

# Challenge in High Altitude related Medical Emergency Recognize, Remedy and Risk Reduction



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- (Statement of declare that there are no conflict of interest)

# Mount Everest

- Elevation 8,848 m (29,028 ft)
- Location: Nepal and China (Tibet)
- Easiest route: South Col (Nepal)
- First ascent
  - **May 29 1953**, Sir Edmund Hillary [at the age of 33] (7/1919-1/2008) & Tenzing Norgay
  - May 8 1978, Reinhold Messner & Peter Habeler without supplementary oxygen

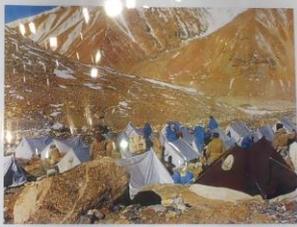


## 1960年中国人首次登上珠穆朗玛峰

首次攀登珠穆朗玛峰是从1959年开始的。最初，中苏联合侦察、气象、修路队伍陆续开进珠峰地区，并准备逐步展开，但随后苏联单方面提出登山活动，随即，中国决定于1960年独立完成的目标。国家体委和中国登山协会组织了100多人的登山队伍，同时，国家在极端困难的情况下，专门拨出20万美元从英国和其他欧洲国家购买了急需的登山装备和器材。中国登山队高山行军和运输之后，开始了最后的突击。



穿过8400米的黄色条带。



海拔5500米的一号高山营地



登山队员出征前在大本营督师。



在8000米的岩石地带休息

经过充分的准备，5月24日上午9时，登山队员王富洲、刘连满、屈银华和贡布向珠峰最后380米高度冲击。他们艰难地向前行进着。两个多小时后，著名的“第二台阶”挡住了他们的去路。他们沿着第三次行军侦察的路线，冒着严寒，用了五个多小时，用搭人梯的方式，爬上了不到7米高的“第二台阶”。这时，队员们又不得不面对另一个对手黑夜的挑战。他们借着雪夜的反光，一步一步地前进。由于前面用时过多，他们背上的氧气已经所剩不多了，他们现在又受到缺氧的沉重威胁。反应最强烈的是刘连满，他每前进一步都非常困难。为了争取时间，大家决定刘连满留下，其余三人以最快的速度突击登顶。严重缺氧的刘连满躺在一块避风的大石块旁边休息，开始进入一种半昏迷状态。这时，他冒着生命危险，毅然决定把自己所剩不多的氧气留给登山的同志，并留下了一封感人的短信。与此同时，三位登山队员正搏斗在前进的道路上。他们匍匐在地上，借着星光和反照的月光，辨认路途，艰难前进。到8830米时，三人的氧气已全部用完，他们就地抛掉背上的空气筒，开始了人类历史上从未有过的艰难而危险的无氧攀登。这样的攀登，其艰苦程度可想而知。他们终于登上了珠穆朗玛峰，完成了人类历史上从北坡登上世界最高峰的创举。（选自小学语文课本《登上世界之巅》作新华社原党组书记、社长郭超人同志）

## 1975年中国测量珠穆朗玛峰高度

1975年，中国组建了一支430多人的登山队伍，并制订出女队员打破8100米女子登山高度世界纪录，创造登顶人数最多纪录，拍摄三部纪录片以及配合中国科学院进行科学考察任务。1975年5月12日4时29分，中国登山队的男队员和女队员相继登顶成功。潘多同时成为从北坡第一个登上珠峰的女性。登山队在珠峰顶峰竖起标尺，为不久后准确测量出今天世界公认的珠峰高度取得了宝贵数据。



登山物资的车队进驻珠峰大本营



登山队副政委那宗诺副政委告别



队伍像尖刀一样直插北坡



潘多躺在顶峰，向大本营发放心电图



登山队员在顶峰竖起红色三角测量标尺



队员在大本营背物资准备出发



快乐的营地生活



队伍越过冰桥继续前进



登山队员顶着猛烈的高空风，行进在高耸7400米的冰塔里



登山队员在顶峰竖起红色三角测量标尺

实现庄严承诺

传递人类梦想



中国首位登上珠穆朗玛峰的女登山家「梅霞」，1975年5月24日随登山队登顶珠峰，成为第一位登顶的女性。她的登顶壮举激励了无数后来者，成为登山史上的一段佳话。



## 兩小時上至海拔4200米 科大生肺水腫命喪黃龍

【本報訊】港人外遊慘劇一宗接一宗，科技大學女畢業生去年8月與家人一同遊玩，短短兩小時多由海拔500多米去到海拔逾4,000米的黃龍風景區，山症發肺水腫死亡。死者家屬質疑旅行社行程安排有問題，出發前亦未有購買高山症保險。最終只願意退款100元慰恤了事。有攀山專家指，上山近3,500米猶如死亡路線，「好旅行社一定有責任」。

**暈倒地上呼吸困難**

歲的周小姐年前於科大化學系畢比斯眼科醫院工作，事發前剛返家。其姊母黃女士向本報表示，4日，趁交與父母及哥哥參加大九龍賽，黃龍旅行團，出發行程單草，提醒團員要小心（團員參考衛生署網頁，並準備。建成都並無大礙，但第二日

卻踏入「死亡陷阱」，「但機用時40分鐘，由海拔500幾米飛成飛去海拔約3,000米嘅九黃機場，之後好快又坐個半鐘頭車，由機場再上去海拔近4,200米嘅黃龍，兩個幾鐘頭升高吃成7倍！」

周小姐與其兄在景區同行，當時忽降陣雨，二人避雨後發現時間緊迫，再雨停即趕往各景點參觀。其間周小姐曾以急步行走，結果突然暈倒地上不能呼吸，其兄急忙找人帶她到山下救護站，再送往鄰近醫院，但終告不治。當地醫生指她死於肺水腫，可能由高山症併發而起。家人其後須盡快處理周小姐後事，卻沒有得到旅行社支援。香港領隊只發電返港向康泰匯報，之後竟建議家屬繼續行程，結果家屬團辦喪事，行李就繼續隨團去了九龍灣，「當地康泰職員又催我哋喇燒埋火化，結果遺體都理唔返香港。」

