Introduction

The first set of German guidelines for diagnosis and treatment of patients suffering from acute or chronic cough was published in 2004. Scientific developments over the past five years necessitate an update.

The guidelines evaluate and establish required diagnostic and therapeutic measures. The purpose of this document is to assist in ascertaining underlying causes and treating cough, in order to eliminate or minimize impairments of patients’ health.

The guidelines aim to introduce scientifically founded, evidence-based steps for the diagnosis and treatment of cough and optimize cost-effectiveness. Recommendations are assessed through the GRADE system (The Grades of Recommendation, Assessment, Development and Evaluation). Cough as a symptom is categorized as either acute (lasting up to 8 weeks) or chronic (lasting more than 8 weeks) and attributed to distinct diseases.

For acute and chronic cough the diagnostic algorithms are updated; cost effectiveness is also taken into account. Additionally, the most frequent diagnostic errors are highlighted. Finally, available therapeutic options are discussed.

Anatomy and physiology of cough

Cough is both an important physiological reflex protecting the airways, and a frequent complaint associated with virtually all pulmonary and several extra-pulmonary diseases. Cough is also a contributing factor in the spreading of infectious disease. The reflex is triggered by physical and chemical stimuli. Irritant receptors and C-fibre receptors are activated in the airways, pleura, pericardium and esophagus. The impulse is then transmitted to the brainstem cough generator circuit via the vagus nerves. There is also a connection to the cortex, allowing voluntary control of both eliciting and - to a limited degree - inhibiting cough [3]. Thus, the reflex is characterized by complexity and plasticity. Diagnostic findings from animal testing are not unconditionally applicable to humans. Efferent innervations reach the effector muscles (diaphragm, abdominal, intercostals, back; as well as muscles of the larynx, and the upper airway) via the vagus.
Mucociliary clearance is the primary means of clearing the bronchial system. Cough acts as a secondary mechanism when the primary is either impaired (e.g. by the effects of smoking) or overwhelmed (e.g. by aspiration). The clearing competence of the cough reflex depends on several conditions: obstruction of the airways, bronchial collapsibility, lung volumes, respiratory muscle- and laryngeal function, as well as the amount and viscosity of the mucus [4]. Cough is productive (wet) if the amount of the daily expectoration is at least 30 ml (two tablespoons worth). The phlegm can be mucous, serous, purulent or bloody. Bronchial casts can also be coughed up.

The cough reflex arc consists of five parts:
1. Cough receptors
2. Afferent nerves of the reflex arc
3. Brainstem cough generator circuit
4. Efferent nerves of the reflex arc
5. Effector organs (muscles).

### Common causes and classification of cough

#### Table 1  Classification of clinical causes of cough.

<table>
<thead>
<tr>
<th>Acute (&lt; 8 weeks)</th>
<th>Chronic (&gt; 8 weeks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diseases of the Airways:</td>
<td>Diseases of the lower Airways/Lungs:</td>
</tr>
<tr>
<td>– Infectious disease of the upper airways: mostly viral infection</td>
<td>– Chronic (non-obstructive) bronchitis, COPD</td>
</tr>
<tr>
<td>– Allergy</td>
<td>– Asthma and other eosinophilie diseases</td>
</tr>
<tr>
<td>– Asthma</td>
<td>– Lung tumors</td>
</tr>
<tr>
<td>– Aspiration: commonly children between the ages of 1 – 3</td>
<td>– Infectious diseases</td>
</tr>
<tr>
<td>– Inhalation intoxication: accidents, fire</td>
<td>– Diffuse parenchymatous lung diseases (DPLD) – Systemic diseases with diffuse lung involvement</td>
</tr>
<tr>
<td>– Postinfectious cough</td>
<td></td>
</tr>
<tr>
<td>Diseases of the Lungs/Plura:</td>
<td>– Aspiration, RADS</td>
</tr>
<tr>
<td>– Pneumonia</td>
<td>– Bronchiectasis, Bronchomalacia</td>
</tr>
<tr>
<td>– Pleurisy</td>
<td>– Rare, localized disease of the tracheobronchial tree</td>
</tr>
<tr>
<td>– Pulmonary embolism</td>
<td>– Cystic fibrosis</td>
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<tr>
<td>– Pneumothorax</td>
<td></td>
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<tr>
<td>Extra Pulmonary Causes:</td>
<td>Diseases of the upper Airways</td>
</tr>
<tr>
<td>– Cardiac disease with acute pulmonary congestion</td>
<td>Gastroesophageal Reflux disease</td>
</tr>
<tr>
<td></td>
<td>Drug induced cough:</td>
</tr>
<tr>
<td></td>
<td>– ACE inhibitors</td>
</tr>
<tr>
<td></td>
<td>– others</td>
</tr>
<tr>
<td></td>
<td>Cardiac Diseases:</td>
</tr>
<tr>
<td></td>
<td>– Any including pulmonary congestion</td>
</tr>
<tr>
<td></td>
<td>– Endocarditis</td>
</tr>
</tbody>
</table>

