Radiation Oncology Emergencies

Berna DeMalignon,M.D

Sletten Cancer Institute

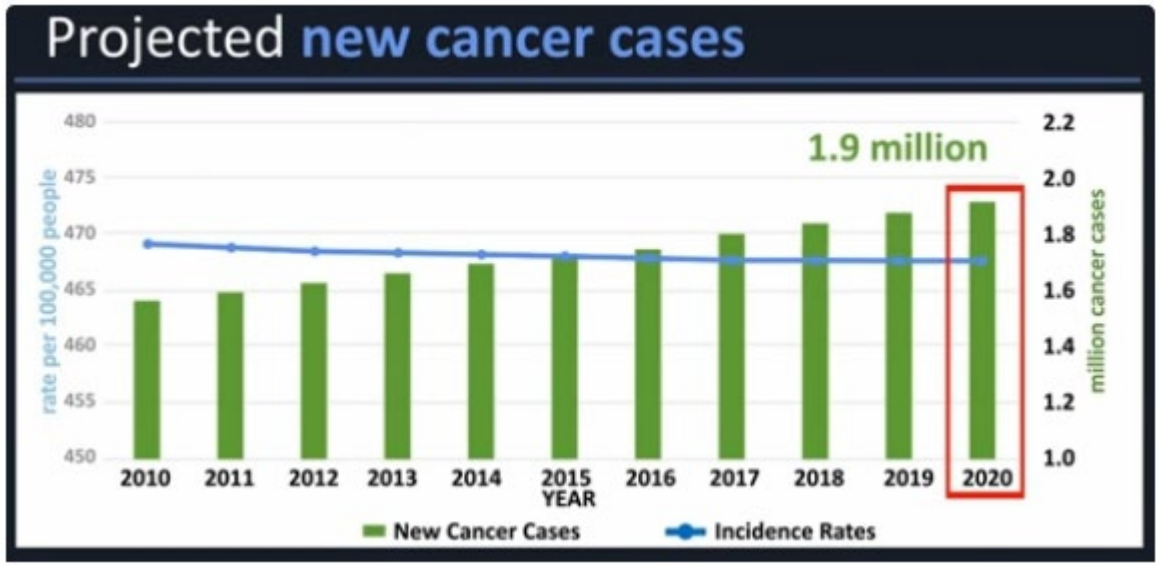
Radiation Oncology

Radiation Oncology Emergencies Overview:

- Cancer in the differential diagnosis/ current statistics
- What is radiation therapy and how does it work?
- Malignant spinal cord compression
- Hemoptysis
- SVC syndrome
- Airway obstruction

American Cancer Society // Infographics // 2018

Rising Global Cancer Epidemic



Males

	Risk of developing		Risk of dying from	
	%	1 in	%	1 in
All invasive sites	39.66	3	22.03	5