黃女士質疑旅行社行程安排，「係咪嗰該迷小徑小上，例如安排團員先到海拔低嘅嘢地方過一晚，而唔係一下子走上幾千米？」她又質疑，旅行社早知旅遊保險不賠償「高

地反應死亡」，但事前卻沒有提醒，結果出事後保險公司沒有任何賠償。

**旅行社否認路線危險**

負責跟進事件的康泰客戶服務部助理經理陳小姐回應指，領隊當時已聯絡當地相應單位援救周小姐，事後亦派了6名當地人員支援周家，並沒有要求他們繼續隨團，而旅行社願意付出5,000元恩恤金予周家。對於路線被指危險，她強調該路線營運已久，「以往都不試過有人出事！咁6天團本身係好短時間，其他旅行社亦係咁安排嘍！」

攀山專家鍾建民指，高山反應十個香港市民九個有，輕則頭痛，重則致命，「正當活嚟水平唔啱人一日都唔應企身升多過五百米，如果個女仔真係一日上咗幾千米，咁個行程真係好高危好有問題，旅行社一定有責任。」

### 高山反應視乎個人體質

【本報訊】高山反應通常發生於海拔2,500米以上地區，屬有一般因短時間急升抵高海拔，氣壓改變而令身體出現不適應反應。家庭發生高山症者，高山反應成因是在高海拔地區，大氣中氧氣及氣壓隨高度上升而下降，同時空氣稀薄令肺部換氣效率降低，結果造成動脈血氧及氧氣量下降。應者初期可輸出現心跳加快，呼吸加速及輕微頭痛等症狀，如身體仍未適應，症狀將漸漸加重並變成急性高山症，「病人好可能有肺或腦水腫，喉嚨之醫療設備嘅高山地區會好危險。」

**中招表面無徵兆**

攀山專家鍾建民補充指，是否容易有高山反應視乎個人體質，「睇表面其實冇得睇，亦唔關年紀事，次次發唔係無間斷嘍！」他表示一旦出現高山反應症狀，唯一解決方法就是盡快往低處，而除今次出事的黃龍外，部份著名旅遊點如南美玻利維亞、厄瓜多爾及青藏高原等均屬高海拔地區，市民出發前應先作了解，避好合適攀登路線及時間以免樂極生悲。

資料來源：周小姐親友

### 疾病致死不屬旅保範圍

【本報訊】立法會保險界議員陳健波說，保單承保範圍各異，但一般旅遊保險通常只承保旅程中治療高山症的醫療費用，例如視乎保額包括安排專機運送患者到平地就醫的費用等；但若高山症引致死亡，會被視作疾病致死，不屬旅保保障範圍。

陳健波補充，旅保承保的意外死亡如滑雪時撞死，「因有外來引致意外因素」才會賠償。

**帶團往高地須培訓**

國際專業保險諮詢協會會長羅少雄則稱，旅保只保障旅遊意外所需開支，如醫

療、遺體運送等，意外身亡賠償有限，購買人壽、意外及醫療保險的保障才較寬，就算發生高山症死亡也獲賠償。

有旅遊業界透露，領隊都需接受發出發往較高海拔地區所需額外指導，如提醒旅客帶備個人應急用品，如何避險等，並且清楚每個地點的求救聯絡站位置，遇意外可即時求救；領隊備急救知識，必要時協助傷者。

他說，旅行社都會呼籲領隊在第一時間向救援機構求助，向公司請其次：「因為事後俾人知你發生咗事嘅時候，隨時畀公司招攬。」

# 奪命珠巔

與妻闖5,300米尼泊爾大本營  
IT男高山症亡



■死者林冠華與妻子常結伴出遊，他更喜歡與妻同遊的合照。

# Classification of high altitude

- > 1500m (4900 ft)
- Intermediate: 1500m - 2500m
- High: 2500m - 4000m
- Very high: 4000m - 5500m
- Extreme high: >5500m

- **Intermediate**

- 1500m - **2500m**
- ↓exercise performance
- ↑alveolar ventilation
- No major impairment in arterial O<sub>2</sub> transport
- **Adaptation** is sufficient
- AMS start to occur at ~ 2500m

- **High altitude**

- 2500m - 4000m
- ↓in arterial O<sub>2</sub> saturation
- Marked hypoxemia may occur during exercise or sleep
- Adaptation not sufficient
- **Acclimatization** required
- Altitude illness can occur with rapid ascent
- Most case of altitude medial problem occur in this range

- **Very high altitude**

- 4000m - 5500m
- Abrupt ascent dangerous
- Arterial O<sub>2</sub> saturation not maintained
- Extreme hypoxemia can occur during sleep, exercise or with illness
- **HAPE / HACE most common**

- **Extreme altitude**

- >5500m
- Severe hypoxemia & hypocapnia at rest
- Progressive physiological deterioration despite maximal acclimatization
- **Acclimatization not possible**
- Sustained human habitation is impossible

# High Altitude

- ***Hypobaric hypoxia***
- Fall in inspired partial pressure of O<sub>2</sub> (P<sub>IO<sub>2</sub></sub>)
- Lower alveolar partial pressure of O<sub>2</sub> (P<sub>AO<sub>2</sub></sub>)
- Fall in arterial partial pressure of O<sub>2</sub> (P<sub>aO<sub>2</sub></sub>) & arterial oxygen saturation (S<sub>aO<sub>2</sub></sub>)
- Reduction in O<sub>2</sub> delivery to tissue → **cellular hypoxia** & organ dysfunction

# Physiology

Altitude (m)	PaO2 (mmHg)	SaO2 %	PaCO2 (mmHg)
Sea level	90-95	96	40
1524	75-81	96	35.6
2286	69-74	92-93	31-33
4572	48-53	86	25
7620	32-39	68	13
8848	26-33	58	9.5-13.8



