Risk factors for and characteristics of dysphagia development in thermal burn injury and/or inhalation injury patients: a systematic review protocol

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Review question/objective

The objective of this review is to identify, critically appraise and synthesize the best available evidence on risk factors for the development of dysphagia (swallowing impairment) in thermal burn injury and/or inhalation injury patients,

More specifically, the objectives are to:

i. Examine the current evidence on factors, including medical interventions such as intubation, that are associated with the development of dysphagia in adults and children with thermal burn injury and/or inhalation injury

ii. Examine the current evidence on the characteristics of dysphagia (such as sensory or physiological impairment, anatomical stage [oropharyngeal versus laryngeal] and dysphagia duration) as a result of thermal burn injury and/or inhalation injury on adults or children.

Background

Dysphagia, or swallowing impairment, is the inability to effectively transfer food and liquid from the mouth to the stomach.¹ It can occur across all age groups and be a result of a variety of congenital, neurological and/or medical conditions and/or structural damage.² Dysphagia is a known potential consequence following thermal burn injury,³-⁵ with a recent Australian study reporting an incidence of 11%⁶ in all burn injuries. The presence of dysphagia amongst this population can complicate and prolong patient recovery by limiting their capacity to safely meet high nutrition and hydration
requirements via oral intake, placing them at risk of aspiration and subsequent respiratory compromise, and increasing the length of time they require a feeding tube.3,6,7

Within the burn injury population it has been reported that nearly 73% of patients admitted to the ICU and 83% of patients requiring mechanical ventilation will present with dysphagia.6 Inhalation injury itself has been reported as a predictive factor for dysphagia, with nearly 87% of patients with inhalation injury admitted in one study developing diagnosable characteristics compared to just under 6% of patients admitted without inhalation injury.6 Inhalation injury, which is caused by the inhalation of hot air, smoke and possibly chemical irritants as a result of a fire, commonly seen when patients are in an enclosed environment at the time of exposure6,9, frequently requires critical care medical interventions, such as endotracheal intubation, re-intubation, tracheostomy, and nasogastric tube feeding. All of these interventions could potentially exacerbate or increase the risk of developing laryngo-pharyngeal pathology and/or dysphagia.4,10-13 Diagnosis of inhalation injury however is challenging, as currently there are no clear consensus guidelines for diagnosis and grading of inhalation injury.8,14,15 Current diagnosis is often clinically based from subjective assessments of history and physical examination, and followed by confirmation with diagnostic studies, such as bronchoscopy.8 Evidence of inhalation injury seen on bronchoscopy includes soot deposits, erythema, edema, mucosal blisters, mucosal erosions, hemorrhages and bronchorrhea.16 The Association for the Advancement of Automotive Medicine (AAAM) has developed a severity scoring system for the classification of injury severity.17 This Abbreviated Injury Scale (AIS) has been adapted to standardize coding for inhalation injury severity17, which is shown in Table 1. Challenges exist in clinical practice however as symptoms of inhalation injury may be delayed in presentation and confounded by acute lung injury as a result of reperfusion injury or systemic inflammatory responses subsequent to the cutaneous burn, and as such do not correlate with the amount of time patients may require intubation for mechanical ventilation.8

<table>
<thead>
<tr>
<th>Grade</th>
<th>Class</th>
<th>Description</th>
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<tbody>
<tr>
<td>0</td>
<td>No injury</td>
<td>Absence of carbenaceous deposits, erythema, edema, bronchorrhea and obstruction</td>
</tr>
<tr>
<td>1</td>
<td>Mild injury</td>
<td>Minor or patchy areas of erythema, carbenaceous deposits in proximal or distal bronchi</td>
</tr>
<tr>
<td>2</td>
<td>Moderate injury</td>
<td>Moderate degree of erythema, carbonaceous deposits, bronchorrhea and obstruction</td>
</tr>
<tr>
<td>3</td>
<td>Severe injury</td>
<td>Severe inflammation with friability, copious carbonaceous deposits, bronchorrhea and obstruction</td>
</tr>
<tr>
<td>4</td>
<td>Massive injury</td>
<td>Evidence of mucosal sloughing, necrosis and endoluminal obliteration</td>
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</table>

In this patient group, severe deconditioning and resultant muscle atrophy associated with prolonged critical illness and hospitalization could also increase the risk of swallowing dysfunction and aspiration.11-13,15 Other predictive factors reportedly associated with the development of dysphagia in the burn injury population include burns to the head and neck regions4 and subsequent scar formation, severity of burned area greater than 18% total body surface, and the need for escharotomy.6
It has recently been acknowledged that the nature and severity of dysphagia in the burn injury population cannot be reliably determined via the standard clinical bedside swallowing assessment alone. This population has an increased risk of impaired pharyngeal and laryngeal sensation, anatomical and/or physiological abnormalities, and consequently silent aspiration. An instrumental evaluation such as a Fibreoptic Endoscopic Evaluation of Swallowing (FEES) in combination with the standard clinical assessment has been recommended to accurately evaluate the complex and multifactorial nature of dysphagia. Diagnostic tools used for the evaluation of oral/pharyngeal/dysphagia in clinical practice and research are listed in Table 2, along with their strengths and limitations for use.

