Why is the Joker Laughing? Clinical Features for the Differential Diagnosis of Pathological Laughter

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The film *Joker* [1] was released in October 2019. The movie, directed by filmmaker Todd Phillips, became a hit, raising more than \$1,071,800,000 in worldwide box offices, and received 11 Academy Awards nominations, winning in two categories, including best actor in a leading role [2]. Its success is due in large part to the brilliant performance by Joaquin Phoenix as Arthur Fleck, a marginalized comedian who becomes a criminal boss known as the Joker. Some of the film's highlights are the episodes of pathological laughter that affect the protagonist on several occasions throughout the plot.

The term *pathological laughter* refers to unmotivated, exaggerated, uncontrollable, and involuntary outbursts of laughter that are incongruent with the experienced emotion [3]. This clinical phenomenon may be encountered in a heterogeneous group of diseases. Therefore, its prevalence varies according to the cause, being up to 40% in amyotrophic lateral sclerosis, 36% in multiple system atrophy, and 11 to 34% in cerebrovascular disease. In many other disorders, its prevalence remains unknown [4].

Considering the importance that *Joker* has gained in popular culture as a portrait of mental illness [5], we think it is interesting to review the aspects involved in the differential diagnosis of pathological laughter exemplified in this movie. In the following paragraphs, we present the main characteristics of the Joker's laugh (in relation with specific scenes from the film which are referenced with timestamps in parenthesis), followed by the discussion of each clinical syndrome.

The Laugh of the Joker

In the film, laughing episodes are excessive and inappropriate in relation to the context in which they occur. For example, in the scene where Arthur Fleck is trying to make a child laugh on the bus, the child's mother reproaches him. Immediately, Arthur begins to laugh uncontrollably while he tries to cover his mouth and makes gestures to explain that it is not his intention but that he cannot avoid it. He even carries a card with the legend "Forgive my laughter: I have a condition. It's a medical condition causing sudden frequent and uncontrollable laughter that doesn't match how you feel. It can happen in people with brain injury or certain neurological conditions. Thank you" (movie time points 00:08:35–00:09:22).

Moreover, there is a clear division between the protagonist's expressed emotion and his feelings, which is evident when the character is distressed, ashamed, or sad while laughing uncontrollably. For example, in the first scene of the film, we see how Arthur Fleck, dressed as a clown, is beaten up by a gang of youths. This scene is followed by the first episode of pathological laughter, which takes place when he meets his social worker and tells her "Is it just me, or is it getting crazier out there?" (movie time points 00:03:53 - 00:05:05). In that scene, we can notice he is obviously distressed by the physical aggression he had experienced. Throughout the movie, different scenes are shown in which the laughter appears in situations with an important emotional impact, totally opposite to the feeling of joy or happiness. For example, when he witnesses a group of young men harassing a woman in the subway (00:30:30–00:32:10); when he confronts Thomas Wayne, a man who Arthur thought was his father (01:06:30–01:07:15), or when he finds out he was adopted and his mother allowed her partner to physically abuse him during childhood, causing multiple traumas (01:13:52–1:15:50). In all these scenes, we see that Arthur tries unsuccessfully to stop his laughter, and sometimes, he also has some additional symptoms like sweating and nausea. When the laughter subsides, he expresses a state of sadness

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and despair. In all the episodes, laughter significantly interferes with his daily activities and deteriorates his quality of life.

Differential Diagnosis

Laughter may be a medical phenomenon in many neurologic and psychiatric entities, including pseudobulbar affect, tics, hallucinations, psychogenic disorders, stereotypes, and seizures. Below, we will discuss some important features for differential diagnosis in relation with the movie.

Pseudobulbar Affect

The above-mentioned characteristics make the Joker's laughing episodes compatible at first sight with the pseudobulbar affect, a clinical entity characterized by episodes of exaggerated or involuntary expression of emotions, including uncontrolled laughing or crying. The main proposed diagnostic criteria for pseudobulbar affect states that the emotional expression should be excessive or incongruent with the emotional experience and independent or in excess of the evoking stimulus. The symptoms must cause significant impairment in social or occupational functioning and cannot be attributed to another medical condition. Supportive criteria include the presence of exaggerated gag reflex, tongue weakness, bradylalia, dysarthria, and dysphagia (pseudobulbar syndrome) or autonomic signs and irritability or anger proneness [3].

The pathophysiologic mechanism responsible for pseudobulbar affect is attributed to dysfunction of the cortico–ponto–cerebellar network, where decreased inhibitory afferences from the brain cortex interfere with cerebellar control of motor expression. The pseudobulbar affect may be encountered in the setting of amyotrophic lateral sclerosis; neurodegenerative extrapyramidal and cerebellar disorders such as Parkinson's disease, multiple system atrophy, or progressive supranuclear palsy; multiple sclerosis; Alzheimer's disease and other dementias; stroke; brain tumors; and traumatic brain injury [4, 6]. Traumatic brain injury could be assumed to be a potential etiology of the case in the *Joker* movie, given that Arthur Fleck was a victim of severe physical abuse during his childhood. In fact, patients with pseudobulbar affect of any etiology have an increased prevalence of anxiety, psychiatric disorders, and inferior social performance in comparison with patients without this condition [6, 7].