# Acclimatization

- ↓ inspired partial pressure of O<sub>2</sub> along with barometric pressure on ascent to altitude  
→ hypoxia
- **Process of body adjust to hypoxia**
- Respond depend on magnitude & rate of onset of hypoxia
- **Series of compensatory changes** in multiple organ systems over difference time course form days to weeks

# Limitation to acclimatization

- **Individual variation, genetic polymorphism**
- **Only reliable indicator: previous Hx of successful ascent to a similar altitude**
- Inhibited by **over exertion, dehydration, alcohol**
- People with inadequate carotid body response, pulmonary or renal disease → inadequate ventilatory response
- Right ventricular strain from excessive pulmonary hypertension
- Impair renal function
- Polycythemia & microcirculatory sludging

# The Causes of Death Among Trekkers in Nepal

D.R.Shlim & J.Gallie et al: Int.J.Sports Med,1992:13

- Review of trekking deaths 1984 – mid 1987
  - Death rate of 15/100,000 trekkers
  - Altitude sickness deaths 3/23 (13%)
- Mid 1987 through 1991
  - Death rate of 14/100,000 (40 out of 275,950 trekkers)
  - Cause of deaths
    - Non altitude illness 14 (35%)
    - Trauma 12 (30%)
    - Altitude sickness 10 (25%)
    - Missing & presume death 4 (10%)

# The Causes of Death Among Trekkers in Nepal

D.R.Shlim & J.Gallie et al: Int.J.Sports Med,1992;13

- **Non altitude illness 14 (35%)**
  - Myocardial Infarct -4/14
  - Diabetic Ketoacidosis- 3/14
  - Sudden cardiac death (SCD)- 3/14
  - Hypothermia- 1/14
  - ?CVA- 1/14

# Mortality on Mount Everest, 1921-2006: descriptive study

Paul G Firth et al: BMJ 2008;337:a2654

- Examine **patterns of mortality** among climbers on Mount Everest from **1921-2006**
- 14138 mountaineers, **8030 Climbers & 6108 Sherpas**
- Mortality rate in other Alpine
  - Denali (6194m), Alaska, 1903-2006: 0.03%
  - Mount Rainer (4392m), Washington, 1987-1996: 0.02%
- Mortality rate among mountaineers **above base camp** {final encampment on any route before technical (roped) climbing began} was **1.3%**

Classification	Climbers	Sherpas	Total
<b>Trauma:</b>	<b>54 (43.2%)</b>	<b>59</b>	<b>113</b>
Falls	34	12	46
Objective hazards	20	47	67
<b>Non-trauma:</b>	<b>46 (36.8%)</b>	<b>6</b>	<b>52</b>
High altitude illness	12	5	17
Hypothermia	11	0	11
Sudden death	7	0	7
Unclassified	16	1	17
<b>Disappeared:</b>	<b>25</b>	<b>2</b>	<b>27</b>
<b>Total</b>	<b>125</b>	<b>67</b>	<b>192</b>
Total death rate (%)	1.6	1.1	1.3

Table 2 Classification of deaths of mountaineers climbing above base camp, 1921-2006. Values are numbers of people killed unless stated otherwise

# Cardiovascular risk during Physical Activity in the Mountains

Andrea Ponchia et al: J Cardio Med:2006, Vol 7: No 2

- Observational study in mountain of the Veneto Region (North-east Italy) from May 1999-May 2002
- **117** Cardiovascular (CV) events
  - SCD 38 (33%)
  - ACS 13 (11%)
  - Stroke 5 (4%)
  - 61 (52%) non-traumatic with probably CV origin (syncope, dyspnoea, palpitation & other undefined disturbances)
- **3.13** CV events per million person-days of physical activity in the mountains
- **1.02** SCDs & **0.35** ACSs per million person-days

# Cardiovascular risk during Physical Activity in the Mountains

Andrea Ponchia et al: J Cardio Med:2006, Vol 7: No 2

- No major CV events among subject **< 40 yr**
- **>60%** events recorded in age classes **> 50yr**
- 83% events occurred in **male** (95% of SCDs & 92% of ACSs)
- 86% of SCDs & 71% of ACS, the **subjects did not practice regular physical activity in mountain or elsewhere**
- Most CV event occurred during exertion or immediately afterward (74% of SCD & 85% of ACS)
- Altitude & other typical aspect of mountain (low temp & difficulty terrain) **not seem to play a significant role in determine the event** (71% SCD & 83% ACS occurred at altitude <1800m)

# Risk Factor Profile for Sudden Cardiac Death During Mountain Hiking

M Burtscher et al: Int J Sports med 2007;28:621-624

- 9 yrs. case-control analysis between persons who died suddenly during mountain hiking & randomly related control in Austria
- Risk profiles of **179** Austrian/German males > age 34 who suffered SCD (who died within 1hr of onset of symptom) during mountain hiking compared to those of **537** matched controls
- Risk factor & triggering associate with SCD during hiking
  - **Prior MI** (17% vs. 0.9%;  $p < 0.0001$ )
  - **Known CAD without prior MI** (17% vs. 4%;  $p < 0.001$ )
  - Diabetes (6% vs. 1%;  $p < 0.001$ )
  - **Hypercholesterolemia** (54% vs. 20%;  $p < 0.001$ )
  - **Less engaged in regular mountain sports activities** (31% vs. 58%;  $p < 0.001$ )

# High-Altitude Exposure in Patients with Cardiovascular Disease: Risk Assessment and Practical Recommendations

Yves Alleman et al: Prog Cardiovasc Dis 2010;52:512-524

- Base on available data, evidence-based recommendations for unacclimatized high-altitude exposure are **not possible**
- General rules: keep the risk as low as possible; should be **in stable and compensated clinical condition** at low altitude and have a **functional class lower than II**

Table 2

Prerequisites, general recommendations, and contraindications to high-altitude exposure