Table 2: Diagnostic tools for the evaluation of oral/pharyngeal/dysphagia and their caveats for use

<table>
<thead>
<tr>
<th>Diagnostic test</th>
<th>Administrator of test</th>
<th>Strengths</th>
<th>Limitations</th>
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<tbody>
<tr>
<td>Bedside clinical swallow assessment/evaluation (CSA/CSE)</td>
<td>Speech and Language Pathologist</td>
<td>Quick and easy to administer Non-invasive</td>
<td>Subjective Risk of false negative</td>
</tr>
<tr>
<td>Video Fluoroscopic Swallow Study (VFSS) (Modified Barium swallow [MBS])</td>
<td>Radiologist, and Speech and Language Pathologist</td>
<td>Objective view of swallow function Identification of altered anatomy “considered gold standard”</td>
<td>Participant needs to be able to attend radiology suite, follow commands and sit upright Low level radiation exposure Specialist equipment and personnel required Expensive Reduced patient acceptance of barium Contra-indicated with some allergies (barium)</td>
</tr>
<tr>
<td>Fibreoptic Endoscopic Evaluation of Swallowing (FEES)</td>
<td>Credentialed Speech and Language Pathologist and/or ENT Medical Specialist</td>
<td>Objective view of swallow function Can be performed at bedside</td>
<td>Specialist equipment and personnel required Reduced patient acceptance possible due to invasive procedure</td>
</tr>
</tbody>
</table>

In a prospective cohort study published in 2012, Rumbach and colleagues aimed to determine clinical profiles for dysphagic and non-dysphagic patients following burn injury as well as profile the progression and resolution of dysphagia by hospital discharge. This study included 438 participants, with and without inhalation injury, who were admitted for thermal burn injury management over a 24-month period. Data collection included duration of ventilation, time to conversion of endotracheal tube to tracheostomy tube, and duration of tracheostomy. A clinical swallow assessment was used to evaluate for the presence of dysphagia, and severity was rated according to a purpose-built dysphagia severity
rating scale (defined as mild, moderate or severe). In this cohort it was determined that patients who developed dysphagia had a statistically higher incidence of inhalation injury, head and neck burns as well as longer periods of intubation and ventilation ($p \leq 0.01$). Eight patients required tracheostomy insertion, with all of these participants presenting as dysphagic prior to and post tracheostomy. Length of hospital stay was significantly longer ($p < 0.01$) for patients with dysphagia. In the dysphagic group, 71% were reported to have moderate to severe dysphagia with swallow deficits in the oral and pharyngeal stages of their swallow. Resolution of dysphagia was seen by week six of admission in 50% of dysphagic participants with a resolution of 75% by week nine and 86% had recovered by discharge from hospital.

In an earlier retrospective study by Clayton and colleagues, patients with severe burn injury based on the Australian and New Zealand Burn Association criteria for transfer to a specialized burn unit, who were admitted consecutively over a seven-year period and who received a tracheostomy, were investigated to determine their risk of dysphagia following decannulation. Of the 230 patients admitted, 201 required intubation and ventilation with 26 (11.3%) of these further requiring tracheostomy insertion as part of their medical management. Clinical swallow assessment was performed on 19 tracheostomized patients, with seven displaying evidence of dysphagia whilst the tracheostomy was in situ and the remaining 12 remained dysphagic post decannulation. Two patients remained unsafe for oral intake and were discharged with percutaneous gastrostomies for enteral tube feeding. In patients who did resume oral intake, the mean time from cessation of ventilation to oral intake was 17.1 days with the mean time to resuming their pre-morbid diet being 27.5 days.

DuBose and colleagues conducted a retrospective study of patients referred to Speech Pathology for swallow evaluation over a six-year period to examine the pattern of dysphagia recovery following burn injury. In this cohort it was determined that there was a strong positive linear relationship between percentage of total body surface area (%TBSA) burned ($r=0.71$), duration of tracheostomy insertion ($r=0.85$), duration of mechanical ventilation ($r=0.94$) and days to oral intake.

To date, no systematic reviews have been identified through searches of MEDLINE and the Cochrane Library and JBI Database of Systematic Reviews and Implementation Reports investigating the risk of developing dysphagia in patients with thermal and/or inhalation injury, or the characteristics and progression of dysphagia in these patients when it does occur. As a result, this review will synthesize the current evidence on swallowing function outcomes in patients who have sustained a thermal and/or inhalation burn injury with the aim of describing dysphagia characteristics, including risk factors for development.

