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Review

The aetiopathogenesis of capsular contracture: A systematic review of the literature

Yara Bachour [1,*], Stephan P. Verweij [2], Susan Gibbs [3,4], Johannes C.F. Ket [5], Marco J.P.F. Ritt [1], Frank B. Niessen [1], Margriet G. Mullender [1]

[1] *Department of Plastic, Reconstructive and Hand Surgery, VU University Medical Centre, Amsterdam, The Netherlands*
[2] *Laboratory of Immunogenetics, Department of Medical Microbiology and Infection Control, VU University Medical Centre, Amsterdam, The Netherlands*
[3] *Department of Dermatology, VU University Medical Centre, Amsterdam, The Netherlands*
[4] *Department of Oral Cell Biology, Academic Centre for Dentistry Amsterdam, University of Amsterdam and VU University, Amsterdam, The Netherlands*
[5] *Medical Library, Vrije Universiteit, Amsterdam, The Netherlands*

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Summary *Background:* Capsular contracture is the most frequent complication after breast augmentation or reconstruction with breast implants. The immune system plays a prominent role in capsular contracture formation, albeit to an unknown extent. Bacterial contamination *in situ* has been hypothesized to be causative for capsular contracture. How this relates to the immunological processes involved is unknown. This article aims to provide an overview of immunological and bacterial factors involved in development of capsular contracture.
Materials and methods: We undertook a systematic literature review focused on immunological factors and microbiota in relation to capsular contraction around implants. This systematic review was performed in accordance with the PRISMA guidelines. PubMed, EMBASE, and the Cochrane databases were searched from inception up to October 2016. Included studies were assessed for the following variables: subject characteristics, number of capsules, primary indication for surgery, surgical procedure, follow-up or implant duration, study methods, type of antibiotics or medical therapies and outcomes related to microbiota and immunological factors.

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* Corresponding author. Department of Plastic, Reconstructive and Hand Surgery, VU University Medical Centre, De Boelelaan 1117, PO Box 7057, 1007 MB Amsterdam, The Netherlands.
E-mail address: yarabachour@gmail.com (Y. Bachour).

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Results: Data on immunological factors and bacterial contamination were retrieved from 64 included studies. Notably the presence of macrophages and *Staphylococcus epidermidis* within capsules was often associated with capsular contracture.
Conclusion: This review provides a clear overview of the immunological factors associated with capsular contracture and provides a hypothetical immunological model for development of the disease. Furthermore, an overview of bacterial contamination and associations with capsular contracture has been provided. Follow-up research may result in clinical recommendations to prevent capsular contracture.

Contents

Introduction

For decades breast implants have been used for breast augmentation or reconstruction after mastectomy.[1] Capsular contracture is the most frequent complication after breast augmentation or reconstruction with breast implants.[2–4] It is the primary reason for reoperation and has high recurrence rates.[3] Hardening, distortion of the breast, and pain are symptoms of capsular contracture. The degree of contracture is clinically graded by the grading system according to Baker.[5] The prevalence of capsular contracture varies between 5% and 19% for breast augmentation.[3,6,7] A much higher percentage has been reported after breast reconstruction, ranging from 19% to 25%.[7–9]

A foreign body reaction is a natural tissue response after insertion of a breast implant. The immune response around the implant involves macrophages, T-cells and a variety of cytokines.[10,11] In time, the pro-inflammatory cells reduce in number and fibroblasts accumulate around the implant. A fibrous capsule is then formed.[12–14] Normally the capsule is soft and thin and does not influence the shape of the breast. Conversely, contracted capsules tend to thicken, stiffen, and constrict around the implant, which is attributed to an excess of myofibroblasts within the capsule.[15] To date, the aetiology of capsular contracture is unknown and there is much debate about the pathogenesis of the disease. Many authors have focused on surgical techniques, and types of prostheses in relation to development of capsular contracture.[3,16–19] However, adaptation of technique or implant characteristics have not reduced the incidence of capsular contraction. Several risk factors have been identified, and additional causative factors have been proposed, such as occurrence of a subclinical infection, an excessive foreign body reaction, and gel-bleed of the silicone prosthesis. Although none of these theories are conclusive so far,[20–27] there is consensus that the immune system plays a prominent role in contracture of the capsule, albeit to an unknown extent.

Bacterial contamination of the implant has frequently been proposed as a likely cause of capsular contraction and some indications for this theory exist.[26,28,29] To understand the possible role of contamination, a clear picture of the immunopathogenesis of capsular contracture is necessary. Therefore, the aim of this systematic review is twofold: 1) to give an overview of immunological factors involved in