#### General prerequisites at low altitude

- Stable clinical condition
- Asymptomatic at rest
- Functional class < II

#### General recommendations at high altitude

- Ascent at a slow rate > 2000 m (increasing sleeping altitude by < 300 m/d)
- Avoid overexertion
- Avoid direct transportation to an altitude > 3000 m

#### Absolute contraindications to high altitude exposure

- Unstable clinical condition, ie,
  - unstable angina
  - symptoms or signs of ischemia during exercise testing at low to moderate workload (<80 W or <5 metabolic equivalents)
  - decompensated heart failure
  - uncontrolled atrial or ventricular arrhythmia
- Myocardial infarction and/or coronary revascularization in the past 3-6 mo
- Decompensated heart failure during the past 3 mo
- Poorly controlled arterial hypertension (blood pressure  $\geq$  160/100 mm Hg at rest, > 220 mm Hg systolic blood pressure during exercise)
- Marked pulmonary hypertension (mean pulmonary artery pressure > 30 mm Hg, RV-RA gradient > 40 mm Hg) and/or any pulmonary hypertension associated with functional class  $\geq$  II and/or presence of markers of poor prognosis<sup>37</sup>
- Severe valvular heart disease, even if asymptomatic
- Thromboembolic event during the past 3 mo
- Cyanotic or severe acyanotic congenital heart disease
- ICD implantation or ICD intervention for ventricular arrhythmias in the past 3-6 mo
- Stroke, transient ischemic attack, or cerebral hemorrhage during the past 3-6 mo

# High-Altitude Exposure in Patients with Cardiovascular Disease: Risk Assessment and Practical Recommendations

Yves Alleman et al: Prog Cardiovasc Dis 2010;52:512-524

- Patient with **Hypertension**
  - BP response to high altitude exposure is **unpredictable & variable**
  - No report of major complication in patient with HT exposure to high altitude
  - No evidence for altered prevalence of high altitude related illness in hypertensive patient
- Patient with **Coronary artery disease**
  - May experience earlier onset & more frequent of symptoms at altitude for a given amount of exercise compare with that at sea level
  - Travel to high altitude is C/I for **at least 3 months** after **ACS, MI, percutaneous or surgical coronary revascularization**

# High-Altitude Exposure in Patients with Cardiovascular Disease: Risk Assessment and Practical Recommendations

Yves Alleman et al: Prog Cardiovasc Dis 2010;52:512-524

## ■ Patient with **Congestive Heart Failure**

- CHF patient likely notice reduced functional capacity at moderate to high altitude compare with at sea level
- **Not travel** to high altitude for patient with **severe functional limitation, clinical/biochemical sign of fluid retention**
- Distinction between pulmonary edema related to decompensate CHF or HAPE can be challenging in field

# High-Altitude Exposure in Patients with Cardiovascular Disease: Risk Assessment and Practical Recommendations

Yves Alleman et al: Prog Cardiovasc Dis 2010;52:512-524

## ■ Patient with **Arrhythmia**

- Patient with PAF/persistent AF, advice ascertain for rhythm/rate control especially during exercise
- Patient with paroxysmal SVT & Atrial flutter recommend radiofrequency catheter ablation before attend high altitude
- Pacemaker function remain unchanged in hypobaric chamber study stimulating altitude up to 4000m
- No data on patient with implantable cardioverter-defibrillators (ICDs) at high altitude
- C/I for high altitude exposure in patient with **uncontrolled ventricular arrhythmia, recent ICD implant & patient with recurrent ICD intervention**

# Altitude Sickness

- Acute Mountain Sickness (**AMS**)
- High Altitude Cerebral Edema (**HACE**)
- High Altitude Pulmonary Edema (**HAPE**)

## ACUTE MOUNTAIN SICKNESS

If you are not feeling well over 2,500m., it may be Acute Mountain Sickness (AMS) until proven otherwise.

### EARLY SYMPTOMS

- Headache
- Loss of Appetite
- Dizziness
- Fatigue on Minimal Exertion

### WHAT TO DO ?

- Don't go higher, rest, drink fluids (not Alcohol)
- Symptoms go away=go up
- Symptoms get worse=go down

### WORSENING SYMPTOMS

- Severe Headache
- Vomiting
- Walking like a drunk
- Increasing tiredness of breath at rest

### WHAT TO DO ?

**Descend ! Descend ! Descend !**  
Don't let anyone with AMS symptoms descend alone.



**HIMALAYAN RESCUE ASSOCIATION NEPAL**

Dhobichaur, Lazimpat, Kathmandu, P.O. Box: 4944

Phone: 4440292, 4440293, Fax: 4411956

## ACUTE MOUNTAIN SICKNESS !!!

MANY PEOPLE SUFFER FROM THE MILD SYMPTOMS OF AMS (ACUTE MOUNTAIN SICKNESS) A LIGHT HEADACHE, LOSS OF APPETITE AND DISTURBS SLEEPS. WHEN SUFFER FROM AMS DO NOT CONTINUE TO GO UP BUT STAY WHERE YOU ARE OR GO DOWN TO ACCLIMATIZE.

1. HACE - HIGH ALTITUDE CEREBRAL EDEMA (SWELLING OF THE BRAIN)
2. HAPE - HIGH ALTITUDE PULMONARY EDEMA (FLUIDS IN THE LUNGS)

### SYMPTOMS INCLUDE :

- \* PERSISTENT, SEVERE HEADACHE
- \* LOSS OF APPETITE
- \* VOMITING
- \* CONFUSED THINKING
- \* SOUND OF LIQUID IN THE LUNGS
- \* PERSISTENT BUBBLING COUGH
- \* DIFFICULTY BREATHING
- \* RAPID BREATHING OR BREATHLESSNESS AT REST
- \* COUGH PRODUCING PINK, BROWN OR WHITE SPUTUM
- \* SEVERE LETHARGY (NOT WANTING TO DO ANYTHING)
- \* BLUENESS OF FACE AND LIPS
- \* HIGH RESTING HEART BREATH (> 110 PER MINUTE)

