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Needling Therapies in the Outpatient Care: Adverse Effects

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Abstract

The invasive techniques have been used for many years. There is a lot of literature on the advances that have been made, as well as the adverse effects or possible complications that have occurred during the performance of these treatments. Acupuncture and injections (saline, anesthetics, corticosteroids or botulinum toxin) have reported several cases of complications. Dry needling is also beginning to have several publications of this type. The objective of this chapter is to summarize the articles published in relation to adverse effects of needling therapies to promote a good practice and knowledge. Original articles in form of randomized controlled trials, case reports and reviews relating adverse effects and possible complications due to invasive/needling techniques: acupuncture, injections and dry needling have been included. 102 articles met the inclusion criteria between January 2000 and January 2020. The first limitation found in the literature was the huge variety of cases, therapists and incidents to generalize. As a conclusion we can state the importance of a good knowledge of the anatomy and its variants, the correct application of these techniques and a continuous training of these therapists must be essential.

Keywords: dry needling, acupuncture, injection, adverse effect, safety

1. Introduction

Muscular pain is a very common pathology in the physiotherapy treatment of outpatient care. The invasive techniques for treating these patients have aroused great interest, there are many reviews made in recent years about its effectiveness but none with conclusive results [1–6]. Articles about post-needling pain [7, 8] and adverse side effects that may occur due to dry needling are being published until this day.

Dry needling is a minimally invasive technique into the most hypersensitive area/point of a tense band in a skeletal muscle (called myofascial trigger point), without the addition of any drug (**Figure 1**). It can be classified as deep or superficial [9]. There is not much evidence about which of the two options is better, it seems that deep dry needling has shown greater effectiveness due to penetrating the myofascial trigger point while the superficial dry needling penetrates the skin and the subcutaneous cellular tissue [10, 11]. In the same way, the appearance of local twitch response would guarantee its effectiveness [12, 13].

These myofascial trigger points present a high equivalence with the ashi points of acupuncture, corresponding to approximately 71% as Melzack introduced [14]. Acupuncture is based on a traditional and invasive Chinese technique of thousand years of age based on metaphysical concepts of "Ch'i" (Qi), the body energy flows through channels called "meridians" that has hypersensitive areas called ashi points

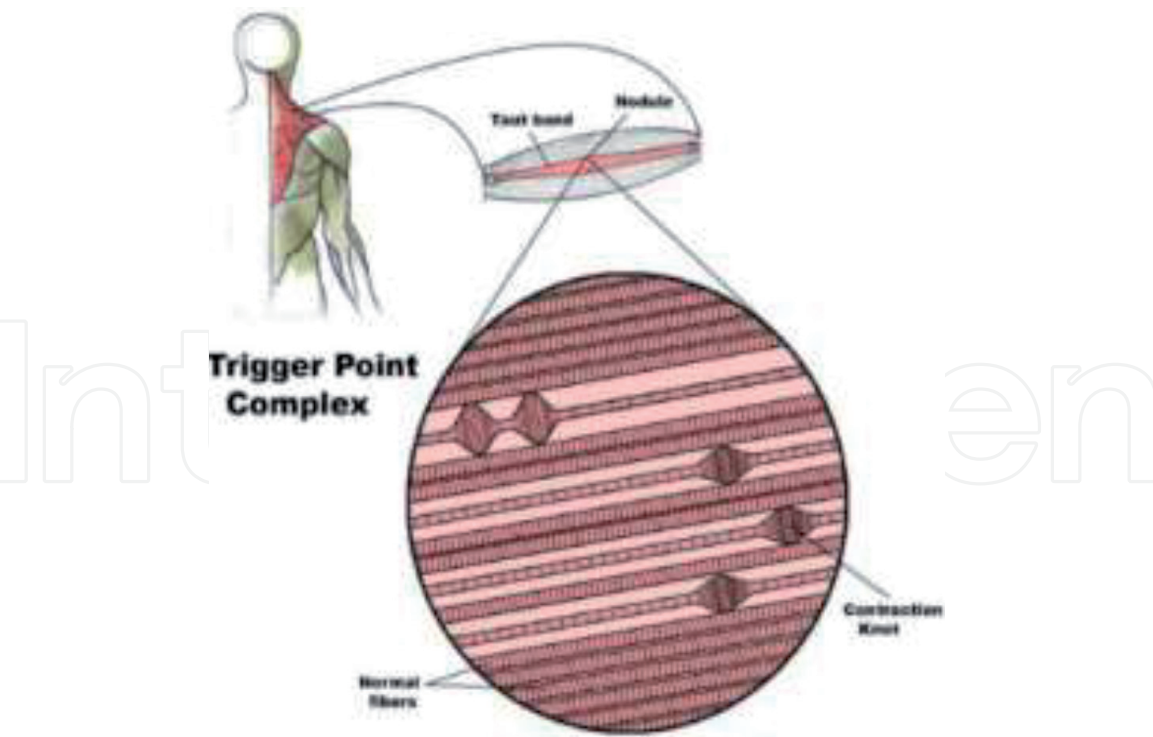


Figure 1.
Myofascial trigger point.