COPD: Chronic Obstructive Pulmonary Disease
RADS: Reactive Airways Dysfunction Syndrome
ACE: Angiotensin Converting Enzyme

### Acute and chronic cough

Diagnosis and treatment of cough depend on whether the patient presents with acute (usual length up to three weeks, possible up to eight weeks) or chronic (more than eight weeks) cough. The natural history of an acute infection of the upper and/or lower airways – the most common cause of cough – is up to three (rarely up to eight) weeks. Medical history and physical examination are usually sufficient in the diagnosis of acute cough.

As opposed to acute cough, a chest x-ray and lung function test should be performed immediately in the case of chronic cough. If the chest x-ray proves inconclusive, the lung function test is unremarkable and cough is the only presenting symptom it will always be difficult to establish the diagnosis. Throughout English-language publications [5–9], these cases are called chronic cough or chronic persistent cough focusing the possible diagnosis on the three most common causes: upper airways cough syndrome, cough variant asthma and gastroesophageal reflux disease [5,10–15]. It is therefore imperative to note the distinction between the definitions of “chronic cough” in these guidelines vs. the use of the term in international publications. In this document, chronic cough is defined just as lasting over eight weeks, while acute cough is defined as lasting up to eight weeks.

#### Table 2  Circumstances requiring an immediate investigation of acute cough.

| Hemoptysis |
| Thorax pain |
| Dyspnea |
| High fever |
| Stay in countries with high prevalence of Tb, contact with a person, stricken with Tb, homeless |
| History of malignant tumor |
| Immune deficiency, HIV infection, immune suppressive therapy |
| Heavy smoker |

Tb: tuberculosis, HIV: Human immunodeficiency virus

#### Recommendation: R1

- Diagnostic tests for acute cough due to common cold:
  - History and physical examination only
- Grade: strong ● ●
- Evidence: none

Special circumstances requiring immediate full diagnosis of acute cough are listed in Table 2 below.
Acute cough

**Recommendation: R4**

- **Appropriate diagnostic tests for acute cough:**
  In most cases history and physical examination suffice in absence of special circumstances (see Table 2).
- **Grade:** strong
- **Evidence:** low

- **Acute viral infections** are the most common cause of cough and usually subside spontaneously after three weeks.
- **Upper airways allergic disease** (Hay fever, intermittent or persistent allergic rhinitis), often in combination with sinusitis, conjunctivitis, pharyngitis and laryngitis, can also trigger acute cough. Itchy eyes and throat are usually characteristic.
- **Intermittent asthma:** can cause acute cough.
- **Aspiration:** can lead to a toxic lung edema, acute interstitial pneumonia and bronchiolitis with re-emergence of cough, often after a discomfort- and cough-free interval of 6–48 hours.

**Recommendation: R5**

- **Treatment of cough due to acute inhalative intoxication:**
  - High dose inhalative corticosteroid
  - Additional systemic corticosteroid, if necessary
- **Grade:** weak
- **Evidence:** none

- **Postinfectious cough:** persists >3 weeks after an acute, often viral airway infection and resolves after <8 weeks. Epithelial damage after B. pertussis or M. pneumoniae infection or a transient increase in bronchial hyper-responsiveness (BHR) - later subsiding spontaneously - are responsible for post-infectious cough. In the latter case a short course of asthma treatment (inhaled corticosteroids or beta2-adrenergics) is effective.

**Recommendation: R6**

- **Treatment of cough due to postinfectious BHR:**
  - Inhalative corticosteroid or beta2-adrenergic
- **Grade:** weak
- **Evidence:** moderate

Pneumonia

Pleurisy

Pulmonary embolism: 50% of patients with acute pulmonary embolism present with a cough [19].

Pneumothorax: all forms can be accompanied by dry cough.