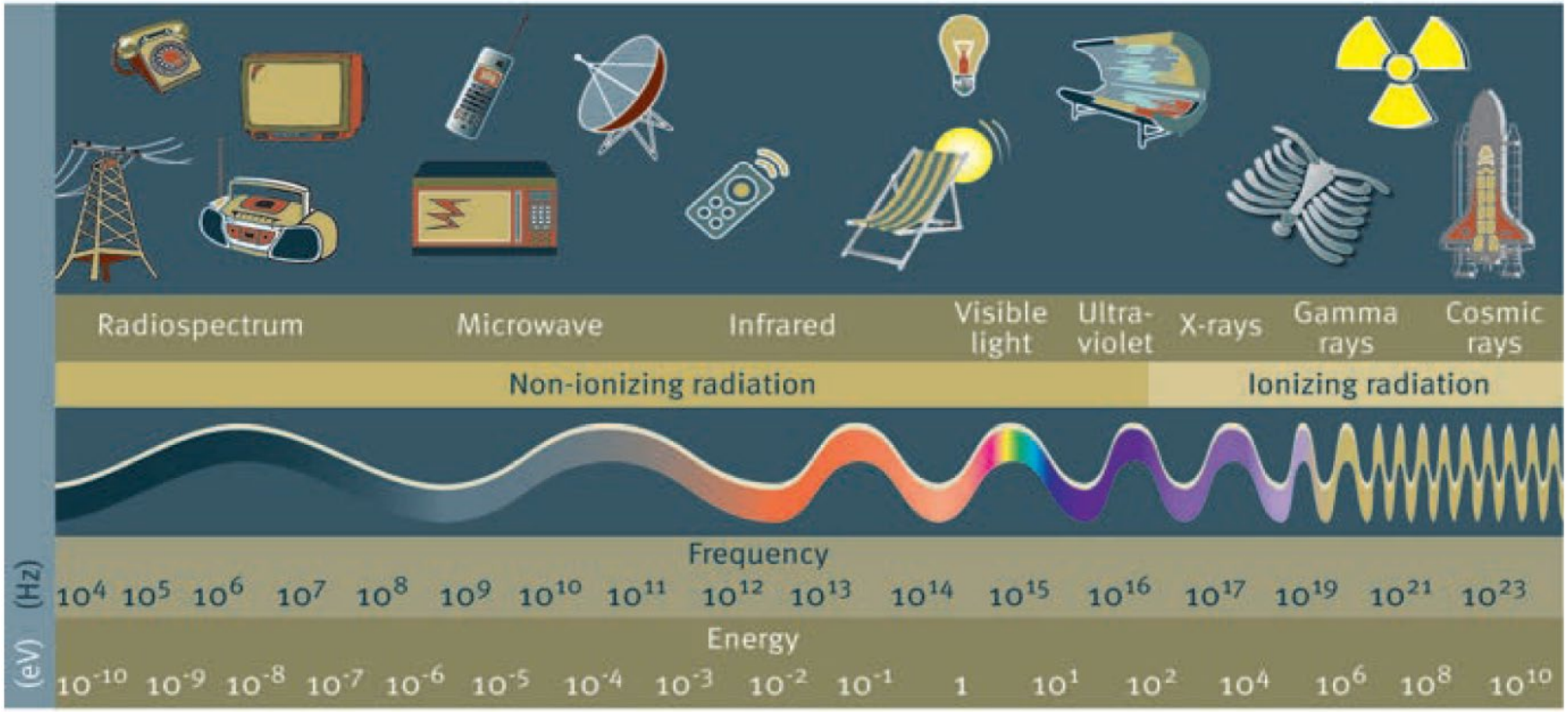
Females

	Risk of developing		Risk of dying from	
	%	1 in	%	1 in
All invasive sites	37.65	3	18.76	5

How Does Radiation Therapy Work?

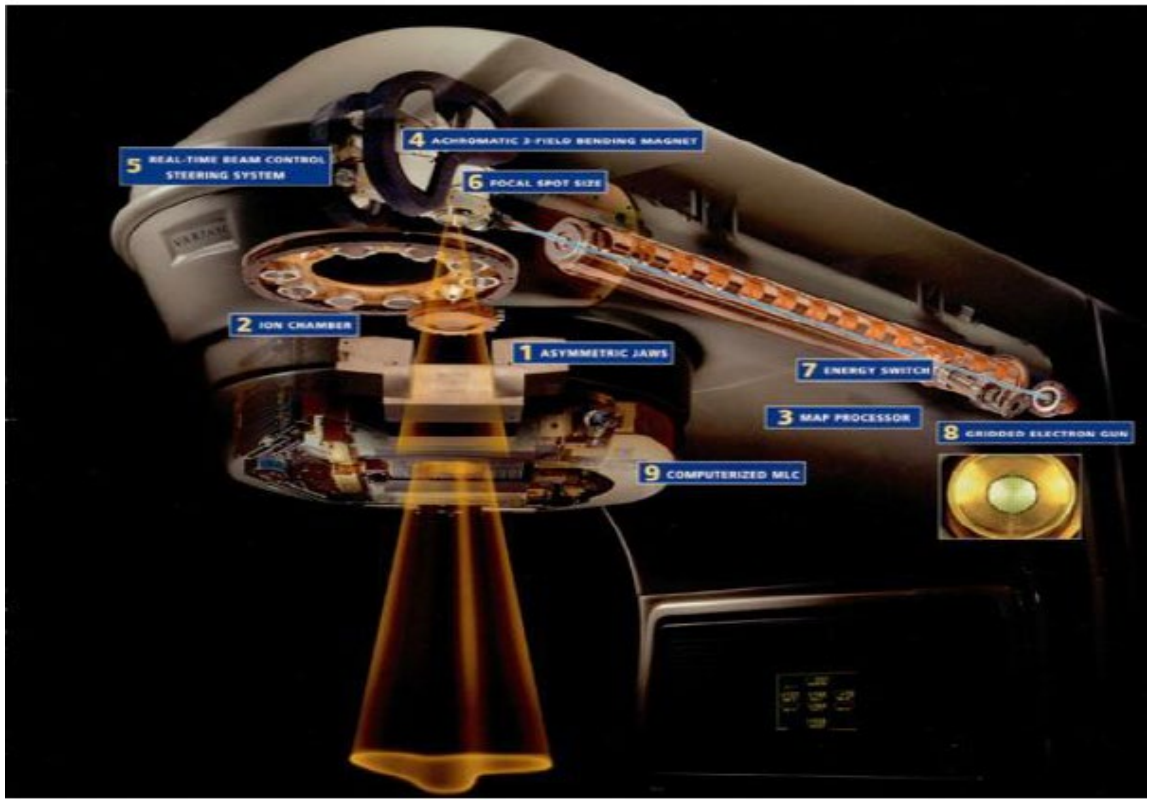
- Therapeutic use of ionizing radiation (IR) as part of cancer treatment to control malignant cells
- IR damages cellular DNA through formation of free radicals and reactive oxygen species
- DNA damage in cancer cells is inherited through cell division (accumulating damage to malignant cells causing them to die)
- Cancer cells are usually undifferentiated and have a decreased ability to repair damage
- Normal cells are differentiated and have the ability to repair themselves (cell cycle check points) G0/G1/S/G2/M