### PREVENTION:

- \* ESPECIALLY WHEN CROSSING HIGH PASSES TREK IN GROUP.
  - \* YOU GO UP DRINK PLENTY OF FLUIDS (NOT ALCOHOLIC BEVERAGES)
  - \* BE PROPERLY EQUIPPED FOR THE COLD
  - \* HAVE REST DAY FOR EVERY 1000m OF ALTITUDE
  - \* IF MILD AMS - DON'T GO HIGHER
  - \* IF HACE OR HAPE SYMPTOMS, DESCEND IMMEDIATELY
- NOTE: DAILY ALTITUDE TALK AT HRA BY DOCTORS (SEASONAL)

AGAPARC



## 高山病防治

### 高山病的起因:

在海平面高度, 氧气浓度为21%, 大气压平均为760毫米汞柱。随着高度的增加, 其浓度不变, 但每单位空气中氧分子个数却减少了。在海拔3658米的高度上大气压仅为483毫米汞柱, 每单位空气中氧分子数量大致比其正常值少40%。为了满足身体的充分供氧, 你必须加快呼吸的频率(即使在休息时)。这种额外的呼吸增加了血液中的含氧量, 但已达不到在海平面高度时的浓度。既然维持身体活动所需的氧的数量是相同的, 身体必须进行调节以适应缺氧的环境。此外, 为某种尚未完全搞清的原因, 高海拔和低气压能使体液从毛细血管渗出, 进而引起体液积于肺部和脑部。没有充分的适应而长时间置身于高海拔地区会带来潜在的严重后果, 甚至染上失温。

造成失温的原因为: 海拔愈高, 气候的变化愈大, 当缺乏适当的保暖设备, 或长期暴露在气候恶劣的低温环境下, 特别是精疲力竭、衣物潮湿的情况下时, 会产生体温下降的生理反应。当体温降到摄氏3.5度以下时, 人体即已进入失温状态。失温的症状有: 感觉寒冷、皮肤苍白、四肢冰冷、剧烈而无法控制的颤抖、言语含糊不清、肌肉不受意志控制、反应迟钝、性情改变或失去理性、脉搏减缓、失去意识等。患者一旦进入失温状况, 可能在数小时之内死亡, 严重者可能心跳极慢, 呼吸细微, 即使呼吸及心跳停止, 也不可认定患者已死亡, 应立即施以急救处理。失温最重要的急救原则是防止患者继续丧失体温, 并逐步协助患者获得正常体温, 将患者带离恶劣的低温环境, 移至温暖的帐篷或屋内。脱掉潮湿冰冷的衣物, 以温暖的衣物、睡袋等裹住患者全身。若患者意识清醒, 则可让他喝一些热而甜的饮料, 若已不省人事, 则让他以复原姿势躺着。可与患者热水瓶或施救者以体温传导, 以防患者体温再度下降。若患者呼吸及心跳停止, 应展开心肺复苏术, 并尽快送医。切记不可给患者喝酒, 亦不可擦拭或按摩患者四肢, 也不可鼓励患者作运动。

### 冻伤

冻伤的原因是因为身体循环系统的末端如手指、脚趾、耳朵、鼻子等, 因长时间暴露在冰冷或恶劣的气候环境中, 或者接触冰雪, 因而产生皮肤或皮下组织冻结伤害。冻伤的症状有: 患处刺痛并逐渐发麻、皮肤感觉僵硬, 呈现苍白或有蓝色斑点、患处移动困难或迟钝。初期, 是皮肤或深部冻伤, 很难分辨出来, 其症状相差不多。此外, 冻伤可能伴随失温现象, 急救时应先处理后者。若只有冻伤现象, 应慢慢地温暖患处, 以防止深层组织继续遭到破坏。尽快将患者移往温暖的帐篷或山屋中, 轻轻脱下伤处的衣物及任何束缚物, 如戒指、手表等, 可用皮肤对皮肤的传热方式, 温暖患处, 或以温水将患处浸入其中, 冻伤的耳鼻或脸, 可用毛巾覆盖, 水温以伤者能接受为宜, 再慢慢升高。如果在1小时内患处已恢复血色及感觉, 即可停止「加温」的急救动作。其次, 抬高患处减轻肿痛。以纱布三角巾或软质衣物包裹或轻盖患部。除非必要, 尽可能不要弄破水泡或涂抹药物。尽速送医。尤需注意不可摩擦或按摩患处, 亦不可以辐射热使患处温暖。温暖后的患处不宜再暴露于寒冷中, 也不要以「解冻」的脚走路。

### 雪盲

造成雪盲的原因是因双眼暴露在雪地中, 没有墨镜保护的眼角膜很容易受伤, 因为无论是否有阳光照射, 雪地的反光都非常强烈, 若是艳阳天在雪地中活动, 在数小时之内即可造成严重的雪盲。雪盲的症状为眼睛非常疼痛, 眼睛感觉像充满风砂, 眼睛发红, 经常流眼泪, 对光线十分敏感, 甚至很难张开眼睛等, 若发生雪盲, 可施行以下的急救措施: 以冷开水或眼药水清洗眼睛, 其次, 以眼罩或类似物(干净之手帕、纱布等)轻轻敷住眼睛。尽量休息, 避免勉强使用眼睛。若有必要, 送医处理。雪盲的症状通常需要5-7天才会消除。

### 高山肺水肿

高山肺水肿的发生是由于体液渗入了肺部, 使得呼吸功能受到干扰。高山肺水肿有致死的可能, 死亡关键就在于对这种紧急情况的迅速反应紧急处理。

高山肺水肿的主要治疗方法就是降低海拔高度。在大型登山活动中都会携带高压氧仓, 可以用来创造暂时性的模拟「下撤情境」, 以将病情稳定几个小时。氧气的供应对于病情的暂时稳定也有帮助。不过, 终究必须实际降低高度才能真正改善病情。