**Keywords**

Dysphagia, burn injury, burn, burns, thermal injury, FEES, MBS

**Inclusion criteria**

**Types of participants**

This review will consider studies that include children (two to 17 years) and adults (≥ 18 years) who have sustained any thermal burn injury of any size to anybody area and/or inhalation injury, and been admitted to an ICU, Burns ICU (BICU) or burns unit for management of their injury. Studies that include patients with significant multi-trauma in addition to burn injury will be excluded.
Types of interventions/phenomena of interest

This review will consider studies that evaluate swallowing function following thermal and/or inhalation injury. In regards to investigating the evidence regarding risk of dysphagia development, studies that examine risk factors including but not limited to head and neck or facial burns, inhalation injury and/or tracheostomies as part of their medical management will be considered for inclusion. Studies investigating intubated patients for mechanical ventilation, as part of their critical care medical management, will be included with particular interest on the intubation duration on dysphagia presentation and progression with or without inhalation injury.

With regards to investigating characteristics of dysphagia, studies investigating oral, laryngeal and/or pharyngeal phase dysphagia, dysphagia duration and rehabilitation requirements (including duration and intensity of Speech Pathology interventions, and rehabilitation strategies employed) will be considered. Studies only investigating oesophageal dysphagia aetiologies will be excluded.

Types of outcomes

This review will consider studies that include the following primary outcome measures: presence of dysphagia or altered pharyngeal/laryngeal function/sensation assessed using objective assessment tools including FEES, Modified Barium Swallow (MBS), videofluoroscopy, video fluoroscopic evaluation of swallowing or subjective assessments such as clinical bedside assessment, clinical swallowing evaluation, and dysphagia screening assessments either alone or combined. Studies comparing efficacy of objective versus subjective evaluation methods will be considered for inclusion.

Secondary outcome measures: Presence of head and neck/facial burn injury, presence of inhalation injury, need for and duration of mechanical ventilation +/- tracheostomy, rehabilitation strategies and duration of rehabilitation required within the acute care setting until dysphagia resolution.

Types of studies

This review will primarily consider observational study designs, including cross sectional and prospective and retrospective cohort studies and case control studies, for inclusion.

Search strategy

The search strategy aims to find both published and unpublished studies. A three-step search strategy will be utilized in this review. An initial limited search of MEDLINE and CINAHL will be undertaken followed by analysis of the text words contained in the title and abstract, and of the index terms used to describe the article. A second search using all identified keywords and index terms will then be undertaken across all included databases. Thirdly, the reference list of all identified reports and articles will be searched for additional studies. Studies published in English will be considered for inclusion in this review. The search will target all studies published in English available since inception of the pre-specified databases.

The databases to be searched include:

PubMed, CINAHL, EMBASE, Web of Science

The search for unpublished studies will include:

Initial keywords to be used will be:
Dysphagia, aspiration, swallow, swallowing, swallow assessment, clinical bedside assessment, burn injury, burn, burns, thermal injury, inhalation, inhalation injury, laryngeal, larynx, pharyngeal, pharynx, supraglottic, vocal fold, vocal cord, arytenoid, modified barium swallow, videofluoroscopy, video fluoroscopic evaluation, FEES, MBS, nasoendoscope, nasoendoscopic, laryngoscopy, laryngoscopic

Assessment of methodological quality
Papers selected for retrieval will be assessed by two independent reviewers for methodological validity prior to inclusion in the review using standardized critical appraisal instruments from the Joanna Briggs Institute Meta-Analysis of Statistics Assessment and Review Instrument (JBI-MAStARI) (Appendix I). Any disagreements that arise between the reviewers will be resolved through discussion, or with a third reviewer.

Data extraction
Data will be extracted from papers included in the review using the standardized data extraction tool from JBI-MAStARI (Appendix II). The data extracted will include specific details about the interventions, populations, study methods and outcomes of significance to the review question and specific objectives. Authors will be contacted for complete data in the event relevant data appears missing from the included studies.

Data synthesis
Quantitative data will, where possible, be pooled in statistical meta-analysis using JBI-MAStARI. All results will be subject to double data entry. Effect sizes expressed as odds ratios (for categorical data) and weighted mean differences (for continuous data) and their 95% confidence intervals will be calculated for analysis. Heterogeneity will be assessed statistically using the standard chi-square test and also explored using subgroup analyses based on the different study designs or defining features of the population groups (including age, type of injury, severity of injury, method of assessment) included in this review where and if appropriate. Where statistical pooling is not possible, the findings will be presented in narrative form including tables and figures to aid in data presentation where appropriate.

Conflicts of interest
The authors have no known conflicts of interest to declare.
References


15. Rumbach A. Dysphagia following thermal burns injury: Clinical risk factors, anatomical and physiological characteristics and road to resolution and recovery. [PhD thesis]: The University of Queensland; 2011.