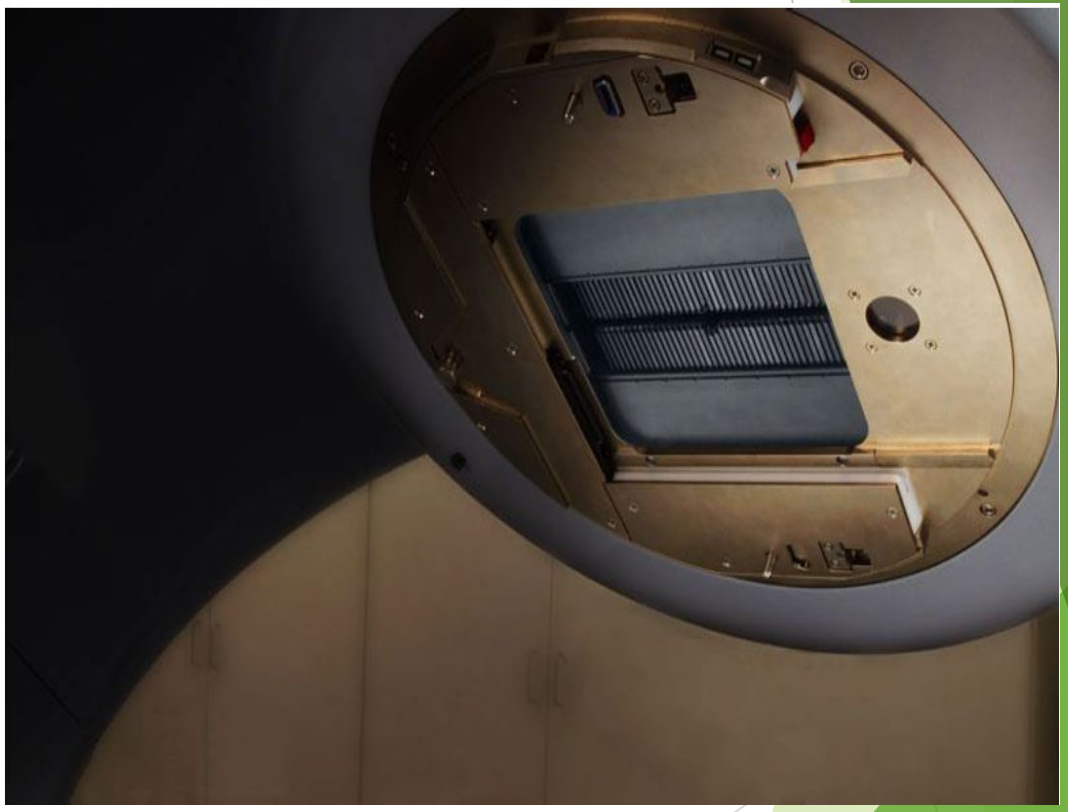
Examples of different applications using radiation