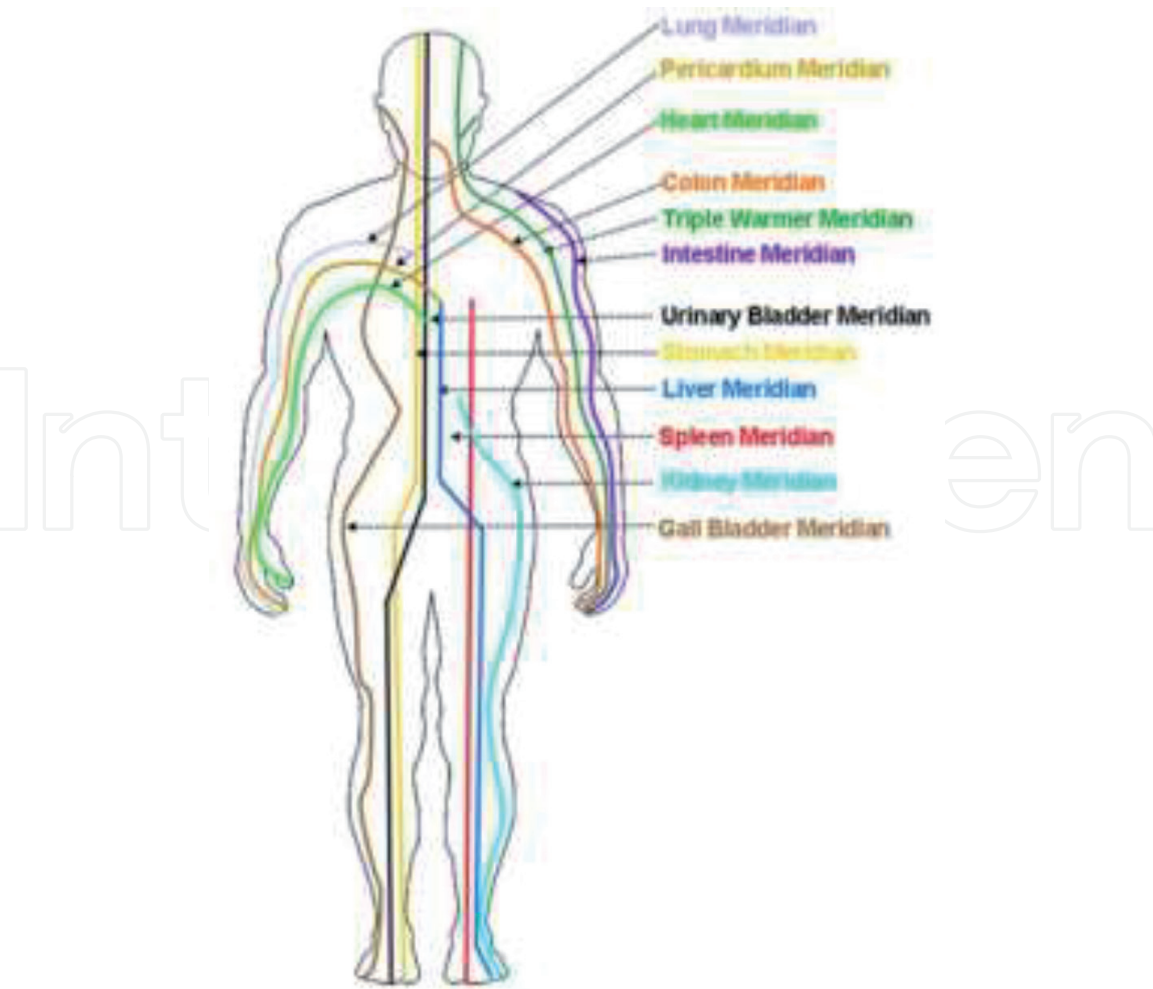


Figure 2.
Acupuncture Meridians.

(Figure 2). Its treatment also consists in the insertion of a needle in these points without any type of drugs [15].

On the other hand, injections have also been the subject of many reviews, [16, 17] they have combined the effects of needling with the effect of local anesthetics. However, in 1943 Lewit [18] demonstrated that the true effectiveness of the infiltrations was due to the mechanical effect generated by the insertion of the needle itself and not the anesthetic.

The objective of this study is to summarize the articles published in relation to adverse effects of needling therapies to promote a good practice and knowledge.

2. Method

2.1 Data sources and searches

A review of the literature was carried out in Pubmed, Web of Science, Medline and PEDro databases. The search was limited to studies on adverse effects and possible complications due to invasive/needling techniques: acupuncture, injections and dry needling in English and Spanish.

The keywords in English first introduced separately were: "acupuncture", "injection", "dry needling" and "adverse effect/event". In a second time, in order to limit the article sample, 12 searches were added: 1–3: "acupuncture/dry needling/injection" AND "complication"; 4–6: "acupuncture/dry needling/injection" AND "iatrogenic"; 7–9: "acupuncture/dry needling/injection" AND "safe practice" and 10–12: "acupuncture/dry needling/injection" AND "academic training". A manual search of the references of pre-selected articles was also carried out.

The search fields were title/abstract of the keywords of the studies published by the journals indexed in Pubmed during the period between 2000 (January) AND 2020 (January). In Web of Science the search fields were TS (theme)/TI (title). In Medline search field was TI (title) and in PEDro a simple search was done. The manuscripts selected for this systematic review met the following inclusion criteria: (i) articles that report the adverse effects and/or complications of invasive/needling techniques; (ii) reviews of such complications; (iii) articles in English and Spanish and (iv) articles with protocols or recommendations on the safe practice of these techniques. We excluded theoretical articles on the application of these techniques and articles that were not published in English or Spanish.

2.2 Study selection and data extraction

Type of articles: randomized clinical trials, case reports and reviews were included in this review. Letters to editor, commentaries to other articles and practical application of these techniques were excluded.

Type of participants: participants of all ages/nationalities/sex/gender/education level/socioeconomic status which has been treated with needling therapies.

Type of interventions and outcomes: articles which have reported adverse effects (mild-severe) due to acupuncture, dry needling and injection were selected.

Type of publications: full text articles published in English or Spanish. Once the articles were found, randomized clinical trials, case reports and reviews were selected. Once duplicates were removed, 2 reviewers analyzed the abstracts in a first screening and then carried out an exhaustive reading of the preselected ones until obtaining the final sample of articles reviewed and included in this study. If there was disagreement among the independent reviewers, a third reviewer decided. The data were extracted independently by the reviewers.

Data extraction: tables summarize the different adverse effects in chronological order classified in relation of the type of intervention.

Quality assessment: both authors selected, reviewed and assessed the quality of studies included in this review. Discrepancies were resolved by consensus.