Acute heart failure with pulmonary congestion: Acute left heart failure (up to lung edema) can trigger both cough and bronchial obstruction [20, 21]. Bradycardia associated with acute emerging AV block II-III can greatly reduce stroke volume eliciting pulmonary congestion and cough [22].

**Acute cough and heart failure:**

**Recommendation: R7**

- Breathlessness, palpitation and acute cough is indicative of left heart failure and/or AV block
- **Grade:** strong
- **Evidence:** low

Chronic cough

**Recommendation: R8**

- **Persistent cough despite controlled asthma:**
  - Additional antitussive up to 4 weeks duration indicated
- **Grade:** weak
- **Evidence:** none

- Cough type (variant) Asthma is characterized by dry cough and bronchial hyperresponsiveness (BHR). Wheezing, dyspnea and bronchial obstruction are absent. Chronic cough with proven BHR can only be confirmed as variant asthma if asthma treatment (inhaled corticosteroids or beta2- adrenergics) eliminates the cough [10, 13–15, 26–30].
**Recommendation: R9**

- **Chronic cough due to BHR:**
  If responsive to inhaled corticosteroid, montelukast or beta2-adrenergics: cough variant asthma

- **Grade:** strong 🌟🌟
- **Evidence:** moderate

**Recommendation: R10**

- **Prevention of progression from variant asthma to asthma:**
  Early treatment with inhaled corticosteroid

- **Grade:** strong 🌟🌟
- **Evidence:** low

- **Lung tumors:** Cough is the most common initial symptom of lung tumors [32]. If a patient presenting with chronic cough is not taking an ACE inhibitor, a chest x-ray should be done at the first consultation. Furthermore, in order to exclude a lung tumor each patient with unexplained chronic cough should have a bronchoscopy at the end of the diagnostic algorithm (🌟 Fig. 2).

**Recommendation: R11**

- **Chronic cough with sputum eosinophilia w/o BHR:**
  Eosinophilic bronchitis, responsive to inhaled corticosteroid

- **Grade:** strong 🌟🌟
- **Evidence:** moderate

- **Eosophageal reflux disease:** Cough is triggered either by reflex or through reflex to pharynx and larynx (laryngopharyngeal reflux) and micro-aspirations [36]. Cough due to reflux can occur with or without heartburn [6], and not necessarily coincides with reflux oesophagitis (non-erosive reflux disease). Thus the gold standard of the reflux diagnosis is a triple sensor 24-hour pH probe and impedance pH-probe. The latter allows diagnosing both acid and weakly acid reflux. Since pH-probes are frequently not available and poorly tolerated, high dose (2 × 40 mg) proton pump inhibitor treatment over the course of up to three months can alternatively be carried out, thereby confirming or excluding the diagnosis of reflux cough [37]. In distinct cases surgical treatment (fundoplication) can be performed [38, 39], yet no evidence-based selection criteria for surgery are available.

**Recommendation: R15**

- **Treatment of chronic cough due to multiple underlying causes:**
  Treat all conditions appropriately, if present (e.g. asthma, rhinitis, reflux)

- **Grade:** strong 🌟🌟
- **Evidence:** moderate

**Recommendation: R16**

- **Pharmacologic treatment of chronic cough due to reflex:**
  Use double standard dose proton pump inhibitor
  Duration of treatment: 2 – 3 months

- **Grade:** strong 🌟🌟
- **Evidence:** moderate

**Recommendation: R17**

- **Surgical treatment of chronic cough due to reflux:**
  Should only be performed if preoperative pharmacological reflux treatment for cough is successful

- **Grade:** weak 🌟
- **Evidence:** moderate

**Recommendation: R18**

Surgical treatment of chronic cough due to weak acid reflux:
Initiate surgical treatment if proton pump inhibitor fails:
no general recommendation

**Grade:** none 🌟🌟
**Evidence:** none

- **Drug induced cough:** Approximately 10% of women and 5% of men cough while taking ACE-inhibitor medication [40]. The therapeutic (antihypertensive, cardiac or nephroprotective) effects of an ACE treatment can be replaced by angiotensin II receptor antagonists, which do not cause cough more frequently than placebo. For further drugs inducing cough updated information is available on www.pneumotox.com.
Therapeutic implications for patients suffering of chronic cough taking an ACE inhibitor:  
Stop/replace ACE inhibitor first even if cough has other possible causes  
**Grade**: strong  
**Evidence**: high

**Infections:**  
- Pertussis in adults is a rare cause of chronic cough, but has been described even without a preceding phase of acute infection. Particularly patients with recent contact to persons suffering from acute pertussis infection should be checked for antibodies. However, interpretation of the results is difficult. After the acute exudative phase of infection (taking up to ten days) a direct culture of Bordatella is no longer possible and antibiotics will have no effect on cough or on the natural history of the infection.