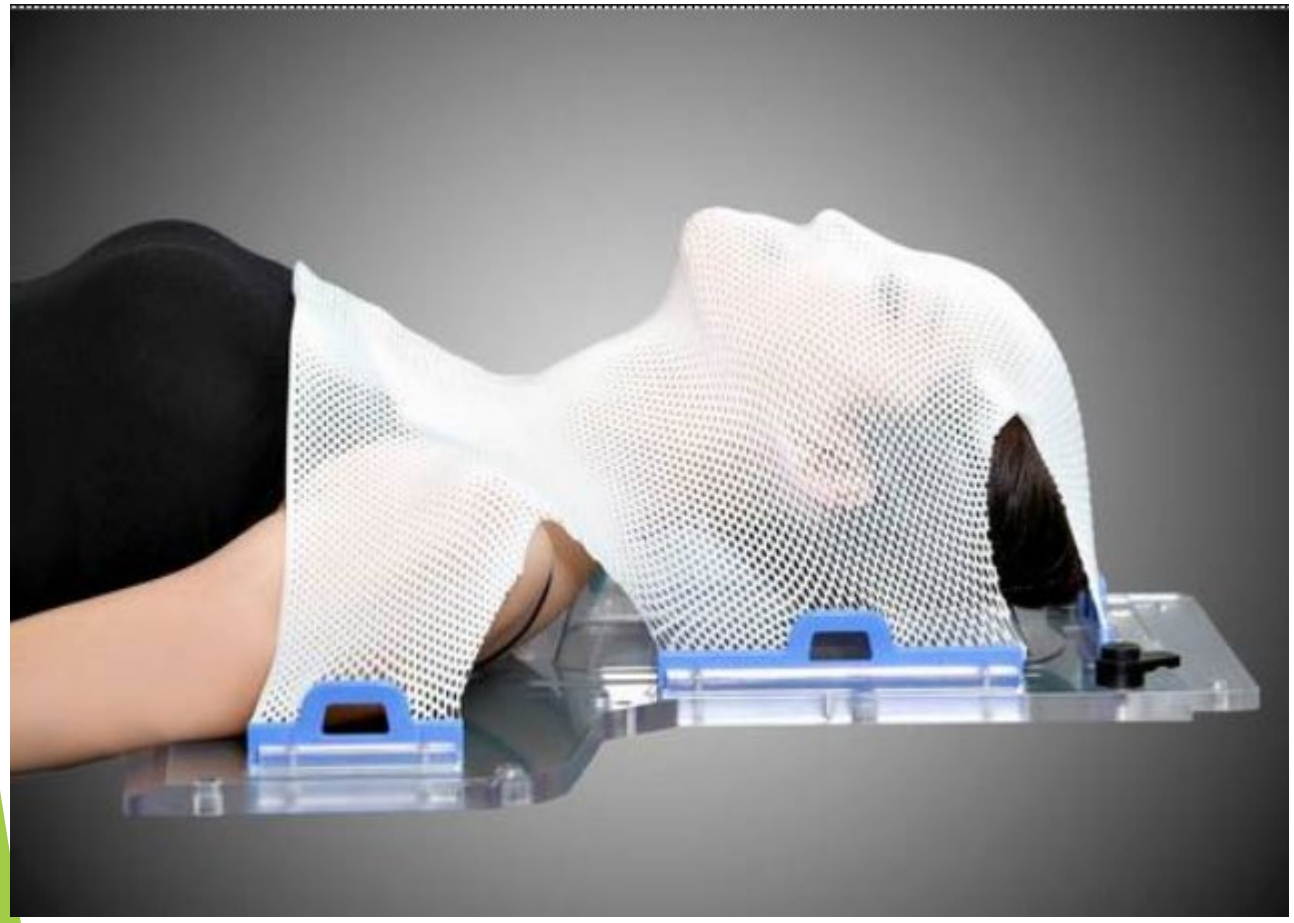
Non-ionizing radiation does not have enough energy—measured in electron volts (eV)—to make changes to atoms or molecules.