Mania and Hypomania

Mania is a clinical state consistent in elevated mood, energy, and activity. It is associated with symptoms such as inflated

self-esteem, decreased need for sleep, verbosity, flight of ideas, distractibility, agitation, and reckless behavior. Manic episodes typically last oneweek and are present almost all day. Classically, mania is considered to be an acute state that is more severe and more long-lasting than hypomania. Hypomania is less severe, has a shorter duration, is not associated with psychotic symptoms, and usually does not affect the social or occupational environment. Both mania and hypomania constitute cardinal manifestations of bipolar disorders, a group of primary mood disorders characterized by recurrent alternating episodes of depression and mania or hypomania. Also, mania can be secondary to neurological disease (e.g., stroke, dementia, neurosyphilis, traumatic brain injury) or secondary to drug use (e.g., corticosteroids, anabolic steroids, alcohol, cocaine, levodopa, atypical antipsychotics) [8].

In the film, the disproportionality or inconsistency of laughter to Arthur Fleck's mood is a core feature that allows differentiating pseudobulbar affect from mania and hypomania, in which the patient feels euphoric while laughing. An important exception takes place at the end of the movie, when Arthur completes his transformation to Joker. He still has episodes of laughter similar to the previous ones, as when he kills a person on live television (movie time points 01:45:15 - 01:46:00) or when he murders a psychiatrist in the Arkham Hospital (01:54:00 - 01:55:40), but in these opportunities, he simply seems to be enjoying these extremely dramatic situations.

Hallucinations

Hallucinations are abnormal sensory perceptions that occur in the absence of an external object or stimulus. This symptom constitutes one of the five domains of the schizophrenia spectrum and other psychotic disorders [9]. Hallucinations can occur with significant frequency in other psychiatric conditions (e.g., posttraumatic stress disorder, bipolar disorder, personality disorders) [10] or be secondary to conditions related to use of toxins/drugs, disorders causing interference with the auditory or visual pathways, tumors, traumatic brain injury, and epilepsy.

Laughter during hallucinations is congruent with the patients' emotions, that is, they laugh because they see or hear something funny or pleasant when it actually does not exist. Joker presents some complex hallucinations, but they are not accompanied by episodes of laughter. The clearest example is that Arthur believes he has a relationship with his neighbor; this belief is in fact a combination of complex visual hallucinations and delusions (i.e., fixed beliefs that are not amenable to change in light of conflicting evidence). He sees and talks to his neighbor in different opportunities like in a stand-up comedy show, where she is part of the public, or at the hospital when his mother gets sick. Subsequently, we discover that

none of those moments were real in the scene where Arthur enters his neighbor's house and finds out she is terrified and begs him to leave because she barely knows him (movie time points 01:18:45 - 01:20:00).

Disorganized Motor Behavior

Disorganized or abnormal motor behavior is the inability to complete goal-directed activities. Patients are observed talking to themselves, becoming agitated in an unpredictable manner, or also undertaking what would be seen as inappropriate laughing or childlike behavior.

Arthur Fleck's disorganized behavior and complex hallucinations and delusions in some instances of the movie may indicate that his laughter attacks could be secondary to a psychotic disorder. These disorders are defined by abnormalities in one or more of the following domains: grossly disorganized or abnormal motor behavior, hallucinations, delusions, disorganized thinking (assessed by a person's speech patterns such as flight of ideas, neologism, perseveration, tangentiality), and negative symptoms (diminished emotional expression, avolition or lack of motivation, anhedonia, and asociality) [9, 11]. Psychotic experiences occur in around 4 to 7% of the general population [12]. Among the most frequent primary psychotic disorders, we can find schizophrenia and other schizophrenia spectrum disorders (schizotypal, schizophreniform and schizoaffective disorders). Furthermore, there are secondary psychotic disorders related to abuse of substances or medications or to another medical condition, such as Alzheimer's or Parkinson's disease, stroke, and traumatic brain injury, among others.

Psychotic disorder due to traumatic brain injury is an important etiologic diagnosis to consider because it is a common cause of neuropsychiatric disorders in young adults, especially males. The rate of pathological laughter and crying reaches 15.5% at 12 months after traumatic brain injury, and it is associated with increased psychiatric morbidity, including higher rates of depression, posttraumatic stress disorder, severe anxiety symptoms, aggression, impulsivity, and disinhibition [13]. Other studies report the development of psychosis five or more years after the event [14]. Lesions of temporal and frontal lobes are most commonly implicated in psychosis after traumatic brain injury, with the most psychotic symptoms associated being persecutory delusions and auditory hallucinations. Negative symptoms are much less prominent [15].