2.3 Data synthesis and analysis

A summary of the findings of the included studies was performed, structured in the incidence/frequency of adverse effects, most prevalent adverse effects, type of intervention, type of population and other associated diseases which could influence the results (Tables 1–3). Each article was named by the author and date; they have a brief description of the intervention, the type of the adverse effect and the conclusion/resolution of the inconvenience.

3. Results

3.1 Selection of the studies

The initial search provided 4.034 potential reports, after applying the inclusion and exclusion criteria, the sample consisted of 2.169 articles from Pubmed, 814 articles from Web of Science, 781 articles from Medline, 270 from PEDro and 9

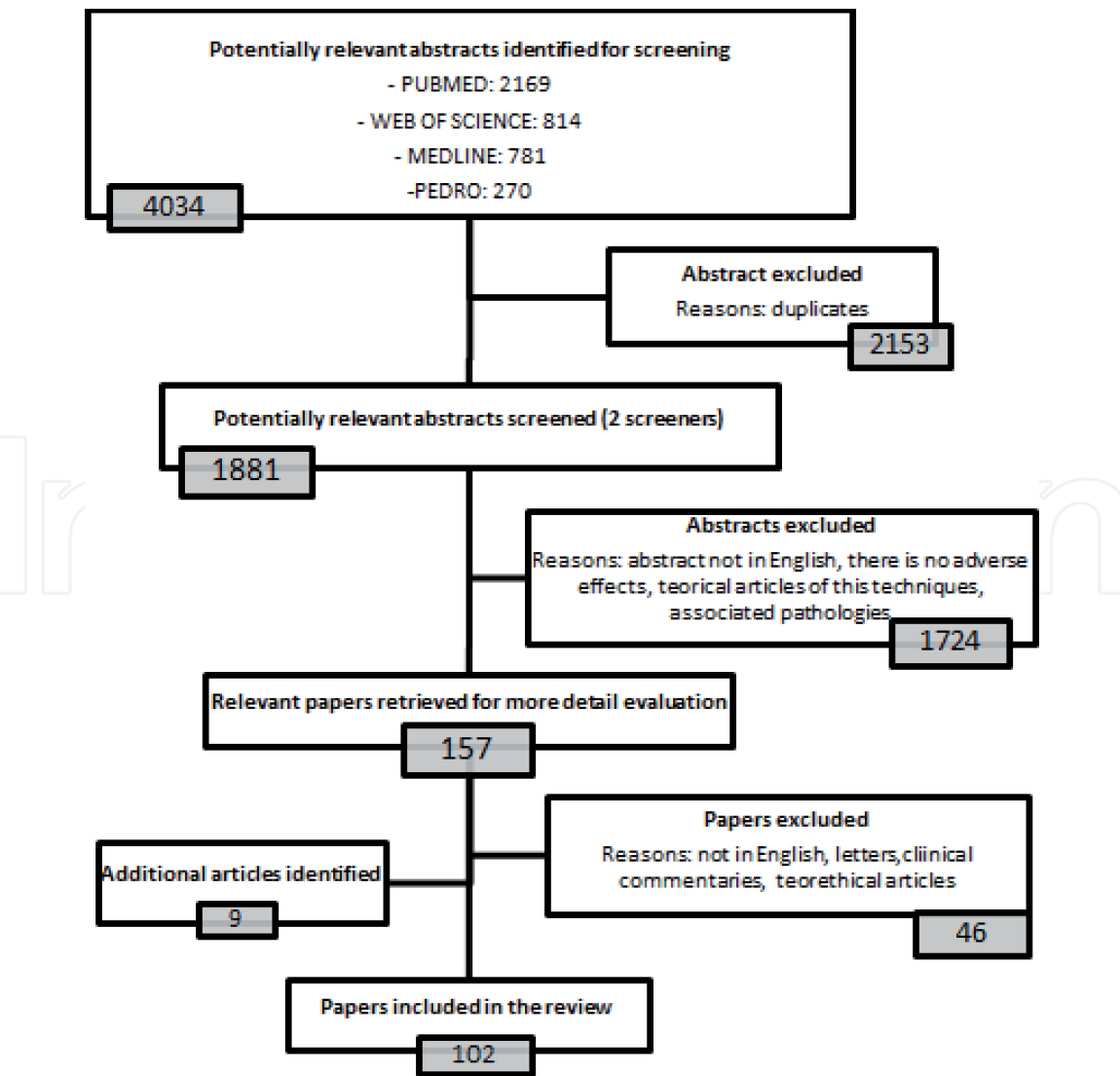


Figure 3.
Flow chart for different stages of the review.

found manually through preselected references from the Google Scholar database (**Figure 3**). After duplicated were excluded, 1,881 articles were selected. Both reviewers screened abstracts in a first time. In a second time, articles selected had a more detailed evaluation and 46 articles were excluded by the language, being letters to the editor or comments on other articles. Finally, 102 articles considered valid (93 from the initial search and 9 found manually). Detailed characteristics of the included studies are described in **Tables 1–3** in relation to acupuncture, injection or dry needling respectively.