19. Ekberg O. Dysphagia Diagnosis and Treatment (Medical Radiology). Dordrecht: Springer. 2012.
Appendix I: Appraisal instruments

MAStARI appraisal instrument

JBI Critical Appraisal Checklist for Randomised Control / Pseudo-randomised Trial

Reviewer ........................................  Date ........................................

Author ........................................  Year ............... Record Number ...........

1. Was the assignment to treatment groups truly random?  Yes ☐ No ☐ Unclear ☐ Not Applicable ☐

2. Were participants blinded to treatment allocation?  Yes ☐ No ☐ Unclear ☐ Not Applicable ☐

3. Was allocation to treatment groups concealed from the allocator?  Yes ☐ No ☐ Unclear ☐ Not Applicable ☐

4. Were the outcomes of people who withdrew described and included in the analysis?  Yes ☐ No ☐ Unclear ☐ Not Applicable ☐

5. Were those assessing outcomes blind to the treatment allocation?  Yes ☐ No ☐ Unclear ☐ Not Applicable ☐

6. Were the control and treatment groups comparable at entry?  Yes ☐ No ☐ Unclear ☐ Not Applicable ☐

7. Were groups treated identically other than for the named interventions?  Yes ☐ No ☐ Unclear ☐ Not Applicable ☐

8. Were outcomes measured in the same way for all groups?  Yes ☐ No ☐ Unclear ☐ Not Applicable ☐

9. Were outcomes measured in a reliable way?  Yes ☐ No ☐ Unclear ☐ Not Applicable ☐

10. Was appropriate statistical analysis used?  Yes ☐ No ☐ Unclear ☐ Not Applicable ☐

Overall appraisal:  Include ☐ Exclude ☐ Seek further info. ☐

Comments (including reason for exclusion)

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________
JBI Critical Appraisal Checklist for Descriptive / Case Series

Reviewer: ___________________________ Date: ___________________________
Author: ___________________________ Year: __________ Record Number: ________

1. Was study based on a random or pseudo-random sample? □ □ □ □
2. Were the criteria for inclusion in the sample clearly defined? □ □ □ □
3. Were confounding factors identified and strategies to deal with them stated? □ □ □ □
4. Were outcomes assessed using objective criteria? □ □ □ □
5. If comparisons are being made, was there sufficient description of the groups? □ □ □ □
6. Was follow up carried out over a sufficient time period? □ □ □ □
7. Were the outcomes of people who withdrew described and included in the analysis? □ □ □ □
8. Were outcomes measured in a reliable way? □ □ □ □
9. Was appropriate statistical analysis used? □ □ □ □

Overall appraisal: Include □ Exclude □ Seek further info □

Comments (Including reason for exclusion)
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
JBI Critical Appraisal Checklist for Comparable Cohort/ Case Control

Reviewer ........................... Date ...............................

Author .............................. Year ........ Record Number .......

<table>
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<tr>
<th></th>
<th>1. Is sample representative of patients in the population as a whole?</th>
<th>Yes</th>
<th>No</th>
<th>Unclear</th>
<th>Not Applicable</th>
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<td>2. Are the patients at a similar point in the course of their condition/illness?</td>
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<td>3. Has bias been minimised in relation to selection of cases and of controls?</td>
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<td>4. Are confounding factors identified and strategies to deal with them stated?</td>
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<td>5. Are outcomes assessed using objective criteria?</td>
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<td>6. Was follow up carried out over a sufficient time period?</td>
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<td>7. Were the outcomes of people who withdrew described and included in the analysis?</td>
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<td>8. Were outcomes measured in a reliable way?</td>
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<td>9. Was appropriate statistical analysis used?</td>
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Overall appraisal: Include ☐ Exclude ☐ Seek further info. ☐

Comments (Including reason for exclusion)

________________________________________________________________________

________________________________________________________________________
Appendix II: Data extraction instruments

MAStARI data extraction instrument

**JBI Data Extraction Form for Experimental / Observational Studies**

Reviewer: 
Date: 

Author: 
Year: 

Journal: 
Record Number: 

**Study Method**

- RCT [ ] 
- Quasi-RCT [ ] 
- Longitudinal [ ] 
- Retrospective [ ] 
- Observational [ ] 
- Other [ ]

**Participants**

Setting: 

Population: 

**Sample size**

Group A: 
Group B: 

**Interventions**

Intervention A: 

Intervention B: 

Authors Conclusions: 

Reviewers Conclusions: 

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doi: 10.11124/jbisir-2016-2224
Study results

**Dichotomous data**

<table>
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<th>Outcome</th>
<th>Intervention ( ) number / total number</th>
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**Continuous data**

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<th>Intervention ( ) number / total number</th>
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