

Fem bästa andningstipsen för att skydda dig mot coronaviruset

Referenser

1. Studie: Bevis för luftburen överföring av SARS-viruset (Severe Acute Respiratory Syndrome)

Titel	Evidence of airborne transmission of the severe acute respiratory syndrome virus. Link to full text
Tidsskrift	N Engl J Med. 2004 Apr 22;350(17):1731-9
Författare	Yu IT1, Li Y, Wong TW, Tam W, Chan AT, Lee JH, Leung DY, Ho T

BACKGROUND:

There is uncertainty about the mode of transmission of the severe acute respiratory syndrome (SARS) virus. We analyzed the temporal and spatial distributions of cases in a large community outbreak of SARS in Hong Kong and examined the correlation of these data with the three-dimensional spread of a virus-laden aerosol plume that was modeled using studies of airflow dynamics.

METHODS:

We determined the distribution of the initial 187 cases of SARS in the Amoy Gardens housing complex in 2003 according to the date of onset and location of residence. We then studied the association between the location (building, floor, and direction the apartment unit faced) and the probability of infection using logistic regression. The spread of the airborne, virus-laden aerosols generated by the index patient was modeled with the use of airflow-dynamics studies, including studies performed with the use of computational fluid-dynamics and multizone modeling.

RESULTS:

The curves of the epidemic suggested a common source of the outbreak. All but 5 patients lived in seven buildings (A to G), and the index patient and more than half the other patients with SARS (99 patients) lived in building E. Residents of the floors at the middle and upper levels in building E were at a significantly higher risk than residents on lower floors; this finding is consistent with a rising plume of contaminated warm air in the air shaft generated from a middle-level apartment unit. The risks for the different units matched the virus concentrations predicted with the use of multizone modeling. The distribution of risk in buildings B, C, and D corresponded

well with the three-dimensional spread of virus-laden aerosols predicted with the use of computational fluid-dynamics modeling.

CONCLUSIONS:

Airborne spread of the virus appears to explain this large community outbreak of SARS, and future efforts at prevention and control must take into consideration the potential for airborne spread of this virus.

2. Studie kall näsa skapar gynnsam miljö för rhinovirus

Titel Temperature-dependent innate defense against the common cold virus limits viral replication at warm temperature in mouse airway cells. [Länk till fulltext](#)

Tidskrift Proceedings of the National Academy of Sciences (PNAS), Jan-2015

Författare Iwasaki A och medarbetare

Signifikans **Rhinovirus is the most frequent cause of the common cold, as well as one of the most important causes of asthma exacerbations. Most rhinovirus strains replicate better at the cooler temperatures found in the nasal cavity** than at lung temperature, but the underlying mechanisms are not known. Using a mouse-adapted virus, we found that airway epithelial cells supporting rhinovirus replication initiate a more robust antiviral defense response through RIG-I-like receptor (RLR)-dependent interferon secretion and enhanced interferon responsiveness at lung temperature vs. nasal cavity temperature.

Airway cells with genetic deficiencies in RLR or type I interferon receptor signaling supported much higher levels of viral replication at 37 °C. Thus, cooler temperatures can enable replication of the common cold virus, at least in part, by diminishing antiviral immune responses.

Most isolates of human rhinovirus, the common cold virus, replicate more robustly at the cool temperatures found in the nasal cavity (33-35 °C) than at core body temperature (37 °C). To gain insight into the mechanism of temperature-dependent growth, we compared the transcriptional response of primary mouse airway epithelial cells infected with rhinovirus at 33 °C vs. 37 °C.

Sammanfattning Mouse airway cells infected with mouse-adapted rhinovirus 1B exhibited a striking enrichment in expression of antiviral defense response genes at 37 °C relative to 33 °C, which correlated with significantly higher expression levels of type I and type III IFN genes and IFN-stimulated genes (ISGs) at 37 °C. Temperature-dependent IFN induction in response to rhinovirus was dependent on the MAVS protein, a key signaling adaptor of the RIG-I-like receptors (RLRs). Stimulation of primary airway cells with the synthetic RLR ligand poly I:C led to greater IFN induction at 37 °C relative to 33 °C

at early time points poststimulation and to a sustained increase in the induction of ISGs at 37 °C relative to 33 °C.

Recombinant type I IFN also stimulated more robust induction of ISGs at 37 °C than at 33 °C. Genetic deficiency of MAVS or the type I IFN receptor in infected airway cells permitted higher levels of viral replication, particularly at 37 °C, and partially rescued the temperature-dependent growth phenotype. These findings demonstrate that in mouse airway cells, rhinovirus replicates preferentially at nasal cavity temperature due, in part, to a less efficient antiviral defense response of infected cells at cool temperature.