Author/year	Description
Tandon, S. (1998) [19]	48-year-old male suffering from bronchial asthma. Pneumothorax following acupuncture with electrical stimulation in the third and fourth intercostal spaces.
Peuker, ET. (1999) [20]	To review the traumatic injuries after acupuncture and discuss how to avoid these adverse effects.
Kirchgatterer, A. (2000) [21]	83-year-old female. Syncope and cardiogenic shock after acupuncture into the sternum.
Lao, L. (2003) [22]	1965-1999 review: 202 incidents in 98 papers from 22 countries.
Ha, KY. (2003) [23]	68-year-old female. Low back pain and sciatica aggravated by acupuncture. Chronic inflammatory granuloma with compression of the lumbar fourth nerve and dural sac.
Chang, SA. (2004) [24]	68-year-old male. Death for massive hematemesis resulting from aortoduodenal fistula caused by acupuncture.
Saw, A.(2004) [25]	55-year-old female, diabetic. Necrotising fasciitis due to acupuncture in a knee osteoarthritis.
Lee, WM. (2005) [26]	36-year-old female. Bilateral pneumothorax after acupuncture.
Ryu, HJ. (2005) [27]	Clinical manifestations and treatment for Mycobacterium abscessus due to acupuncture.
Kung, YY. (2005) [28]	2 elderly patients: 72-year-old male and 63-year-old female. Between 2000 and 2002: syncope after acupuncture.
Chauffe, RJ. (2006) [29]	Since 1985: 9 pneumothorax cases after acupuncture. 27-year-old student seeking acupuncture at levator scapular.
Su, J. (2007) [30]	52-year-old female with chronic coughing. Acupuncture at BL13: paravertebral point at the level of the spinous process of the third vertebra: bilateral pneumothorax.
Lee, S. (2008) [31]	79-year-old male (hypertension and diabetes). Bacterial aortitis with pseudoaneurysm formation after acupuncture.
Hwang, JK. (2008) [32]	25-year-old female: Pneumoretroperitoneum after acupuncture in right psoas muscle.
Juss, JK. (2008) [33]	50-year-old female. Pneumothorax by acupuncture at scapulothoracic region.
Jindal, V. (2008) [34]	Acupuncture to prevent postoperative nausea in children and to inhibit chemotherapy vomiting in adults.
Tsakazaki, Y. (2008) [35]	32-year-old female (recurrent headache). Subarachnoid hemorrhage following acupuncture.
Witt, CM. (2009) [36]	Review of acupuncture for osteoarthritis knee or hip, low back pain, neck pain or headache, asthma, rinitis or dysmenorrhoea. 229.230 patients: 19.726 suffered at least one adverse effect.
Kim, JH. (2009) [37]	55-year-old female. Hemopericardium after acupuncture.
Kuo, HF. (2010) [38]	39-year-old female with paresthesia and soreness at popliteal fossa. Fistula arteriovenous: vascular complication after acupuncture.

Author/year	Description
Ernst, E. (2010) [39]	Systematic review of cardiac tamponade due to acupuncture. 5 Databases, no restrictions in time or language. 26 cases (14 fatal consequences).
Nam, KH. (2010) [40]	4 cases of epidural hematomas after facet block, acupuncture and epidural injections.
Inayama, M. (2011) [41]	37-year-old female. Pneumothorax and pleural fluid collection after acupuncture on neck and upper back.
Hsieh, RL. (2011) [42]	44-year-old female (aplastic anemia). Staphylococcus infection after acupuncture at right calf.
He, W. (2012) [43]	Chinese review of 167 papers: 1,038 cases (35 deaths).
Xu, S. (2012) [44]	Frequency and severity of adverse events of acupuncture, moxibustion and cupping between 2000-11: 117 reports with 308 adverse effects from 25 countries.
Lee, JH. (2012) [45]	47-year-old female: epidural abscess at C1-C3 after acupuncture and cupping.
Tagami, R. (2013) [46]	69-year-old male: bilateral pneumothorax after acupuncture at upper back.
Stenger, M. (2013) [47]	64-year-old male: pneumothorax after acupuncture for lumbar pain and sciatica.
	82-year-old female: pneumothorax after acupuncture for herpes zoster.
Lee, SW. (2014) [48]	47-year-old female with abdominal pain after acupuncture. Endoscopy: needle in the posterior wall of the antrum.
Hamptom, DA. (2014) [49]	43-year-old female with chronic neck pain. Pneumothorax after acupuncture.
Peuker, E. (2014) [50]	38-year-old female. Pneumothorax after acupuncture at subacromial region (BL13), paravertebral point at the spinous process of the third thoracic vertebrae.
Chun, KJ. (2014) [51]	48-year-old female, (breast cancer 7 years before). Cardiac tamponade after acupuncture at fourth intercostal space.
Peuker, E. (2014) [52]	Review of traumatic lesions after acupuncture.
Wu, J. (2014) [53]	Chinese review of adverse effects between 1980 and 2013. 3 databases: 182 incidents in 133 relevant papers.
Ji, GY. (2014) [54]	54-year-old female; 38-year-old female and 60-year-old male: 3 cases of hemiplegia after cervical paraespal needling (intramuscular stimulation, acupuncture or lidocaine) in 2002-2013 in Korea.
Schar, ML. (2015) [55]	39-year-old female with peripheral neuropathy history. Pneumothorax and broken needle in her chest.
Karavis, MY. (2015) [56]	37-year-old female. Haemothorax after acupuncture for neck and right upper back pain.
Callan, AK. (2015) [57]	15-year-old female with scoliosis. Periscapular abscess after acupuncture due to instrumentation.
White, A (2015) [58]	715 adverse effects: 90 trauma (186 secondary reports); 204 infections (91 reports); 144 miscellaneous (12 deaths).
Brogan, RJ. (2015) [59]	66-year-old male. Left pneumothorax after acupuncture (paraespal, infrascapular and axillary regions bilaterally) for low back pain secondary to arthritis.
Wigger, O. (2015) [60]	51-year-old female with breast pain and dyspnea. Cardiac perforation due to acupuncture.