**Recommendation: R19**
- Treatment of cough due to pertussis:  
  Use central cough suppressants  
  **Grade**: weak  
  **Evidence**: none

**Recommendation: R20**
- Treatment of chronic cough due to active Tb:  
  Use additional central cough suppressants  
  **Grade**: weak  
  **Evidence**: none

**Recommendation: R21**
- Chronic cough due to heart diseases:  
  Aside from chronic left heart failure (cough generally occurs upon physical exertion or prone position), cardiac drugs including ACE inhibitors, beta-blockers (only in patients with BHR), Amiodarone (eliciting Alveolitis), AV – block II – III, endocarditis [41] and cardiac arrhythmia [42, 43] can cause chronic cough.

**Recommendation: R22**
- Surgical treatment of chronic cough due to bronchiectasis:  
  Complete surgical resection of localized bronchiectasis is also effective for cough  
  **Grade**: weak  
  **Evidence**: low

**Recommendation: R23**
- Antitussive treatment of chronic cough due to bronchiectasis:  
  Central active cough suppressants contraindicated  
  **Grade**: weak  
  **Evidence**: none

**Recommendation: R24**
- Physiotherapy for tracheobronchomalacia:  
  Use cough - preventing physiotherapy techniques  
  **Grade**: weak  
  **Evidence**: none

## Table 3
### Diffuse parenchymatous lung diseases with cough as an early symptom.

<table>
<thead>
<tr>
<th>DPLD</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amiodarone induced DPLD</td>
<td>Cough can be the sole early manifestation</td>
</tr>
<tr>
<td>Methotrexat induced DPLD</td>
<td>The autoimmune disease itself or the methotrexat treatment can cause the cough.</td>
</tr>
<tr>
<td>Sjögren’s syndrome</td>
<td>9% pulmonary involvement, cough is rarely the presenting symptom.</td>
</tr>
<tr>
<td>Giant cell arteritis</td>
<td>Cough indicates lung involvement</td>
</tr>
<tr>
<td>Wegener’s disease</td>
<td>Airway involvement can cause cough even when chest x-ray is negative</td>
</tr>
<tr>
<td>Inflammatory bowel disease</td>
<td>Bronchiectasis, bronchial narrowing, COP* or even treatment (sulfasalazine) can trigger cough</td>
</tr>
<tr>
<td>Sarcoidosis</td>
<td>Airway involvement can cause cough</td>
</tr>
</tbody>
</table>

* COP: Cryptogenic organizing pneumonia
Isolated orphan airways disease: usually emerges in patients over 40 years old. Can lead to expiratory bronchial collapse, irreversible central obstruction of the airways. Coughing is frequently the main symptom. (Table 4)

Cystic fibrosis: CF is an autosomal recessive inherited disease. Abortive forms can manifest in adulthood for the first time through cough, bronchial infections and bronchiectasis [48].

Chronic cough and sleep apnea: Sleep apnea patients often complain of chronic cough.

Psychogenic (habit or tic) cough: By definition the sensitivity of the cough reflex is not increased in patients with psychogenic cough, but difficult to measure reliably. There is always a risk of misdiagnosis of multicausal or idiopathic cough as being psychogenic cough.

Chronic idiopathic cough: Despite extensive diagnostic procedures, underlying causes of cough cannot be determined in up to 18% of patients with chronic persistent cough (ratio female/male = 2:1). Capsaicin or citric acid sensitivity of the cough reflex is increased in these patients [49].

**Recommendation: R25**

- Chronic idiopathic cough: Do not perform diagnostic cough provocation test with capsaicin according to standardized provocation protocol
  - Grade: weak ○
  - Evidence: low

**Recommendation: R26**

- Chronic idiopathic cough: Treatment with inhaled off label local anaesthetics
  - Grade: weak ○
  - Evidence: very low

**Diagnosis of cough**

- Applying the algorithms frequently allows for a provisional diagnosis, which must be confirmed by successful treatment. Failure can therefore require continued investigation based on the algorithm. Multicausal cough requiring combination treatment also has to be considered.