3. Stor produktion av kvävemonoxid (NO) i näsans bihålor

Titel High nitric oxide production in human paranasal sinuses.

Tidskrift Nat Med. 1995 Apr;1(4):370-3.

Författare Lundberg JO, Farkas-Szallasi T, Weitzberg E, Rinder J, Lidholm J, Anggård A, Hökfelt T, Lundberg JM, Alving K.

Nitric oxide (NO) is present in air derived from the nasal airways. However, the precise origin and physiological role of airway-derived NO are unknown. We report that NO in humans is produced by epithelial cells in the paranasal sinuses and is present in sinus air in very high concentrations, close to the highest permissible atmospheric pollution levels.

Sammanfattning In immunohistochemical and mRNA in situ hybridization studies we show that an NO synthase most closely resembling the inducible isoform is constitutively expressed apically in sinus epithelium. In contrast, only weak NO synthase activity was found in the epithelium of the nasal cavity. Our findings, together with the well-known bacteriostatic effects of NO, suggest a role for NO in the maintenance of sterility in the human paranasal sinuses.

4. Nitric Oxide Inhibits the Replication Cycle of Severe Acute Respiratory Syndrome Coronavirus

Titel Nitric Oxide Inhibits the Replication Cycle of Severe Acute Respiratory Syndrome Coronavirus [Länk till fulltext](#)

Tidskrift J Virol. 2005 Feb; 79(3): 1966–1969

Författare Sara Åkerström, Mehrdad Mousavi-Jazi, Jonas Klingström, Mikael Leijon, Åke Lundkvist, and Ali Mirazimi

Sammanfattning Nitric oxide (NO) is an important signaling molecule between cells which has been shown to have an inhibitory effect on some virus infections. The purpose of this study was to examine whether NO inhibits the replication

cycle of the severe acute respiratory syndrome coronavirus (SARS CoV) in vitro.

We found that an organic NO donor, S-nitroso-N-acetylpenicillamine, significantly inhibited the replication cycle of SARS CoV in a concentration-dependent manner. We also show here that NO inhibits viral protein and RNA synthesis.

Furthermore, we demonstrate that NO generated by inducible nitric oxide synthase, an enzyme that produces NO, inhibits the SARS CoV replication cycle.

5. Carbon dioxide inhibits the growth rate of Staphylococcus aureus at body temperature

Titel	Carbon dioxide inhibits the growth rate of Staphylococcus aureus at body temperature Länk till fulltext
Tidskrift	Surgical Endoscopy And Other Interventional Techniques volume 19, pages 91–94(2005)
Författare	M. Persson, P. Svenarud, J.-I. Flock & J. van der Linden

BACKGROUND:

Since the 1930s, carbon dioxide (CO₂) has been combined with cold storage for the preservation of food. However, its use for the prevention of surgical wound infection was long considered to be impractical. Now CO₂ is widely used during laparoscopic procedures, and a method has been developed to create a CO₂ atmosphere in an open wound. The aim of this study was to investigate the effect of CO₂ on the growth of Staphylococcus aureus at body temperature.

METHODS:

Sammanfattning First, S. aureus inoculated on blood agar were exposed to pure CO₂ (100%), standard anaerobic gas (5% CO₂, 10% hydrogen, 85% nitrogen), or air at 37 degrees C for a period of 24 h; then a viable count of the bacteria was made. Second, S. aureus inoculated in brain-heart infusion broth and kept at 37 degrees C were exposed to CO₂ or air for 0, 2, 4, 6, and 8 h; then the optical density of the bacteria was measured.

RESULTS:

After 24 h, the number of S. aureus on blood agar was about 100 times lower in CO₂ than in anaerobic gas (p = 0.001) and about 1,000 times lower than in air (p = 0.001). Also, in broth, there were fewer bacteria with CO₂ than with air (p < 0.01). After 2 h, the number of bacteria was increased with air (p < 0.001) but not with CO₂ (p = 0.13). After 8 h, the

optical density had increased from zero to 1.2 with air but it had increased only to 0.01 with CO(2) ($p = 0.001$).

CONCLUSION:

Pure CO(2) significantly decreased the growth rate of *S. aureus* at body temperature. The inhibitory effect of CO(2) increased exponentially with time. Its bacteriostatic effect may help to explain the low infection rates in patients who undergo laparoscopic procedures.

6. Virus and bacteria inactivation by CO2 bubbles in solution

Titel Virus and bacteria inactivation by CO2 bubbles in solution [Länk till fulltext](#)

Tidskrift Nature partner journals: Clean Water volume 2, Article number: 5 (2019)

Författare Adrian Garrido Sanchis, Richard Pashley & Barry Ninham

Sammanfattning The availability of clean water is a major problem facing the world. In particular, the cost and destruction caused by viruses in water remains an unresolved challenge and poses a major limitation on the use of recycled water. Here, we develop an environmentally friendly technology for sterilising water. The technology bubbles heated un-pressurised carbon dioxide or exhaust gases through wastewater in a bubble column, effectively destroying both bacteria and viruses. The process is extremely cost effective, with no concerning by-products, and has already been successfully scaled-up industrially.