Author/year	Description
Yao, Y. (2015) [61]	54-year-old male. Epidural abscess at C4-T2 due to acupuncture.
Huisma, F. (2015) [62]	53-year-old female. Pneumothorax after acupuncture at posterior left hemithorax medial to the scapula.
Kim, JS. (2016) [63]	Review between 2011 and 2015: 17 pneumothoraxes (1 bilateral and 16 unilateral).
Ehgbal, K. (2016) [64]	74-year-old female. Quadriplegia and sensory deficit due to cervical subdural hematoma at C4-C6 after acupuncture at neck and shoulder.
Li, X. (2017) [65]	Meta-analysis of 33 randomized controlled trials about dry needling and manual acupuncture until February 2016. 33 trials with 1.692 patients.
Kim, D. (2017) [66]	55-year-old female. She died by acute peritonitis three days after acupuncture.
Domenicucci, M. (2017) [67]	64-year-old male. Hematoma epidural spinal C2-T12 (hemiparesis and paresthesias) after acupuncture for lumbosacral pain.
Lee, HJ. (2017) [68]	Retrospective observational study (2010-2014): 10 pneumothorax and 2 pneumoperitoneum.
Sia, CH. (2018) [69]	50-year-old women. Pneumothorax after acupuncture for neck pain.
Lin, SK. (2019) [70]	Pneumothorax incidence after acupuncture in Taiwan (1997-2012) 411.734 patients, 5.407.378 treatments.
Lee, H. (2019) [71]	80-year-old male. Retroperitoneal abscess after lumbar acupuncture.
Lin, SK. (2019) [72]	Cellulitis after acupuncture incidence in Taiwan (1997-2012). 407.80 patients, 6.207.378 treatments.
Liu, ZH. (2019) [73]	42-year-old male. Broken needle in retroperitoneum after acupuncture treatments 2 years ago.
Tucciarone, M. (2019) [74]	36-year-old male. Abscess in prevertebral muscles after acupuncture.
Ullah, W. (2019) [75]	Old man. Pericarditis secondary to acupuncture after Staphylococcus aureus infection.
Priola, SM. (2019) [76]	47-year-old female. Epidural intracranial abscess after acupuncture.
Ullah, W. (2019) [77]	Systematic review about cardiac complications after acupuncture. 30 articles: 8 infections, 22 cardiac tamponades.
Corado, SC. (2019) [78]	79-year-old female. Pneumothorax 2 days after interscapular acupuncture.

Table 1.
Detail of articles included about acupuncture.

Author/year	Description
Antoni, RO. (1961) [79]	Review of 226 cases between 1955 and 1959: 71 iatrogenic pneumothoraxes.
Shafer, N. (1970) [80]	29-year-old female with severe neck pain with radiation into her right arm and limitation of motion. Pneumothorax after injection.
Cheng, J. (2007) [81]	Review from 1966 to November 2006: 35 papers. Infections, nerve injury, pneumothorax, embolism.
Usman, F. (2011) [82]	37-year-old female, 20 weeks pregnant. Retrosternal abscess after injection at sternoclavicular joint.
Ahiskalioglu, EO. (2016) [83]	25-year-old female. Pneumothorax after 4ml injection of lidocaine at thoracic region for neck and low back pain.

Author/year	Description
Soriano, PK. (2017) [84]	39-year-old male. Hipokalemic paralysis after injection guided by ultrasound in iliopsoas.
Choe, JY. (2017) [85]	70-year-old male (diabetic and cardiac history). Descending necrotizing mediastinitis after lidocaine injection at upper trapezius. Death by septic shock.
Lee, DG. (2018) [86]	38-year-old male. Scapular neuropathy after 1% lidocaine injection and 6ml of saline.
De la Torre-Canales, G. (2019) [87]	Systematic review about adverse effects of botulinum toxin A for masticatory muscles. 16 articles.
Camões-Barbosa, A. (2019) [88]	33-year-old female. Weakness after botulinum toxin A injection for spasticity.
Mozafari, N. (2019) [89]	55-year-old male. Cutaneous necrotic lesion after interferon beta 1-b injection.
Yurük, D. (2019) [90]	Rhabdomyolysis after epidural steroid injection.
Marcus, F. (2019) [91]	4 cases of Nicolau Syndrome: rare complication after intramuscular injections.
Kang, HY. (2019) [92]	Systemic toxicity after cervical epidural steroid injection guided (February 2016-October 2017) 11 patients.
Park, HB. (2019) [93]	Possible association between injections and calcification in lateral epicondylitis.
Al-Omari, AA. (2019) [94]	78-year-old male. Avascular necrosis after one intra-articular injection.
Lobaton, GO. (2019) [95]	62-year-old male. Vertebral osteomyelitis after epidural steroid injection. Permanent neurological injury.
Quincer, E. (2019) [96]	5-year-old male. Nicolau Syndrome after intramuscular injection in deltoid muscle.
Anderson, SE. (2019) [97]	Adverse effects after intra-articular corticosteroid injections (2000-2016), 1.708 patients, 104 adverse effects.
Kim, BR. (2019) [98]	Review of adverse events of intra-articular facet joint injections. (2007-2017). 11.980 procedures, 101 adverse events in 99 patients.
Wang, RN. (2019) [99]	61-year-old female. Oculo-motor nerve palsy after epidural lumbar injection.
Petrin, Z. (2019) [100]	87-year-old female. Paralysis without hematoma after lumbar epidural steroid injection.
Rensma, HG. (2019) [101]	33-year-old male. Nicolau syndrome after elbow injection.
Hu, Y. (2019) [102]	Optic perineuritis after hyaluronic acid injections.
Lee, JH. (2019) [103]	81-year-old female. Osteonecrosis after intra-articular corticosteroid injection.
Ali, D. (2019) [104]	72-year-old female. Ischaemic stroke after cervical transforaminal injection.
Rouientan, A. (2019) [105]	22-year-old male. Complication after botulinum toxin A.
Jani, P. (2019) [106]	Iatrogenic adrenal suppression after facet joint injection.
Desai, K. (2019) [107]	Review of 354 cases about iatrogenic peripheral nerve injuries.
Park, CW. (2019) [108]	68-year-old male. Iatrogenic injury of sciatic nerve after intramuscular injections.

Author/year	Description
Ali, SS. (2019) [109]	Iatrogenic spinal epidural hematoma and intracranial hypotension after thoracic epidural injection.
Sencan, S. (2019) [110]	3 males treated with transsacral blocks. Neuropatic sciatic after gluteal injection.

Table 2.
Detail of articles included about injections.