Psychogenic Laughter

Psychogenic non-epileptic seizures are involuntary paroxysmal behavioral, motor, sensory, autonomic, cognitive, or emotional changes resulting from psychological alteration. Clinical features of psychogenic non-epileptic seizures include spontaneous vocalizations such as moaning, grunting,

gasping, screaming, and crying [16]. Laughter has rarely been described, given that it has a gradual onset and a variable, usually prolonged, duration. However, distinct from the Joker's case, the symptom is fluctuating, often associated with erratic movements of the head or other parts of the body and patients typically close their eyes while laughing [17]. The definite diagnosis requires a careful evaluation and usually complementary electroencephalogram video recording.

Seizures

Seizures are paroxysmal clinical events secondary to abnormal excessive and synchronous neuronal activity. Signs and symptoms occurring during the paroxysm are wide and include alterations in mood and emotional expression [18]. Focal emotional seizure with laughing or gelastic seizures consist of recurrent stereotyped laughter or similar vocalizations associated with facial spasm, such as a smile. The episodes usually have no obvious trigger and are not associated with a pleasant feeling. Unlike the Joker, who remains aware during the attacks, in gelastic seizures, the consciousness is altered, and the patient does not remember what has happened. Paroxysms are generally associated with cognitive disorders and other types of seizures, which are absent in the film's protagonist. Finally, gelastic crises are infrequent in adults and are classically described in children with hypothalamic hamartomas [19].

Tics

Tic disorders represent a spectrum of neurodevelopmental disorders usually beginning before 18 years of age. The clinical phenomena of tics consist of non-purposeful, repetitive, and patterned phonetic or motor behaviors, typically associated with preceding uncomfortable sensory experiences which are relieved by tic performance [20]. In some cases, phonetic tics are very similar to laughter. An important characteristic of the Joker, however, is that his laughter does not generate a sense of relief and cannot be controlled. This condition makes it possible to differentiate the symptoms of pseudobulbar affect from tics. In the latter case, the patient is able to control the need to laugh at least partially but, nonetheless, experiences a measure of anxiety that is only relieved when the phonic component of the tic is manifested [21].

Stereotypies

Stereotypies are repetitive, seemingly driven, pseudo-purposeful motor behaviors usually beginning in the first decade of life. They may interfere with social, academic, or other activities and even result in self-injuries. Stereotypies may be primary (i.e., isolated) or secondary, appearing in association

with other behavioral and cognitive symptoms as a part of the clinical spectrum of chromosomal disorders or inborn errors of metabolism [20].

Some repetitive vocalizations similar to laughter may also be observed as part of those secondary stereotypies found in patients with schizophrenia, autism, or the microdeletion syndrome 15q13.3. In these cases, the phenomenon in the differential diagnosis gives way or changes with distracting maneuvers and is usually accompanied by motor stereotypes, which are absent during the Joker's laughter episodes [21].

Gelastic Cataplexy

Laughter is also part of the gelastic cataplexy, a clinical phenomenon characterized by episodes of sudden loss of muscle tone with collapse or falls occurring during laughter in people with Niemann Pick disease type C [22], which is a rare genetic lysosomal lipid storage disease with visceral, neurological, and psychiatric manifestations. This description does not fit well with the Joker's symptoms, as he always maintains the postural tone during laughter.

Isolated Pathological Laughter

Finally, it cannot be ruled out that the disorder of pathological laughter might be linked to any of the drugs consumed by the character, whose names were not specified in the film. Isolated pathological laughter has been described with the use of paroxetine, ziprasidone, and valproic acid, among others [23].

Approach to the Patient with Pathological Laughter

Evaluation of patients with pathological laughter requires a careful interview and physical examination. In most cases, clinical features allow differentiation among most of the entities mentioned above. It is always necessary to consider the history of medical, psychiatric, and neurological disease and the use of medications and substance abuse. The patient's physical appearance, mannerisms, abnormal movements and other neurological signs should be noted and taken into account, as they may be relevant to the diagnosis. Medical or neurological conditions should be ruled out first; brain imaging is usually required to exclude structural lesions of the central nervous system. Laboratory and other tests, such as electroencephalogram, should be performed in concordance with clinical suspicions. Treatment would depend on the etiology. Dextromethorphan plus quinidine is indicated for symptomatic treatment of pathological laughter in pseudobulbar affect; dopamine antagonist drugs are useful for the treatment of hallucinations and psychotic symptoms. Lithium and other mood stabilizer drugs are commonly used

for mania. Seizures will require antiepileptics depending on the clinical context. Behavioral strategies are useful for psychogenic disorders, tics, and stereotypies. For these last two, alpha agonists and antipsychotics are useful.

In conclusion, this article exemplifies how popular media such as the *Joker* film may be used for neuropsychiatric education. The interesting performance of Joaquin Phoenix as the Joker provides the possibility to explore aspects involved in the differential diagnosis of pathological laughter, a challenging symptom situated at the crossroads of neurology and psychiatry.

Declarations

Ethical Consideration No IRB approval was needed for this study

Disclosures On behalf of all authors, the corresponding author states that there is no conflict of interest.

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