7. Carbon dioxide insufflation deflects airborne particles from an open surgical wound model

Titel Carbon dioxide insufflation deflects airborne particles from an open surgical wound model [Länk till fulltext](#)

Tidskrift Journal of Hospital Infection Volume 95, Issue 1, January 2017, Pages 112-117

Författare P.Kokhanenko, G.Papottia, J.E.Caterb, A.C.Lynchc, J.A.van der Lindend, C.J.T.Spencea

Background:

Surgical site infections remain a significant burden on healthcare systems and may benefit from new countermeasures.

Sammanfattning **Aim:**

To assess the merits of open surgical wound CO2 insufflation via a gas diffuser to reduce airborne contamination, and to determine the distribution of CO2 in and over a wound.

Methods:

An experimental approach with engineers and clinical researchers was employed to measure the gas flow pattern and motion of airborne particles in a model of an open surgical wound in a simulated theatre setting. Laser-illuminated flow visualizations were performed and the degree of protection was quantified by collecting and characterizing particles deposited in and outside the wound cavity.

Findings:

The average number of particles entering the wound with a diameter of <5 mm was reduced 1000-fold with 10 L/min CO₂ insufflation. Larger and heavier particles had a greater penetration potential and were reduced by a factor of 20. The degree of protection was found to be unaffected by exaggerated movements of hands in and out of the wound cavity. The steady-state CO₂ concentration within the majority of the wound cavity was >95% and diminished rapidly above the wound to an atmospheric level (w0%) at a height of 25 mm.

Conclusion:

Airborne particles were deflected from entering the wound by the CO₂ in the cavity akin to a protective barrier. Insufflation of CO₂ may be an effective means of reducing intraoperative infection rates in open surgeries.

8. Studie näsan minskar i omfång när den inte används

Titel Influence of long-term airflow deprivation on the dimensions of the nasal cavity: a study of laryngectomy patients using acoustic rhinometry.

Tidskrift Ear Nose Throat J. 2007 Aug;86(8):488, 490-2.

Författare Ozgursoy OB1, Dursun G.

Sammanfattning We conducted a prospective study to investigate the long-term effect of nasal airflow deprivation on nasal dimensions after total laryngectomy. We evaluated 48 patients who had an initial diagnosis of laryngeal cancer; 6 were disqualified during follow-up, leaving us with data on 42 patients for our final analysis. Acoustic rhinometry was used to measure the minimum cross-sectional area (MCSA) and the volume of the nasal cavity on both the left and right sides before and after laryngectomy. In addition, patients underwent endoscopic nasal examinations and answered questionnaires pre- and postoperatively.

At both the 1- and 2-year follow-ups, the mean MCSAs and the mean nasal volumes of both the left and right nostrils were significantly smaller than the preoperative values ($p < 0.001$). The endoscopic examinations revealed only a mild deterioration in the appearance of the nasal mucosa over the long term. Questionnaire responses obtained at the 2-year follow-up visit

revealed that all 42 evaluable patients were experiencing a moderate degree of nasal obstruction while inhaling through the nose. Our data indicate that the dimensions of the nasal cavity appear to be substantially and permanently reduced after total laryngectomy.

Our study had two important advantages over other similar studies. First, because ours was a prospective study, we were able to obtain preoperative data and use it to make postoperative comparisons of the same patients rather than using healthy controls as comparators. Second, we used acoustic rhinometry, while most other studies relied on anterior rhinoscopy or rhinomanometry, which are inferior methods of making the evaluations in question. We believe that our findings represent a substantial contribution to our knowledge of the physiologic and functional alterations of the nasal cavity that occur as a result of a complete cessation of nasal airflow.

9. Studie humma och produktion av kväveoxid (NO) och luftflöde i bihålorna

Titel Humming, nitric oxide and paranasal sinus ventilation. [Länk till fulltext](#)

Tidskrift Karolinska University Press 2006

Författare Mauro Maniscalco

The paranasal sinuses are air-filled bony cavities surrounding the nose. They communicate with the nose via the sinus ostia through which fluid and gases pass in both directions. A proper ventilation is crucial for sinus integrity and blockage of the ostia is a major risk factor for development of sinusitis.

