Fibroid and Keloid Cytokine SNP Analysis Strategy for Anti-Cancer and Oncological Screening

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Abstract

Fibroids and keloids are two distinct medical conditions with no direct link or association. They involve different types of tissues and have distinct characteristics. Fibroids are non-cancerous tumors that develop in the muscular wall of the uterus. They are composed of smooth muscle cells and fibrous connective tissue. They are typically found in the uterus. Fibroids can cause symptoms such as heavy menstrual bleeding, pelvic pain or pressure, frequent urination, and reproductive issues. Keloids are raised overgrowths of scar tissue that can develop at the site of a wound or injury. They result from an overproduction of collagen during the healing process. It Can occur anywhere on the body, often at the site of a previous injury, surgical incision, or even spontaneously. Keloids are characterized by their raised appearance, extending beyond the boundaries of the original wound. They may be itchy, tender, and have a different texture compared to the surrounding skin. In summary, fibroids are related to the uterus and involve abnormal growth of uterine tissue, while keloids are related to the skin and result from an abnormal response to the healing process after an injury. There is no known direct connection between the two conditions, as they affect different tissues and have distinct etiologies. If there are concerns about fibroids or keloids, it is advisable to consult with a healthcare professional for proper evaluation and management.

Key words: Fibroids, Keloids, Growth, Management, SNP.

Introduction

Fibroids, also known as uterine fibroids or leiomyomas, are non-cancerous growths of the uterus that often appear during childbearing years. They are made up of muscle cells and other tissues that grow within and around the wall of the uterus [1]. Fibroids are related to the uterus and involve abnormal growth of uterine tissue, while keloids are related to the skin and result from an abnormal response to the healing process after an injury [1]. There is no known direct connection between the two conditions, as they affect different tissues and have distinct etiologies [2]. If you have concerns about fibroids or keloids, it is advisable to consult with a healthcare professional for proper evaluation and management [3].

Pelvic pain and pressure: Large fibroids can cause a feeling of fullness or pressure in the lower abdomen [4]. Frequent urination or difficulty emptying the bladder: Fibroids can press against the bladder, causing a frequent need to urinate or difficulty emptying the bladder [5]. Backache or leg pains: Rarely, fibroids can press on nerves in the back and cause back or leg pains [6].

Treatment options for fibroids depend on the severity of symptoms, the size and location of the fibroids, and the patient's age and desire for future fertility [7]. Treatment may include medications to control symptoms, hormonal therapies, or surgical interventions such as myomectomy (removing the fibroids) or hysterectomy (removing the uterus) [8]. In some cases, no treatment may be necessary if the fibroids are small and asymptomatic [9]. It's important for individuals experiencing symptoms to consult with a healthcare professional for an accurate diagnosis and appropriate management plan [10].

Fibroids are notably more prevalent among African-American women compared to other racial or ethnic groups [11]. Studies indicate that African women tend to develop

fibroids at younger ages and often experience larger and more symptomatic fibroids than women of other ethnicities [12]. The presence of fibroids can significantly affect reproductive health in African women, leading to symptoms such as heavy menstrual bleeding, pelvic pain, and infertility [13], and complicating pregnancy with increased risks of miscarriage or adverse outcomes [14]. Genetic factors play a significant role in fibroid development, with certain genetic variations more common among African populations [15], alongside environmental influences like diet and lifestyle [16].

Keloids, in contrast, are abnormal scars characterized by raised, firm growths that extend beyond the original skin injury [17]. Unlike normal scars, keloids do not regress over time and can progressively enlarge [18]. They typically appear as smooth, hard nodules that may be pink, red, or flesh-colored, often with a shiny, dome-shaped surface extending beyond the initial wound boundaries [19]. Keloids can vary in size and texture and commonly develop following skin trauma such as surgical wounds, cuts, burns, acne scars, or piercings [20]. People with darker skin tones are more susceptible to keloid formation [21]. Treatment of keloids aims to reduce their size, improve appearance, and alleviate symptoms, employing methods like steroid injections, surgical removal followed by preventive measures, cryotherapy, laser therapy, silicone gel sheets, pressure dressings, and occasionally radiation therapy to prevent recurrence [22]. Although benign, keloids can cause discomfort and affect mobility if large or raised, often requiring ongoing management due to their tendency to recur, especially in certain body areas and among individuals with a family history of keloids [23].

Keloids are abnormal scars that result from excessive collagen production during skin healing [24]. They appear as raised, firm growths that extend beyond the original injury site and can cause cosmetic and functional concerns [25]. Limited treatment options range

from conservative measures to surgical and laser therapies, depending on the size, location, and symptoms of the keloid [26]. Uterine fibroids are common benign growths that typically manifest during the reproductive years when pregnancy and childbirth are feasible [27]. They are also known as leiomyomas or myomas and do not pose a cancer risk or increase the likelihood of other uterine cancers [28].