Radiation Therapy-LINAC

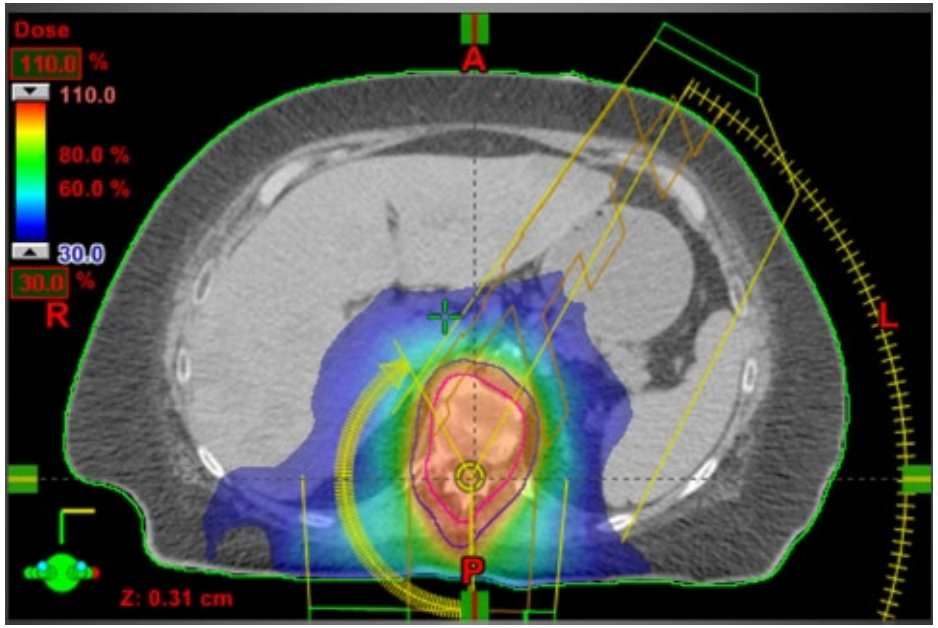


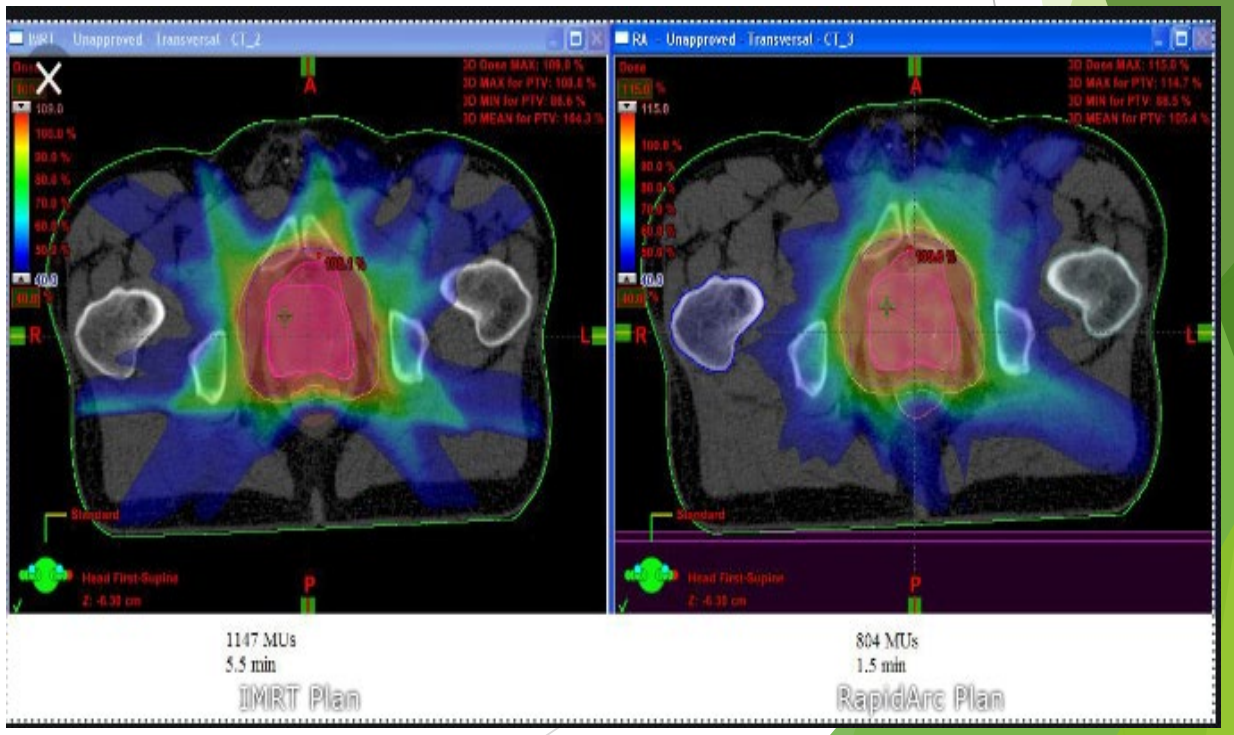


Immobilization Devices



Treatment Planning





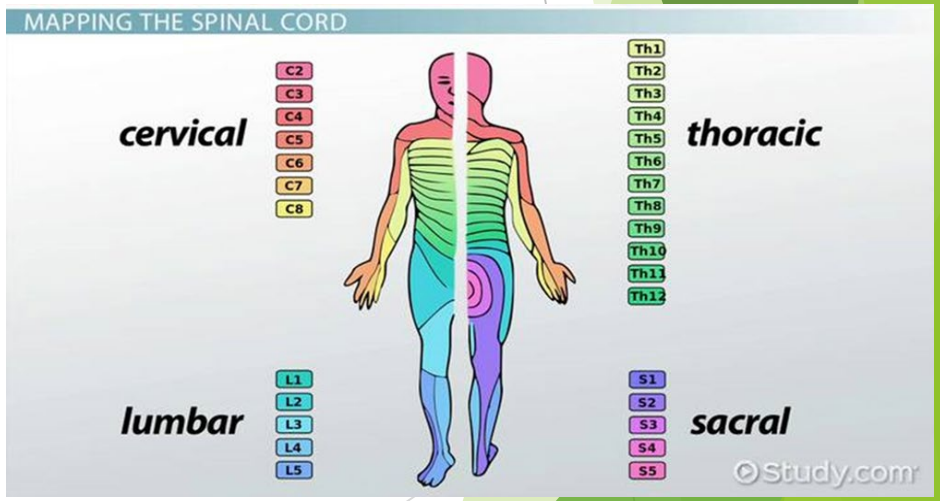
Malignant Spinal Cord Compression

- MSCC can be defined as compression of the dural sac and its contents by an extradural tumor mass.
- Can occur in 5-15% of all cancer patients
- Most common sites:
- Thoracic spine (70%)
- Lumbosacral (20%)
- Cervical (10%)