高山肺水肿通常会在超过海拔3000米的地方发生未适应环境的登山者身上出现, 但也可能在较低底的2600米处发生。一般而言, 需要在高出持续待上一到三天才会发生高山肺水肿。这先种初期症状包括协调能力失调、头痛以及没有精力。请患者假装前面有高空绳索, 以脚跟对脚尖的直接步法走上5米的协调测试, 是协调测试的有效方法。患者也许会出现恶心以及强迫性呕吐的症状。

如果高山肺水肿加剧(很可能迅速恶化), 病人思考会变模糊, 许多脑部问题也会出现, 例如身体一侧的肌肉失去控制能力, 恍惚和昏迷。存活的关键是下降高度。有些登山队会服用利尿剂如肾上腺皮质激素类药物作为补充疗法。

# AMS

- S/S typical occur 6-12 hours after arrival at new high altitude, may arise day later often first night sleep
- **Spectrum** of illness and severity
- Symptom tend to worse at night
- **Headache** is cardinal symptom

# Diagnosis of AMS

- 1991 Hypoxia and Mountain Medicine Symposium at Lake Louise, Canada
  1. In setting of **recent gain in altitude > 2500m**
  2. Present of **headache**
  3. Plus **at least one** of following symptom
    - **GI** (anorexia, nausea, vomiting)
    - **Fatigue or weakness**
    - **Dizziness or light headedness**
    - **Difficulty sleep**

# Diagnosis of AMS

- AMS and Lake Louise Score
  - **Criteria 1 to 3 plus total score of at least**
    - AMS score **3** ( self report score, Q **1-5**)
    - AMS score **5 or >** (self report score + clinical assessment score, Q **1-8**)
  - Self report score
    - 3 to 5 = mild AMS
    - 6 or > = severe AMS
  - **Serial assessment** for respond to treatment

# AMS score

Self report score	Severity	Score
<b>1. Headache</b>	No headache	0
	Mild headache	1
	Moderate headache	2
	Severe, incapacitating headache	3
<b>2. GI</b>	No upset	0
	Poor appetite or nausea	1
	Moderate nausea or vomiting	2
	Severe nausea & vomiting	3
<b>3. Fatigue / weakness</b>	Not tired or weak	0
	Mild fatigue / weakness	1
	Moderate fatigue / weakness	2
	Severe, incapacitating fatigue	3

# AMS score

Self report score	Severity	Score
<b>4. Dizziness / lightheaded</b>	Not dizzy	<b>0</b>
	Mild dizziness	<b>1</b>
	Moderate dizziness	<b>2</b>
	Severe, incapacitating dizziness	<b>3</b>
<b>5. Difficulty sleeping</b>	Slept well as usual	<b>0</b>
	Did not sleep well as usual	<b>1</b>
	Woke many times, poor night's sleep	<b>2</b>
	Could not sleep at all	<b>3</b>

# AMS score

Symptom score	Severity	Score
6. Change in mental status	No change	0
	Lethargy / lassitude	1
	Disoriented / confused	2
	Stupor / semi-consciousness	3
7. Ataxia (heel to toe walking)	No ataxia	0
	Maneuvers to maintain balance	1
	Steps off line	2
	Falls down	3
	Can't stand	4
8. Peripheral edema	No	0
	One location	1
	Two or more location	2

# Prediction of AMS

- No reliable predictors
- Previous altitude experience
- Rate of ascent, altitude attained (sleep altitude)
- Duration of exposure to altitude
- Amount of exercise undertaken at altitude
- Underlying physiological susceptibility
- No significant effect of age, gender, physical fitness

# Acetazolamide (Diamox)

- Carbonic anhydrase inhibitor
- Force kidney to excrete bicarbonate
- Re- acidification the blood
- Respiratory stimulant especially at night
- **Net effect to accelerate acclimatization**
- Make a process normally take 24-48 hrs speed up to about 12-24 hrs
- **Not immediate cure of AMS**

# Dexamethasone

- Treat / mask the symptom
- **Emergency drug, buys time** especially at night where descent not possible
- Not help acclimatization
- Not to go higher until at least 18 hrs if use dexamethasone
- **Severe rebound** can occur if abrupt discontinue of medication

# Oxygen

- Symptom resolve very rapidly (minutes) on moderate flow (2-4 L/min) through nasal cannular
- **Rebound symptom** if duration of therapy is inadequate





### 注意事项

远离火源，避免剧烈撞击，不要与油类接触。

本品为一次性使用，用后请 

执行标准：《中国药典》2005-2 GB8982-1998  
生产许可证号：川Q20050288 川食药监械生  
产许（2006）第0023号

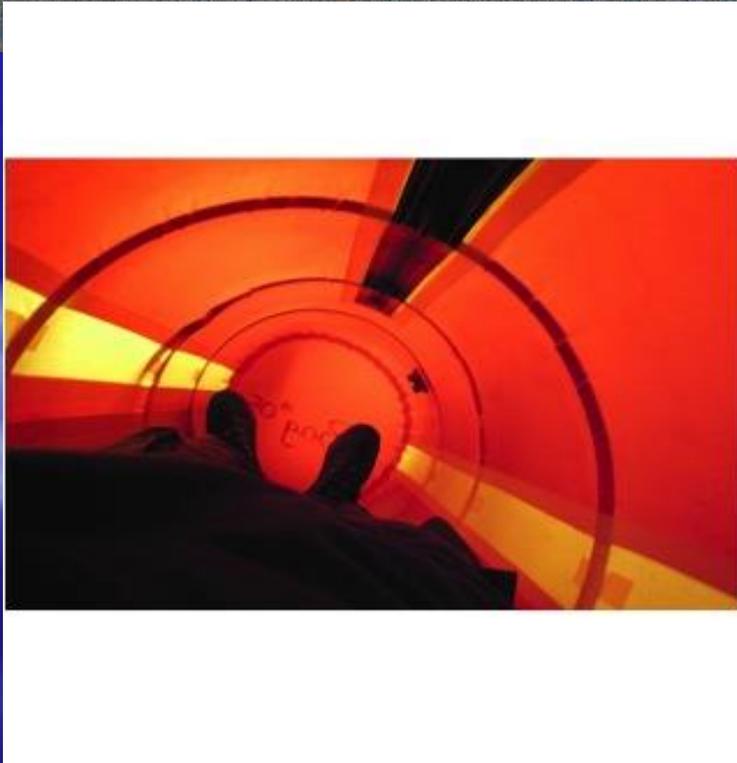
罐内压力：1.4Mpa (20°C)  
氧气纯度：99.5%  
充装容量：14L  
保质期：常温条件下保存期二年  
生产日期见罐底  
成都新炬化工有限公司  
地址：成都市新都区新都镇 邮编：610512  
电话：028-83922067 83922180  
网址：<http://www.cdxinju.com>