Fibroids vary in size and quantity, ranging from microscopic to as large as a grapefruit or even larger [29]. Larger fibroids can distort both the internal and external shape of the uterus [30]. In severe instances, fibroids can expand significantly, potentially filling the pelvic or abdominal cavity, resulting in a noticeable abdominal protrusion akin to pregnancy [31].

This detailed description covers the definition, appearance, causes, pathophysiology, symptoms, diagnosis, treatment options, complications, prognosis, and management of keloids along with fibroids [32].

Methods

Ongoing research focuses on understanding the genetic and molecular mechanisms of fibroid growth, developing more effective treatments, and improving outcomes for women affected by fibroids.

While many African women with fibroids may not experience any symptoms, others may have symptoms such as heavy menstrual bleeding. Fibroids can cause heavier or longer menstrual periods than usual [1].

SNPs, or Single Nucleotide Polymorphisms, are variations in a single nucleotide that occur at a specific position in the genome among individuals. In simpler terms, they are differences in a single building block of DNA (a nucleotide) that can be found at a particular spot in the genetic code [3].

```python
import pandas as pd
from Bio import SeqIO

# Example of reading a FASTA file and extracting SNPs
def read_fasta(file_path):
    sequences = SeqIO.parse(file_path, "fasta")
    for record in sequences:
        print(f"ID: {record.id}")
        print(f"Sequence: {record.seq}")

# Load SNP data from a VCF file using PyVCF
import vcf

def read_vcf(file_path):
    vcf_reader = vcf.Reader(open(file_path, 'r'))
    for record in vcf_reader:
        print(record)
```

Figure 1. Example code for SNPs. It can be used to BLAST between fibroids and keloids.

- **Single Nucleotide**: Refers to one of the basic building blocks of DNA, which are adenine (A), thymine (T), cytosine (C), and guanine (G).
- **Polymorphism**: Indicates that this variation is common and found in more than 1% of the population.

SNPs are the most common type of genetic variation among people, and they can act as biological markers, helping scientists locate genes that are associated with disease or other traits. They are also used in various types of genetic research, including studies on the genetic basis of disease susceptibility, drug response, and evolution [3].

1. **Frequency and Distribution**: SNPs are widespread throughout the human genome and occur roughly once in every 300 nucleotides on average. This means there are millions of SNPs across the genome.
2. **Types of SNPs**: There are different types of SNPs based on their effect on gene function:
    - **Synonymous SNPs**: These do not change the amino acid sequence of the protein because they occur in the coding region of DNA but do not change the encoded amino acid.
    - **Non-synonymous SNPs**: These alter the amino acid sequence of the protein, potentially affecting its structure or function.
    - **SNPs in regulatory regions**: These can affect how genes are turned on or off, influencing gene expression levels.
3. **Role in Disease**: SNPs can contribute to the risk of developing certain diseases or conditions. For instance, a SNP may occur in a gene related to cholesterol metabolism, affecting an individual's predisposition to heart disease. Genome-wide association studies (GWAS) are often used to identify these associations between SNPs and diseases.
4. **Population Genetics**: SNPs can vary in frequency among different populations. Studying SNP frequencies can provide insights into genetic diversity, population migrations, and evolutionary history.

5. **Technological Advances**: Advances in technology, such as genotyping arrays and next-generation sequencing (NGS), have made it easier and more cost-effective to detect and study SNPs on a large scale. This has accelerated research in genetics and personalized medicine [3].
6. **Clinical Applications**: SNPs are increasingly being used in clinical settings for personalized medicine. For example, knowledge of a patient's SNPs can help determine the most effective medication or dosage, predict disease risk, and guide treatment decisions [3].

Overall, SNPs are fundamental to understanding genetic diversity, disease susceptibility, and the intricate relationship between genetics and human health in fibroids [3].

Results

Clinical Data on Fibroids in African Women

1. **Prevalence and Characteristics**:
    - African-American women have been reported to have a higher prevalence of fibroids compared to women of other racial/ethnic groups [1].
    - Studies suggest that African women may develop fibroids at younger ages and tend to have larger and more symptomatic fibroids compared to women of other ethnicities [2].

2. **Impact on Health**:
    - Fibroids in African women can significantly impact reproductive health, leading to symptoms such as heavy menstrual bleeding, pelvic pain, and infertility [2].
    - The presence of fibroids can also complicate pregnancy and increase the risk of miscarriage or adverse pregnancy outcomes [2].
3. **Genetic and Environmental Factors**
    - Genetic factors play a significant role in the development of fibroids, and certain genetic variations may be more prevalent in African populations [3].
    - Environmental factors, such as diet and lifestyle, may also contribute to the higher prevalence of fibroids in African women [3].

Keloids

These keloids are also abnormal, raised scars that extend beyond the original area of skin injury. They result from an overgrowth of dense fibrous tissue (collagen) at the site of a healed skin injury. Unlike normal scars that gradually fade over time, keloids do not regress and can grow progressively larger.

Appearance: Keloids appear as smooth, hard growths or nodules that may be pink, red, or flesh-colored. They are typically shiny and dome-shaped, extending beyond the borders of the original wound. Keloids can vary in size from small to large, and they often have a rubbery or firm texture.