In this thesis we have explored an entirely new approach to monitor sinus ventilation – the nasal humming test. We show in human studies *in vivo* and in a sinus/nasal model that **the oscillating airflow generated during humming produce a dramatic increase in sinus ventilation.**

Sammanfattning Interestingly, the increased gas exchange can be readily monitored on-line by simultaneously measuring the levels of the gas nitric oxide (NO) in nasally exhaled air. The sinuses constitute a major natural reservoir of NO and when gas-exchange increases during humming NO escapes rapidly into the nasal cavity thereby creating a highly reproducible peak in exhaled NO.

When exploring the different factors that determine the humming peak in NO we found that sinus ostium size was the most important but the humming frequency also influenced the sinus NO release. In patients with severe nasal polyposis and completely blocked sinus ostia the humming peak in NO was abolished. Moreover, in patients allergic rhinitis, absence of a NO peak was associated with endoscopic signs suggestive of ostial obstruction. In the last study we went on to study if an oscillating airflow could be used not only to wash gas out from sinuses but also to enhance

passage of substances into the sinuses. Indeed, we found evidence of an intra-sinus drug deposition by adding a sounding airflow to an aerosol.

In conclusion, the ventilation of the paranasal sinuses increased greatly when a person is humming; a finding that could have both diagnostic and therapeutic implications. Measurements of nasal NO during humming may represent a test of sinus ostial function. In addition, aerosol in combination with a sounding airflow could possibly be useful to increase the delivery of drugs into the paranasal sinuses.

10. Studie på utflödet av kvävemonoxid (NO) från näsan vid hummande

Titel Exhaled nasal nitric oxide during humming: potential clinical tool in sinonasal disease?

Tidskrift Biomark Med. 2013 Apr;7(2):261-6. doi: 10.2217/bmm.13.11.

Författare Maniscalco M1, Pelaia G, Sofia M.

Sammanfattning The use of nasal nitric oxide (nNO) in sinonasal disease has recently been advocated as a potential tool to explore upper inflammatory airway disease. However, it is currently hampered by some factors including the wide range of measurement methods, the presence of various confounding factors and the heterogeneity of the study population. The contribution of nasal airway and paranasal sinuses communicating with the nose through the ostia represents the main confounding factor.

There is accumulating evidence that nasal humming (which is the production of a tone without opening the lips or forming words) during nNO measurement increases nNO levels due to a rapid gas exchange in the paranasal sinuses. The aim of this review is to discuss the basic concepts and clinical applications of nNO assessment during humming, which represents a simple and noninvasive method to approach sinonasal disease.

11. Studie på effekten av daglig hummning på bihålainflammation (rhinosinuitis)

Titel Strong humming for one hour daily to terminate chronic rhinosinuitis in four days: A case report and hypothesis for action by stimulation of endogenous nasal nitric oxide production. [Länk till fulltext](#)

Tidskrift In Medical Hypotheses 2006 66(4):851-854

Författare Eby, George A.

Sammanfattning Rhinosinuitis is an inflammation or infection of the nose and air pockets (sinuses) above, below and between the eyes which connect with the back of the nose through tiny openings (ostia). Rhinosinuitis can be caused by bacteria, viruses, fungi (molds) and possibly by allergies. Chronic rhinosinuitis (CRS) is an immune disorder caused by fungi. The immune

11. Studie på effekten av daglig hummning på bihåleinflammation (rhinosinusitis)

response produced by eosinophils causes the fungi to be attacked, which leads to damage of the sinus membranes, resulting in full-blown rhinosinusitis symptoms. Gaseous nitric oxide (NO) is naturally released in the human respiratory tract. The major part of NO found in exhaled air originates in the nasal airways, although significant production of NO also takes place in the paranasal sinuses.

Proper ventilation is essential for maintenance of sinus integrity, and blockage of the ostium is a central event in pathogenesis of sinusitis. Concentrations of NO in the healthy sinuses are high. **Nasal NO is known to be increased 15- to 20-fold by humming compared with quiet exhalation. NO is known to be broadly antifungal, antiviral and antibacterial.** This case report shows that a subject hummed strongly at a low pitch (~130 Hz) for 1 h (18 hums per minute) at bedtime the first night, and hummed 60—120 times 4 times a day for the following 4 days as treatment for severe CRS.

The humming technique was described as being one that maximally increased intranasal vibrations, but less than that required to produce dizziness. The morning after the first 1-h humming session, the subject awoke with a clear nose and found himself breathing easily through his nose for the first time in over 1 month. During the following 4 days, CRS symptoms slightly reoccurred, but with much less intensity each day. By humming 60—120 times four times per day (with a session at bedtime), CRS symptoms were essentially eliminated in 4 days.

Coincidentally, the subject's cardiac arrhythmias (PACs) were greatly lessened. It is hypothesized that strong, prolonged humming increased endogenous nasal NO production, thus eliminating CRS by antifungal means.