- Most common malignancies: breast, lung, prostate, unknown primary, prostate, renal, multiple myeloma, lymphoma

Malignant Spinal Cord Compression

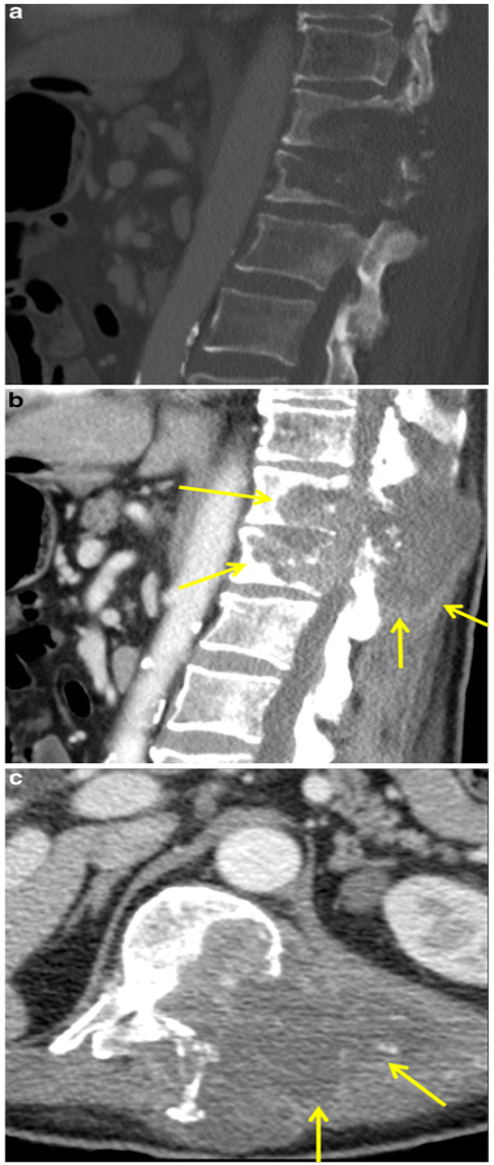
- Presentation: BACK PAIN, radicular pain, paraplegia, weakness, +/- sensory loss, autonomic dysfunction (urinary retention, constipation)
- Evaluation- complete neurologic and PE that includes:
  - Gentle percussion of spinal column
  - Passive neck flexion
  - Straight Leg raise
  - Motor and sensory exam/reflexes
    - Pinprick testing toe to head- sensory level
  - Is there a “sensory level”?
  - RECTAL exam



Malignant Spinal Cord Compression

- Diagnosis- image the ENTIRE spine
  - X-ray
    - 66% will have bony abnormalities
    - Erosion, loss of pedicles, vertebral body collapse, paraspinous soft tissue mass
    - Cannot exclude epidural metastases
    - Does not exclude cord compression if normal
    - Follow-up with MRI
  - MRI
    - Entire spine with and without contrast. Multiple levels are involved in up to 50%. Some of these areas can be asymptomatic.
  - High resolution CT scan- if MRI contraindicated

Malignant Spinal Cord Compression



Malignant Spinal Cord Compression

Goal of treatment:

- recovery and maintenance of normal neurological function
- stabilization of the spine
- local tumor control
- pain control

Time is critical: Damage to cord is vascular in nature. Epidural venous plexus compression ⇨ edema of the cord ⇨ white matter ischemia and if prolonged-infraction and permanent damage to cord.

Malignant Spinal Cord Compression Treatment:

- Steroids
  - START DEXAMETHASONE IMMEDIATELY/PPI. Do not wait for MRI, unless considering lymphoma and clinically appropriate, in which case may want to biopsy first.
  - 10 mg IVP followed by 4 mg IV every 6 hours
- Radiotherapy +/- surgery is the standard of care in patients who have MSCC.
- Chemotherapy may be considered in select, newly diagnosed patients who have excellent neurologic status and very chemosensitive tumors (eg, multiple myeloma, germ-cell tumors).
- Prognosis and spinal stability must be assessed for individualizing treatment. Some may be best served with supportive care only.