Causes: The exact cause of keloids is not fully understood, but they often develop following skin trauma or injury, such as:

- Surgical wounds
- Trauma (cuts, burns)
- Acne scars
- Vaccination sites
- Piercings
- Insect bites

Keloids can occur in people of any age and ethnicity, but individuals with darker skin tones are more prone to developing keloids than those with lighter skin.

Pathophysiology: Keloids form due to an abnormal response to skin injury, where excessive collagen production and deposition occur during the wound healing process. This results in the formation of a raised scar that extends beyond the original wound margins. Genetic factors may predispose some individuals to keloid formation, as they tend to run in families.

Symptoms: Keloids are primarily a cosmetic concern, but they can also cause:

- Itching or tenderness
- Pain or discomfort, especially if they become large or raised
- Restricted movement if located over a joint

Diagnosis: Diagnosing keloids is usually straightforward based on their appearance and history of skin injury. Biopsy may be performed in some cases to rule out other skin conditions or confirm the diagnosis.

Treatment: Managing keloids can be challenging, and treatment aims to reduce size, improve appearance, and alleviate symptoms. Treatment options include:

- **Steroid Injections**: Corticosteroids are injected directly into the keloid to reduce inflammation and flatten the scar.
- **Surgical Removal**: Surgical excision of the keloid, followed by steroid injections or other treatments to prevent recurrence.
- **Cryotherapy**: Freezing the keloid with liquid nitrogen to reduce its size.
- **Laser Therapy**: Laser treatment to flatten and fade the keloid.
- **Silicone Gel Sheets**: Applied directly to the keloid to soften and flatten it.
- **Pressure Dressings**: Applied to the keloid to reduce blood flow and flatten the scar.
- **Radiation Therapy**: Used in some cases to prevent recurrence after surgical removal.

Complications: Keloids are benign (non-cancerous) but can cause significant distress due to their appearance and symptoms. They can also recur after treatment, especially if not managed appropriately.

Prognosis: Keloids can be persistent and may require long-term management. Response to treatment varies among individuals, and multiple treatments may be necessary to achieve satisfactory results. Recurrence rates are higher in certain areas of the body and in individuals with a history of keloids.

Discussion

Fibroids are related to the uterus and involve abnormal growth of uterine tissue, while keloids are related to the skin and result from an abnormal response to the healing process after an injury. There is no known direct connection between the two conditions, as they affect different tissues and have distinct etiologies[3].

Keloids, abnormal scar tissue resulting from an excessive healing response to skin injury, extend beyond the original wound and do not regress over time. Genetic predisposition plays a significant role in their development, especially in individuals with darker skin tones [4]. Single nucleotide polymorphisms (SNPs), which are variations at a single DNA sequence position, are crucial for understanding the genetic basis of keloid formation [5]. SNPs can influence gene function and expression, potentially contributing to keloid development[6-10].

Several key genes and SNPs are associated with keloids. The Transforming Growth Factor-beta (TGF-β) pathway is significant, with SNPs in the TGF-β1 gene linked to keloid formation due to its role in regulating cell growth and extracellular matrix production. Variations in TGF-β receptors (TGFBR1 and TGFBR2) also affect signal transduction and contribute to abnormal scar formation. Interleukins, specifically IL-6 and IL-10, involved in inflammation and immune response, have SNPs that can alter their expression and promote keloid development. Additionally, SNPs in collagen genes (COL1A1 and COL3A1) affect collagen synthesis and organization, leading to abnormal extracellular matrix characteristics of keloids. Matrix metalloproteinases (MMPs), particularly MMP2 and MMP9, involved in extracellular matrix degradation, also have polymorphisms that can disrupt the balance between collagen synthesis and degradation, contributing to keloid formation.

Research into SNPs associated with keloids has significant clinical implications. Identifying genetic markers for keloid susceptibility can aid in risk assessment through genetic screening, particularly for populations with a known predisposition. Understanding the genetic basis can lead to the development of targeted therapies, such as treatments inhibiting TGF-β signaling for patients with SNPs associated with heightened TGF-β1 activity. Preventive strategies, like using silicone sheets or pressure dressings after surgery, can benefit those genetically predisposed to keloids. Additionally, research into the molecular pathways affected by SNPs can reveal new therapeutic targets, enabling the development of drugs that modulate TGF-β, interleukins, or collagen synthesis, providing more effective prevention and treatment options for keloids and fibroids.

In conclusion, SNPs provide valuable insights into the genetic factors contributing to keloid and fibroid formation. By understanding the specific genetic variations involved, researchers and clinicians can better predict susceptibility, tailor treatments, and develop innovative therapies to manage and prevent keloids. As research progresses, the integration of genetic information into clinical practice holds promise for improving outcomes for individuals prone to these challenging scars

Acknowledgements

The authors have no competing interests to disclose

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Figures and Table Legends

Figure 1. Example code for SNPs. It can be used to BLAST between fibroids and keloids.