. Traynor, “Actinomycoses-like organisms in cervical smears from women using intrauterine contraceptive devices,” *British Medical Journal*, vol. 281, no. 6239, pp. 534–537, 1980.

[68] G. D. P. Garrido, A. Cogollo, M. M. Rivera, R. Sanjuan, and L. A. Díaz, “Prevalencia Citológica de microorganismos compatibles con actinomycoses sp entre usuarias de dispositivo intrauterino,” *Revista de la facultad de Medicina de la Universidad Autónoma sw Bucaramanga*, vol. 2, no. 6, pp. 120–123, 1999.

[69] S. Torres G., C. K. Schalper, and Z. C. Píerart, “Análisis de la presencia de actinomycosis pélvica en mujeres de una comunidad rural en Chile,” *Revista chilena de obstetricia y ginecologia*, vol. 67, no. 3, pp. 232–236, 2002.

[70] S. F. Madrid, Z. S. Díaz, F. Muñeces, and R. Klaassen, “Actinomycosis ginecológica,” *Revista Chilena de Obstetricia y Ginecologia*, vol. 68, no. 1, pp. 21–27, 2003.

[71] E. G. Cano Ramos, A. Camargo Velasco, A. CaíTera Terrazas, N. Adriana, V. N. R. Galán-Gutiérrez, and M. L. R. Castañeda, “Detección de actinomyces spp de muestras cérvico- vaginales de mujeres con y sin dispositivo intrauterino,” *Bioquímica*, vol. 27, no. 3, pp. 60–68, 2002.

[72] E. G. C. Ramos, A. Camargo-Velasco, A. V. N. R. Carrera-Terrazas, and M. L. R. Castañeda, “Detección de actinomycoses spp de muestras cérvico-vaginales de mujeres con y sin dispositivo intrauterino,” *Bioquímica*, vol. 27, no. 3, pp. 60–68, 2002.

[73] F. R. Pérez-López, J. J. Tobías, and P. Chedraui, “Female pelvic actinomycosis and intrauterine contraceptive devices,” *Journal of Contraception*, vol. 1, pp. 35–38, 2010.

[74] G. C. Martínez, P. E. de los Ríos, F. Quijano, R. Delgado, and D. Lopez, “Enfermedad pélvica inflamatoria por actinomycosis, simulando un tumor pélvico, informe de cinco casos,” *Sociedad Mexicana de Oncología*, vol. 4, no. 4, p. 102, 2005.

[75] D. T. P. Evans, “Actinomycyes israeli in the female genital tract: a review,” *Genitourinary Medicine*, vol. 69, no. 1, pp. 54–59, 1993.

[76] T. Beedham, R. Ellice, H. Smith, and M. M. Usherwood, “Female genital actinomycosis,” *European Journal of Obstetrics and Gynecology and Reproductive Biology*, vol. 9, no. 5, pp. 341–345, 1979.

[77] A. Moniruddin, H. Begum, and K. Nahar, “Actinomycosis: an update,” *Medicine Today*, vol. 22, no. 1, pp. 43–47, 2010.

[78] E. Purola and J. Paavonen, “Actinomycosis and IUDs,” *Duodecim*, vol. 97, no. 5, pp. 231–234, 1981.

[79] Ş. Demirezen, D. Kaya, G. Hasçelik, D. G. Kivanç, and M. S. Beksaç, “Comparison of PCR, culturing and Pap smear microscopy for accurate diagnosis of genital Actinomyces,” *Journal of Medical Microbiology*, vol. 62, no. 5, pp. 727–733, 2013.