Malignant Spinal Cord Compression Radiation:

- Transport and positioning for RT may be associated with severe discomfort
- Side effects are generally mild and can include nausea, esophagitis, diarrhea. Pre-medicating with anti-emetics prior to daily RT is encouraged.
- The rate of in-field recurrences is significantly higher after short-course RT than after longer courses such as 3Gy x 10 fractions in 2 weeks or 2Gy x 20 fractions in 4 weeks.
- If poor survival prognosis, short-course RT with 1-5 fractions is considered appropriate.
- LC in MSCC is better with long-course RT. This was confirmed in a prospective nonrandomized study by Rades et al in 2011 comparing short-course RT (8Gy x 1 or 4Gy x 5) to longer-course RT (3Gy x 10, 2.5Gy x 15, or 2Gy x 20). In that study,1-year LC was 81% after longer-course RT and 61% after short-course RT.

Malignant Spinal Cord Compression

Validation of a Survival Score for MSCC/Rades et al

Table 1. Significant Prognostic Factors and Corresponding Scores

Prognostic Factor	Score
Type of primary tumor	
Breast cancer	8
Prostate cancer	7
Myeloma/lymphoma	9
Lung cancer	3
Other tumors	4
Other bone metastases at the time of RT	
Yes	5
No	7
Visceral metastases at the time of RT	
Yes	2
No	8
Interval from tumor diagnosis to MSCC, mo	
≤15	4
>15	7
Ambulatory status before RT	
Ambulatory	7
Nonambulatory	3
Time of developing motor deficits before RT, d	
1-7	3
8-14	6
>14	8

RT indicates radiotherapy; MSCC, metastatic spinal cord compression.

Malignant Spinal Cord Compression

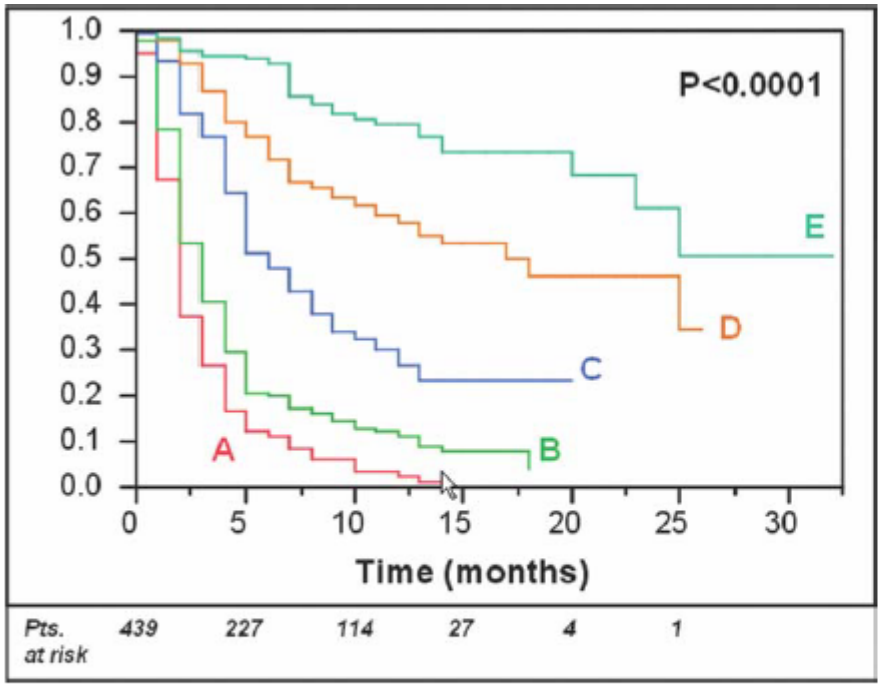


Figure 1. Kaplan-Meier curves of the 5 groups from the current study are shown with respect to survival (Group A: 20-25 points; Group B: 26-30 points; Group C: 31-35 points; Group D: 36-40 points; and Group E: 41-45 points). Pts indicates patients.