Cough can persist up to eight weeks after subsiding of an acute infection (postinfectious cough). Except for special circumstances (Table 2), further examination according to the algorithm for chronic cough is only necessary after eight weeks (box 12).

**Recommendation: R28**

- Diagnostic work-up of acute cough: Usually taking history and physical exam are sufficient
  - Grade: strong ⊗ ⊗
  - Evidence: low

**Recommendation: R29**

- Antibiotic treatment in otherwise healthy patients suffering of acute cough: Not necessary
  - Grade: strong ⊗ ⊗
  - Evidence: moderate
Also the most common diagnostic and therapeutic shortcomings should be considered: early-stage, diffuse parenchymatous lung disease not yet evident on chest x-ray, eosinophilic bronchitis (eosinophile cell count in the sputum > 3%) and a psychogenic cough (rare in adults) all should be taken account of. In some patients, the cause of chronic cough will remain unclear despite exhausting available diagnostic tools. In this case the patient suffers from chronic idiopathic cough where the source of an increased sensitivity of the cough reflex cannot be established (Box 26).

**Symptomatic treatment of cough**

Causal treatment should always be sought. However, if this approach is impossible (e.g. acute viral respiratory infection) or would only prove effective in a delayed manner (e.g. tuberculosis), symptomatic treatment can be considered instead or in addition to causal treatment of cough. Symptomatic treatment targets one or several of the five parts of the cough reflex arc. Effects can be protussive (increasing cough and expectoration) or anti-tussive.

**Physiotherapy of cough:** Despite being clinical routine in both hospital and outpatient care [51] as well as in rehabilitation, evidence for the physiotherapy of cough is very low. Physiotherapy aims to:
- increase expectoration using effective coughing techniques for patients with productive but ineffective cough
- suppress voluntarily non-productive cough
- instruct patient in the use of physiotherapeutic equipment improving expectoration such as Acapella®, Flutter® and RC Cornet®.

**The most frequent shortcomings in diagnosis of cough**

- Trivialization of cough in smokers without diagnostic workup.
- Change of the established sequence of examinations without reason.
- Extrapulmonary causes (ENT, gastric, neurological, cardiac) are disregarded.
- No bronchoscopy though cause of cough was not determined.
- Multiple causes overlooked.

**Recommendation: R30**

- **Cost-effective diagnostic work-up of cough:** Follow algorithms
- **Grade:** strong ✯✯
- **Evidence:** none

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Fig. 1 Clinical algorithm for the diagnosis of acute cough.

* In otherwise healthy patients, antibiotics are not beneficial even in cases of purulent (green or yellow) sputum [50]. They are only recommended in co-morbid or elderly patients with sputum purulence.

**Caveat remittent small pulmonary emboli with episodes of remittent cough, palpitations, breathlessness; slight hemoptysis may also occur.**
patient with chronic cough

history/physical exam

Cardiac or neurological cause likely? yes → targeted diagnosis and treatment

no → chest x-ray PA and lateral

cough explained by result? yes → further diagnosis and treatment

no → lung function test

normal lung function? yes → is non-specific provoked pathological?

no → further diagnosis and treatment

normal ENT exam? yes → reflux?

no → smoking or exposure to hazardous material?

yes → absention*  no → further diagnosis and treatment

yes → in-depth reflux diagnostic workup – ph-probe (impedance, triple sensor) – manometry

no → further ENT diagnosis and treatment

are HRCT scan and bronchoscopy normal? yes → eosinophilia in sputum? no → pathological?

yes → appropriate reflux therapy

no → in-depth reflux diagnostic workup

no → further diagnosis and treatment

chronic idiopathic cough due to increased sensitivity of the cough reflex

success? yes → cough to BHR

no → further diagnosis and treatment

abstention successful, cough subsided? yes → further ENT diagnosis and treatment

no → further diagnosis and treatment

Fig. 2 Clinical algorithm for the diagnosis of chronic cough.

pa: postero-anterior.