# Hyperbaric therapy

- Portable hyperbaric bag
- Gamow Bag, Certec Bag, PAC (portable altitude chamber)
- Air impermeable bags completely envelop the patient
- Inflated to significant pressure above ambient atmosphere
- Physiological descent + oxygen
- Extent of descent depends on altitude which bag is used
  - e.g. at 4250m inside bag ~ 2100m



# The Gamow Bag

## TRAINING AND REFERENCE MANUAL

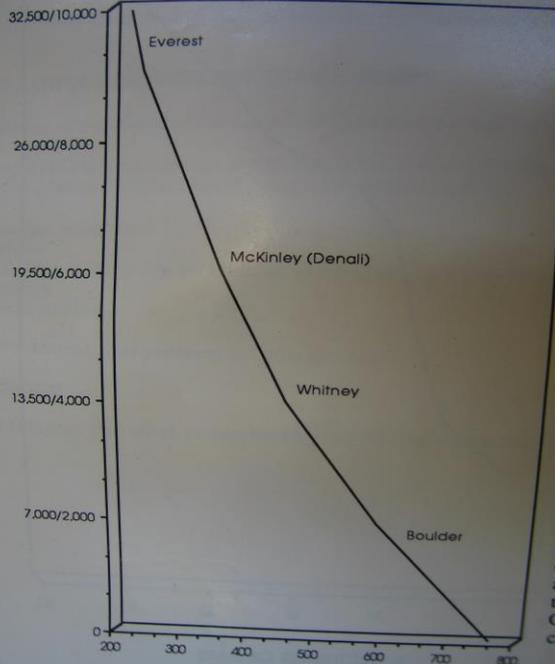


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PRESSURE vs ALTITUDE



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### AMBIENT CONDITIONS

### INSIDE GAMOW BAG

Meters	Feet	mm Hg	Meters	Feet	mm Hg	Δ Change (f)
0	0	760	-1022	-3353	863	3353
300	984	731	-751	-2464	834	3448
600	1969	705	-495	-1624	808	3593
900	2953	679	-232	-761	782	3714
1200	3937	654	24	78	757	3859
1500	4921	630	288	945	733	3976
1800	5906	607	535	1755	710	4151
2100	6890	584	798	2618	687	4272
2400	7874	562	1054	3458	665	4416
2700	8859	541	1310	4298	645	4561
3000	9843	522	1555	5102	626	4741
3300	10827	503	1805	5922	607	4905
3600	11812	484	2053	6736	588	5076
3900	12796	466	2299	7543	570	5253
4200	13780	449	2544	8347	553	5433
4500	14765	433	2787	9144	537	5621
4800	15749	417	3028	9935	521	5814
5100	16733	401	3268	10722	505	6011
5400	17717	387	3505	11500	491	6217
5700	18702	372	3741	12274	476	6428
6000	19686	359	3975	13042	463	6644
6300	20670	345	4206	13800	449	6870
6600	21655	333	4436	14555	437	7100
6900	22639	320	4664	15303	424	7336
7200	23623	309	4890	16044	413	7579
7500	24608	297	5113	16776	401	7832
7800	25592	286	5335	17504	390	8088
8100	26576	276	5554	18223	380	8353
8400	27560	266	5771	18935	370	8625
8700	28545	256	5986	19640	360	8905
9000	29529	246	6198	20334	350	9195