Author/year	Description
Lee, JH. (2011) [111]	58-year-old female with neck and upper extremity pain. Acute cervical epidural hematoma (C3-T1) after dry needling.
McCutcheon, L. (2011) [112]	Techniques modifications to avoid pleura and lung. Understanding anatomy and its variants. Safe technique for training physiotherapists.
Brady, S. (2014) [113]	2 questionnaires for 10 months. 39 physiotherapists and 1463 adverse effects. Safe technique.
Halle, JS. (2016) [114]	To evaluate benefits/risks of these techniques to minimize them.
Halle, JS. (2016) [115]	Adequate training and education: safe and effective technique. To inform patients via informed consent.
McManus, R. (2018) [116]	27-year-old female, secretary. Neurapraxia of radial nerve after dry needling.
Berrigan, WA. (2018) [117]	62-year-old female. Epidural hematoma and broken needle after dry needling.
Uzar, T. (2018) [118]	36-year-old male. Pneumothorax after dry needling for pain in back muscles.
Kim, DC. (2018) [119]	16-year-old male. Local abscess after dry needling at the thigh for pain after a knee injury.
McDowell, JM. (2018) [120]	Safety of acupuncture and dry needling in pregnant women. 124 responses: only 60 needle pregnant women and a 60% of them feel safety.

Table 3.
Detail of articles included about dry needling.

3.2 Characteristics of the reviewed articles

102 articles met the inclusion criteria of the research in the period between 2000 (January) and 2020 (January) in form of original articles, case reports and reviews. From these 102 articles selected, 23 refer to pneumothorax including more than 120 cases (19 of acupuncture, 3 of injection and 2 of dry needling); 4 articles refer to cardiac tamponade with more than 25 cases (both of acupuncture), 21 in relation to infections, abscesses or hemorrhages (14 of acupuncture, 6 of injection and 1 of dry needling) and other 7 articles refer to adverse effects such as syncope and cardiogenic shock (acupuncture), 3 pneumoperitoneo (acupuncture), 9 hematoma (6 of acupuncture, 1 of injection, 2 of dry needling), hemiplegia (acupuncture), cardiac perforation (acupuncture), hypokalemic paralysis (injection), 6 neuropathies (injection), 1 neuroapraxia (dry needling) and 12 cutaneous lesions/Nicolau syndrome/necrosis (3 of acupuncture, 9 of injection). In 11 articles there already was an existing disease, in other 4 the needle was broken and unfortunately in 4 articles the consequences were fatal. It has also collected 21 review articles of these needling therapies (more than 21.000 adverse effects described). Finally, 6 articles have synthetized information about benefits, risks, perception of security and even modifications of the application of these techniques (**Figure 4**).

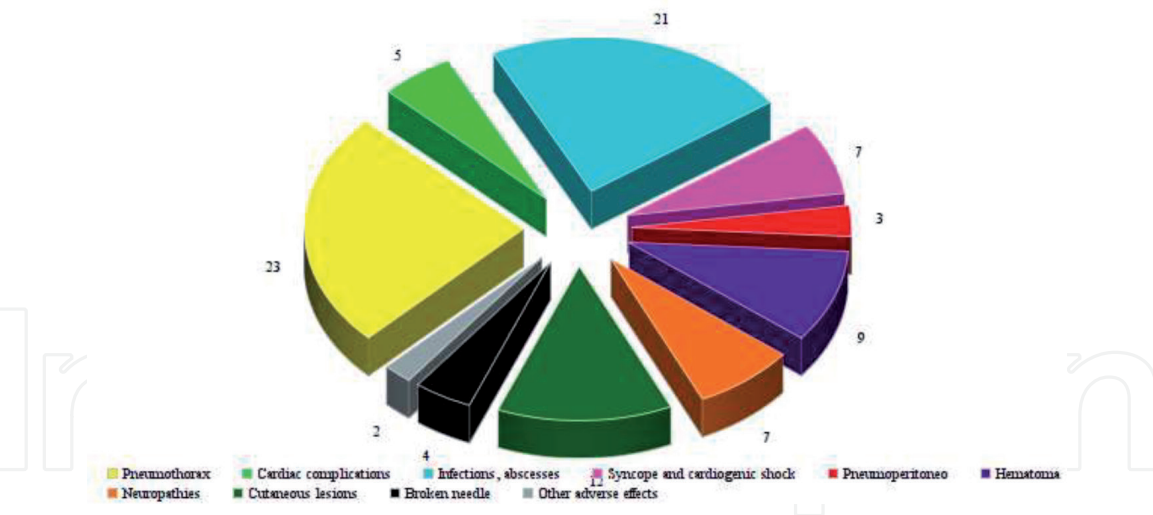


Figure 4.
Prevalence of most common adverse events.

4. Discussion

Considering the outpatient care treatment, adverse effects are possible complications that can occur during or even after the application of these techniques. In more cases there has little importance such as pain, a slight bleeding or a small bruise that disappears quickly. However, other adverse effects without a clear cause can suppose a serious risk for the patient.

These risks have always been present, but in recent years publications have increased considerably. There is no consensus about the classification of these adverse effects. Some authors [111] categorized them into four groups: delayed or missed diagnosis, adverse effects during treatment, bacterial or viral infections, or tissue or organ trauma.

4.1 Incidence/frequency of adverse effects

The incidence/frequency of these adverse effects is not clear. Acupuncture seems to have an incidence of 2/125.000 cases [30]; White et al. [58] estimated the risk of a serious adverse event with acupuncture at 0.05 per 10.000 treatments, and 0.55 per 10.000 individual patients, Lin et al. [70] reported a pneumothorax incidence of 0.87 per 1.000.000 acupuncture treatments and 1.75 per 1.000.000 in anatomical risk areas; these authors also showed a cellulitis incidence [72] about 64.4 per 100.000 treatments.

In relation to injections, Anderson et al. [97] explained an incidence of 5.8% of adverse effects. Kim et al. [93] introduced the incidence separately in relation with the case: 0.84% and 1.63% in relation to the patient; on the other hand, the procedure had an incidence of 0.07% and the administrated drug 0.15%. Finally, the unknown etiology had a 0.63% for this author [93] and for other authors it is unknown [121].

Data about incidence of dry needling procedures has not been found.

The most reviewed articles refer isolated cases and not a periodicity, but other authors have published several reviews that try to synthesize this information. Considering these 3 needling techniques, acupuncture leaves a clear superiority in relation to the number of publications with adverse effects.