* based on clinical suspicion, changes in severity and/or characteristics of cough may require immediate bronchoscopy therefore ignoring the steps of the algorithm.
Recommendation: R31
Physiotherapy for chronic productive cough with and w/o bronchiectasis:
Prescribe physiotherapy
Grade: weak
Evidence: very low

Recommendation: R32
Physiotherapy for chronic dry cough:
Prescribe physiotherapy for voluntary cough suppression
Grade: None
Evidence: none

Recommendation: R33
Use of physiotherapeutic equipment for chronic productive cough with and w/o bronchiectasis:
Prescribe physiotherapeutic equipment
Grade: Weak
Evidence: low

Recommendation: R34
Prescription of expectorants to ease cough:
In symptomatic COPD and bronchiectasis patients
Grade: weak
Evidence: very low

Recommendation: R35
Use of fixed combination phytopharmaca (ivy, thyme, primrose) for acute cough due to common cold:
Prescribe fixed combination
Grade: strong
Evidence: moderate

In cystic fibrosis bronchiectasis inhaled dornase alfa eases cough [56].

Recommendation: R36
Cystic fibrosis bronchiectasis:
Use dornase alfa
Grade: strong
Evidence: moderate

Recommendation: R37
Bronchiectasis with persistent cough:
Use inhaled antibiotics (i.e. tobramycin, colistin)
Grade: weak
Evidence: high

Drugs that reduce mucus production
Inhalative anticholinergics (i.e. ipratropium and tiotropium) are thought to reduce mucus production; however their antitussive effect is not consistent [57].

Drugs that increase mucociliary clearance
Theophylline and beta2-adrenergics do increase mucociliary clearance but are not effective relieving cough [58].

Drugs for the reduction of irritation of cough receptors
By “coating” cough receptors in the throat, demulcents are thought to have an antitussive effect. Cough syrups, lozenges, cough drops and honey, share sugar as the common ingredient. Effectiveness, if any, is limited in time to the contact of the sugar with the receptor, usually 20 – 30 minutes.

Drugs that affect mucosal oedema
Systemic alpha-adrenergics for nasal decongestion are popular in the US but virtually not in use in Germany. Fixed combinations with anticholinergic and central effective antihistamines chlorpheniramine or dexbrompheniramine are not available.
Antibiotics are only effective against cough caused by a bacterial infection characterized by purulent phlegm (i.e. suppurative bronchitis, bronchiectasis, exacerbation of COPD, purulent rhinitis and sinusitis). Antibiotics are not indicated in acute bronchitis.
Anti-inflammatory therapy: inhalative und nasal corticosteroids (oral leukotriene antagonists and probably topical nedocromil) alleviate cough in asthma, eosinophilic bronchitis, postinfectious cough due to BHR and rhinitis.
Local anesthetics: Local anesthetics disable electrophysiological activity in the receptors and afferent nerves [59] (e.g. during bronchoscopy). They are increasingly used off label for idiopathic cough and in palliative medicine [60].
Drugs affecting central mechanism for cough (antitussives) are systemically applied morphine or codeine as well as natural and synthetic derivatives (i.e. dextromethorphan, dihydrocodeine, noscapine and pentoxyverin). Some non-addictive herbal remedies (thyme, ribwort, sundew) claim central antitussive properties, though this is not proven by clinical studies. Opiates are recommended for symptomatic treatment of dry cough [61]. They have limited efficacy in the treatment of cough resulting from common cold [62].
Combinations of cough
Case reports are available for most complications of cough, listed below.

Table 5  Complications of cough.

<table>
<thead>
<tr>
<th>Urinary incontinence (in women)</th>
<th>Hoarseness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pungent thorax pain</td>
<td></td>
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<tr>
<td>Trigeminal headache</td>
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<tr>
<td>Conjoint epithymoma</td>
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<tr>
<td>Gastroesophageal reflux</td>
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<tr>
<td>Petechial hemorrhage</td>
<td></td>
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<tr>
<td>Rib fracture</td>
<td></td>
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<tr>
<td>Mediastinal emphysema</td>
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<tr>
<td>Cough Syncope</td>
<td></td>
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<tr>
<td>Seizure initiated by cough</td>
<td></td>
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<tr>
<td>Headaches</td>
<td></td>
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<tr>
<td>Ingual herniation</td>
<td></td>
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<tr>
<td>Rupture of the rectus abdomini muscle</td>
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</tbody>
</table>

Conflict of interest

According to the rules of the Association of the Scientific Medical Societies in Germany, http://www.uni-duesseldorf.de/AWMF/, the conflict of interest statements were reported on the appropriate AWMF form and assessed by all authors. According to the subject of the guideline no conflict of interest was detected.1

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