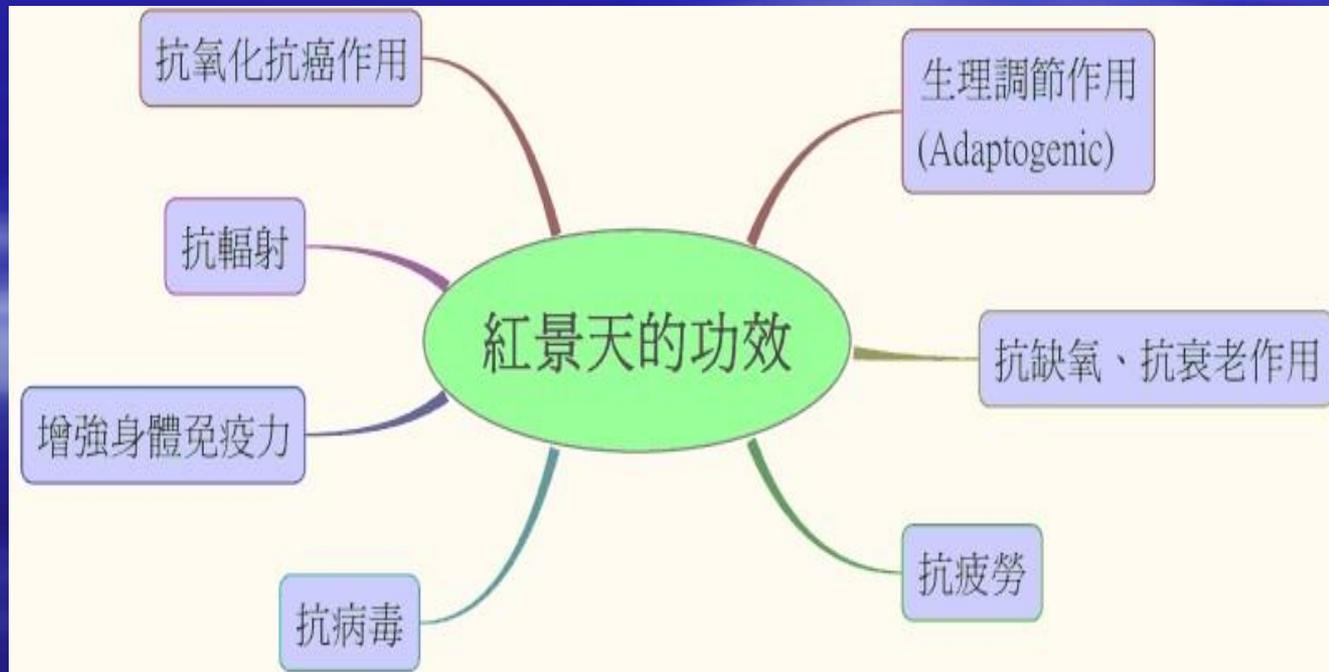
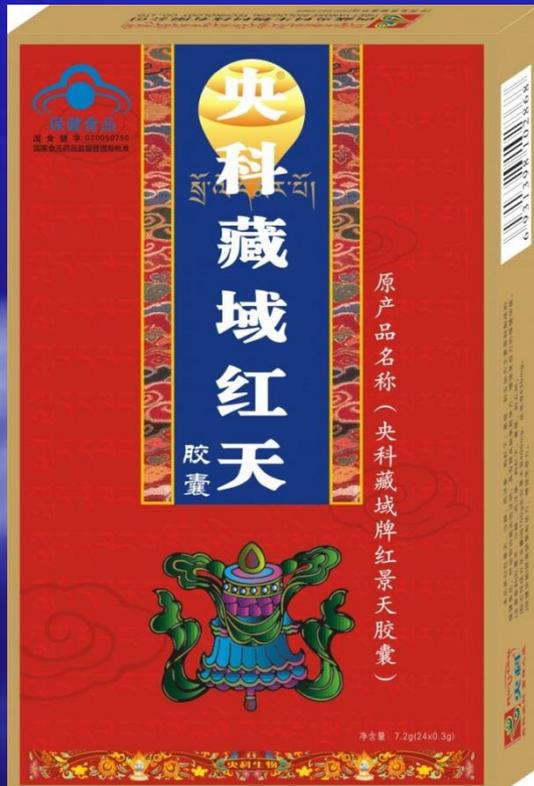
# Ginkgo biloba



# CoCa

- Peru, Colombia, Ecuador, Vnenzula, Bolivia
- Herbal tea with mild stimulant effect
- Raw material for manufacture of cocaine





# High altitude cerebral edema (HACE)

- **End stage / severe AMS**
- Presence of a **change in mental status and / or ataxia in a person with / without AMS**
- Incidence
  - ~ 1% of persons travel > 4000m
  - ~ 3% of those with AMS
- Without prompt treatment, further neurological deteriorate & **death (from brain herniation)** are likely

# Diagnosis

- Clinical
- Tandem - gait test
- Not affect finger - nose test
- Lake Louise Consensus
  - In setting of recent **gain in altitude**
  - **Either** presence of a change in mental status **and/or** ataxia in a person **with** AMS
  - **Or** presence of **both** mental status change **and** ataxia in a person **without** AMS

# Treatment

- **Do not delay descent**
- If descent not possible
  - Dexamethasone
    - 8 mg IMI stat then 4 mg IMI / PO Q6H
  - Oxygen
    - 4 L/m flow of 4-6 hours
  - Hyperbaric treatment
    - Dramatic improve in mental status (in hours)
    - Require 4-6 hrs treatment

# High Altitude Pulmonary Edema (HAPE)

- Occur first 1-4 days after arrive at altitude >2500, usually on second night after ascent
- Not necessary preceded by AMS
- 50% HAPE have AMS
- 14% HAPE have HACE
- Most common cause of death related to high altitude, rapidly fatal within few hours

# Lake Louise Consensus definition of HAPE

- In setting of a **recent gain in altitude**, the presence of the following:
- Symptoms: **at least two** of:
  - Dyspnoea at rest
  - Weakness or decreased exercise performance
  - Cough
  - Chest tightness or congestion
- Sign: **at least two** of:
  - Tachypnoea
  - Tachycardia
  - Crackles or wheezing in at least one lung field
  - Central cyanosis

# Management of HAPE

- **Early diagnosis** is critical
  - Greatest threat is own failure to accurately assess a dangerous situation & respond **appropriately** (James A.Litch. ET intubation & Mechanical Ventilation following respiratory arrest from HAPE; WJM,Mar 1999-vol 170,No 3)
- **Urgent descent**
  - Improve rapidly with descent only 500-1000m
  - Persistent symptom after descent (esp to previous asymptomatic level)
    - Additional causes of pulmonary compromise: pneumonia; cardiogenic pul edema; ARDS; PE

# Management of HAPE

- **Oxygen**

- Life saving if available
- 4 L/min x 4-6 hour

- **Nifedipine (Adalat)**

- Useful when oxygen unavailable
- vasodilatation → ↓ pulmonary hypertension
- 20mg stat then 10mg Q4H PO

- **Hyperbaric treatment**

- Dramatic improvement
- 2-4 hour of treatment

# Prevention of Altitude Illness

## THE GOLDEN RULES OF ALTITUDE

- 1) IF YOU ARE ILL AT ALTITUDE ASSUME IT IS DUE TO ALTITUDE UNTIL PROVEN OTHERWISE
- 2) DO NOT ASCEND WITH SYMPTOMS
- 3) IF SYMPTOMS DO NOT IMPROVE OR WORSEN → **DESCEND**
- 4) ONLY ASCEND 300-400m PER DAY AND TAKE A REST DAY EVERY 1000m
- 5) DO NOT LEAVE A PERSON WITH ALTITUDE ILLNESS ALONE

- Gradual ascent
- Climb high, sleep low
- If feel unwell at altitude, it is altitude illness until proven otherwise
- Never ascent with symptom of AMS
- If getting worse, go down at once



- Questions ?

- Thanks You