Peuker et al. [20] investigated the traumatic wounds caused by acupuncture and discuss how these complications could be avoided. Lao et al. [22] reviewed 98

publications (1965–1999) and they found 202 complications (infections, tissue/organ damage and nerve injury). Cutaneous disorders, hypotension, fainting and vomiting were some adverse effects described. Chauffe et al. [29] found 9 cases of pneumothorax since 1985. Witt et al. [36] reviewed acupuncture studies in chronic osteoarthritis pain of the knee or hip, lumbar, cervical, head, allergic rhinitis, dysmenorrhea and asthma. Out of 229,230, 19,726 reported at least 1 adverse effect (bleeding, pain, vegetative symptoms). The longest duration of these adverse effects was 180 days (nerve injury). Ernst et al. [39] conducted a review of cardiac tamponade after acupuncture: 26 cases were found and 14 with fatal complications. He et al. [43] reviewed 167 articles with 1,038 cases (35 deaths) from Chinese literature. 468 cases were syncope, 307 pneumothorax, and 64 subarachnoid hemorrhage. Xu et al. [44] checked the frequency and severity of these effects (2000–2011): 117 articles with 308 adverse effects in 25 countries (294 for acupuncture, 4 moxibustion and 10 cupping). Peuker et al. [52] reviewed the traumatic lesions after acupuncture. Wu et al. [53] performed a review in China (1980–2013), finding 182 incidents in 133 papers (internal organ, tissue and nerve injury are the major complications). The adverse effects included were syncope, infection, hemorrhage, allergy, burn, aphonia, hysteria, cough, thirst, fever, somnolence and broken needles. White et al. [58] found 715 incidents in their review: 90 reports of trauma and 12 reports of death. In Taiwan, Lin et al. [70, 72] published 2 reviews (1997–2012) about pneumothorax and cellulitis incidence respectively. They evaluated 411,734 patients with 5,407,378 treatments of acupuncture [70] and 407,802 patients with 6,207,378 acupuncture treatments [72]. In both articles the authors emphasized the importance of the previous medical history. Ullah et al. [77] reviewed 133 articles and selected 30 cases with relevant cardiac complications: 8 were infective complications and 22 cardiac tamponades.

Regarding injections, 8 articles have been found. Antoni Ro et al. [79] reviewed 226 cases (1955–1959), finding 71 cases of pneumothorax and Cheng et al. [81] performed a review (1966–2006) explaining the complications of this technique: “infections, spinal cord injury and peripheral nerve injuries, pneumothorax, air embolism, pain or swelling at the site of injection, chemical meningism, granulomatous inflammation of the synovium, aseptic acute arthritis, embolia cutis medicamentosa, skeletal muscle toxicity, and tendon and fascial ruptures”. De la Torre et al. [87] introduced a review about the adverse effects caused by botulinum toxin A in masticatory muscles. They used 436 citations and concluded with 16:7 were myofascial pain and 9 were trigeminal neuralgia. The most frequent adverse effects were “temporary regional weakness, tenderness over the injection sites and minor discomfort during chewing”. Most of them had a spontaneous resolution. Marcus et al. [91] found a very rare complication due to injections (diclofenac, dexamethasone and benzathine penicilin): Nicolau Syndrome. They found 4 cases (2016–2018). Park et al. [93] investigates an association between steroid injection and calcification in lateral epicondylitis. They evaluated 110 patients (February 2016–October 2018) and concluded that the injections history and the number of them has a significative association with soft tissue calcifications. A review (January 2000–April 2016) about adverse events due to intra-articular corticosteroid injections was made by Anderson et al. [97] 1,708 patients from 3 regional hospital participated: 99 patients had 104 adverse effects within 90 days post-injection. The most prevalent symptom was flare (78 patients) and 10 patients had skin reactions. There were no infections. Years before, Kim et al. [98] had reviewed 11,980 injections in 6,066 patients (January 2007–December 2017). There were 101 facet-joint injections and 99 patients developed adverse effects. 7 patients had an infectious spondylitis, 1 patient died of an uncontrolled infection and 2 patients had partial recovery of their neurological

condition. Finally, Desai et al. [107] published a review of 17 years where reflected the iatrogenic peripheral nerve injuries due to injections. They included “intra-muscular injections, brachial nerves procedures, subclavian and jugular venous cannulation and routine intravenous injections”. The most frequent symptoms were pain, paresthesia and sensory-motor deficits. 190 patients needed surgical intervention, 164 had any sequel or no recovery and 9 had neurological deterioration with weakness.

There is not standard data on the incidence of these events. Unfortunately, the huge diversity of pathologies, interventions, therapists... makes difficult a generalization.

4.2 Most prevalent adverse effects

There is no consensus about the most frequent adverse effect in the literature. Some of them are pneumothorax, cardiac tamponade, air embolism, spinal epidural haematoma/abscess, abdominal visceral injury, median and fibular nerve injury and infection [20, 36, 75, 77, 81, 87, 111].

Some authors reflected that pneumothorax is the most cited adverse effect, [50, 63] while for others is infection [44]. White et al. [58] agree with both theories being the most common complication pneumothorax and injury to the central nervous system and infection will be in second place. Ullah et al. [77] concluded that cardiac tamponade is the most frequent complication.

It seems that invasive techniques on the thorax are related to a high incidence of pneumothorax [118]. There are some investigations in different countries (United Kingdom, Japan, Czechoslovakia, Switzerland, Germany, Japan and Taiwan) about it. The incidence of these cases is low, less than 1/10.000. However, there have been more than 100 cases reporting iatrogenic pneumothorax due to acupuncture and dry needling, including cases of death [112]. Lin et al. [70] showed an incidence of 0.84/1.000.000 and 1,75/1.000.000 at risk anatomical areas. Most iatrogenic pneumothorax used to be unilateral, but there are bilateral cases too [26, 30]. In this article there are 23 articles related to pneumothorax [19, 26, 29, 30, 33, 46, 47, 49, 50, 55, 56, 59, 62, 63, 68–70, 78–80, 83, 112, 118].

Other incidents (less frequent) reported in the literature but not less important are cardiac tamponade [21, 39, 51, 75, 77], granulomas [23], fistulas [24, 38], necrosis [25, 42, 85], infections [27, 57, 119], abscesses [27, 45, 61, 71, 74, 76], pneumoretroperitoneum [32], hemorrhages [35], hemopericardium [37], haematomas [40, 64, 67, 109, 111, 117], chilothorax [41], organ perforation [48, 60], needle rupture [53, 55, 117], hemiplegia [54], hemothorax [56], peritonitis [66], cellulitis [72], hypokalemic paralysis [84], nerve injury [86, 99, 102, 107, 108, 110, 116], weakness [88], necrosis [89, 90, 94, 103], Nicolau Syndrome [91, 96, 101], toxicity...[92] Almost all had a complete resolution of the symptoms. However, publications with fatal and irreversible consequences have also been found [24, 37, 98].

4.3 Special considerations

There are several aspects must be considered when carrying out these techniques in the treatment of muscular pain in outpatients. These incidents, even taking caution may occur; therefore, it is important to obtain a complete clinical history highlighting possible underlying pathologies [70–72]. Several articles have found patients with asthma [19], diabetes [25, 85], anemia [42], herpes zoster [47], cancer [51], miastenia gravis [55] and scoliosis [57] and sclerosis [89]. These pathologies could influence the appearance or greater probability of developing a complication.

4.4 Type of population

The age of the patients is other aspect to discuss. A review performed in children (acupuncture to prevent postoperative nausea) has been published without conclusion about its effectiveness [34]. Quincer et al. [96] showed the case of a 5-year-old boy who developed a Nicolau Syndrome after an intramuscular injection in deltoid. Besides, cases of elderly people who have suffered syncope's due to acupuncture have also been described [28]. These patients (the most prevalent population in the outpatient) may be more debilitated and suffer more adverse effects even taking precautions.

There are some types of population could be considered "at risk" when using these needling techniques, like pregnant women. We have found an article that exposes a retrosternal abscess due to sternoclavicular joint injection with resolution [82]. McDowell et al. have developed a review on the safety of acupuncture and dry needling in pregnant women in New Zealand. They conclude that of 124 responses obtained, only 60 therapists needle pregnant women and only 66% of them express safety. More training is needed in this field, particularly on dry needling [120].

In relation to sex, only one article showed major incidence in men than in woman [70].

4.5 Other applications of needling therapies

It seems that the most frequent application of these techniques is analgesia, including analgesic blocks [40], but there are other applications such hyaluronic acid in eyebrow [102], botulinum toxin A for axilar hiperhidrosis [105] and aesthetics for rejuvenation have also presented adverse effects [122, 123].

4.6 Reviews about safety

Among all reviews a meta-analysis of 33 randomized controlled trials was found. The authors conclude that acupuncture and dry needling are effective techniques, but more research on the safety of them is needed [65]. McCutcheon et al. [112] also reviewed the safety of acupuncture and dry needling, suggesting modifications of these techniques to avoid pleura and the lung. However, there are no conclusive results.

Considering the severity of these techniques, Brady et al. [113] conducted a study to check the adverse effects of dry needling. They filled in 2 questionnaires for 10 months to 39 physiotherapists and regrouped 1.463 adverse effects (common/less common/rare). They showed that it was a safe technique. Similarly, Halle et al. have published 2 articles [114, 115]. They assessed the risk/benefit of these techniques to minimize them, proposed an adequate education, knowledge of anatomy, training and to inform the patient via informed consent.

Guided techniques should be an interesting option to reduce these complications, but several articles do not support this affirmation [92, 110]. More investigation in this line is needed. On the other side, if dry needling seems to be safe, maybe it would be chosen instead injections to avoid the possible events effects derivate to the administered drugs like Kim et al. [93] exposed.

4.7 Limitations

Language was the first limitation, several articles have been found in France [124, 125], Portugal [126], Russia [127], Germany [128], Italy [129], Denmark [130], and Iceland [131] that have not been included in the revision due to its

original language. 3 reviews in Chinese [132], German [128] and Danish [133] respectively were excluded for the same reason. The first two expose a synthesis or classification of adverse effects and the third, is a review on acupuncture in children in Denmark. Letters and comments were also excluded; however, we highlight the case of acupuncture in the disease of behgets [134]; a letter to editor where they expose a case of pneumothorax during a demonstration of dry needling in the thoracic iliocostal [135] and a needle broken as a complication of acupuncture [136]. Neither has been taken into account articles on practical applications, effectiveness of such techniques or superiority of some over others.

4.8 Future investigations

Acupuncture seems to have the most adverse effects reported throughout the literature, while injections and dry needling are increasing their publications, probably due to the increase in popularity especially of the second [114, 115]. Nowadays adverse effects seem to be common, but complications are rare. All authors of these articles agree in some tips to take in consideration:

- The anatomy of the area to treat should be familiar to the healthcare professionals before undertaking the procedure.
- Communication with the patient via informed consent is needed.
- Aseptic conditions during the procedure are necessary.
- The appropriate time to apply the treatments correctly becomes essential for a good practice and an adequate achievement of the results.
- A correct training and continuous formation of healthcare practitioners are necessary.

5. Conclusion

This is a brief summary of the adverse effects found in the literature. There is no clear consensus about incidence, the most prevalent adverse effect, the intervention protocols, or experience of the therapist... As a conclusion, needling therapies are usual techniques in the outpatient care and complications are possible even considering all the precautions. Therapists have to know how to react, recognize the adverse effects and correct them as far as possible or refer the patient to the corresponding service, being always updated to new advances and familiar to the normal and variants of anatomy of the patients to avoid complications as much as possible. Caring the aseptic conditions and the communication with the patient to inform them about all the parts of the treatment with needling therapies are essential.

Conflict of interest

None declared.

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