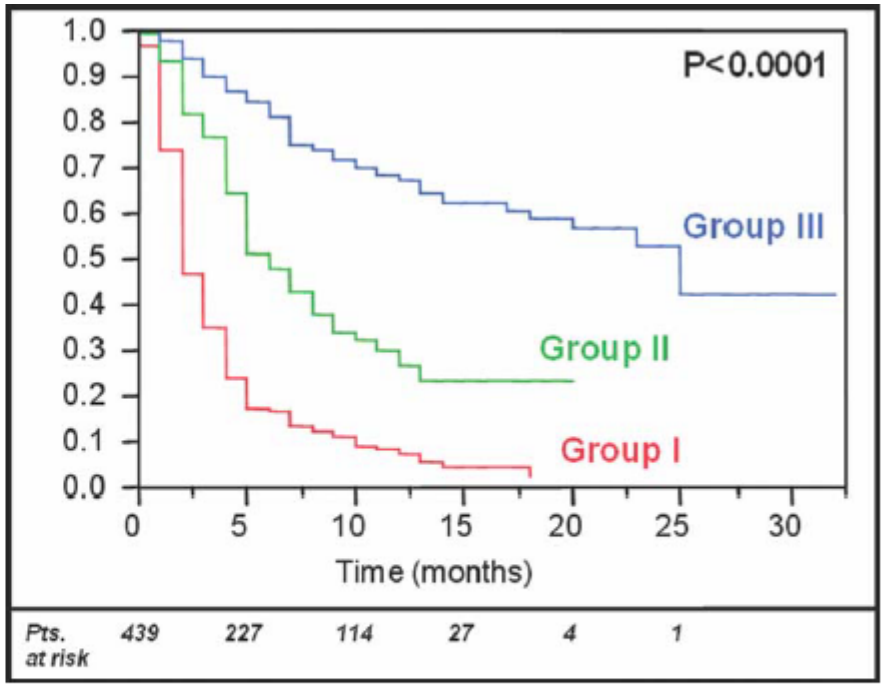
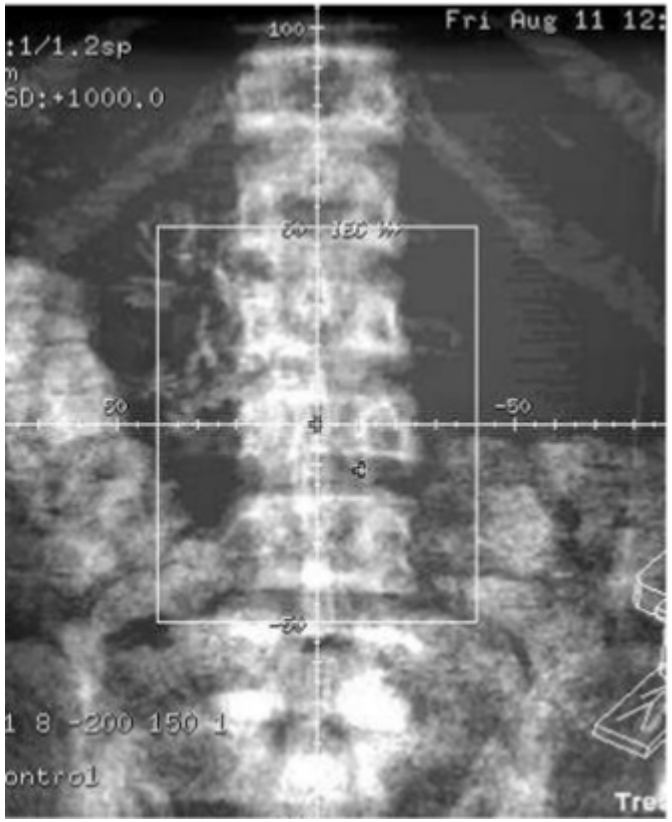


Figure 2. Kaplan-Meier curves of the 3 newly designed groups of patients (Pts) in the current study are shown with respect to survival (Group I: 20-30 points; Group II: 31-35 points; and Group III: 36-45 points).

Malignant Spinal Cord Compression

Radiation Therapy Setup Field:



Malignant Spinal Cord Compression

- Refer for surgery
  - Survival likely to be >3 months
  - Unknown primary and tissue diagnosis needed
  - Mechanical instability(SINS)
  - Prior radiation to affected area, may depend on dose and when prior treatment was given
  - Progression of cord compression despite steroids and radiation
  - Limited extent of bone disease/compression. Limited systemic disease
  - Compression due to bony retropulsion

- Surgery involves: palliative decompression and posterior stabilization. For tumors invading the vertebral body, wide laminectomy is performed; for tumors destroying the posterior column of the spine, debulking surgery is performed.

Malignant Spinal Cord Compression
Resection followed by radiation therapy vs radiation alone:

- In 2005, a RCT showed superiority of surgery+ RT vs RT alone (Patchell et al, Lancet). Post-treatment ambulatory rates were 84% after combined treatment and 57% after RT alone.
- Eligible patients had good KPS, relatively favorable survival prognosis, involvement of only one spinal region.
- This trial offered surgery specifically for patients who could potentially benefit.
- However, because of the narrow inclusion criteria, the addition of surgery seems suitable for only 10% to 15% of patients.

Malignant Spinal Cord Compression

Radiation therapy:

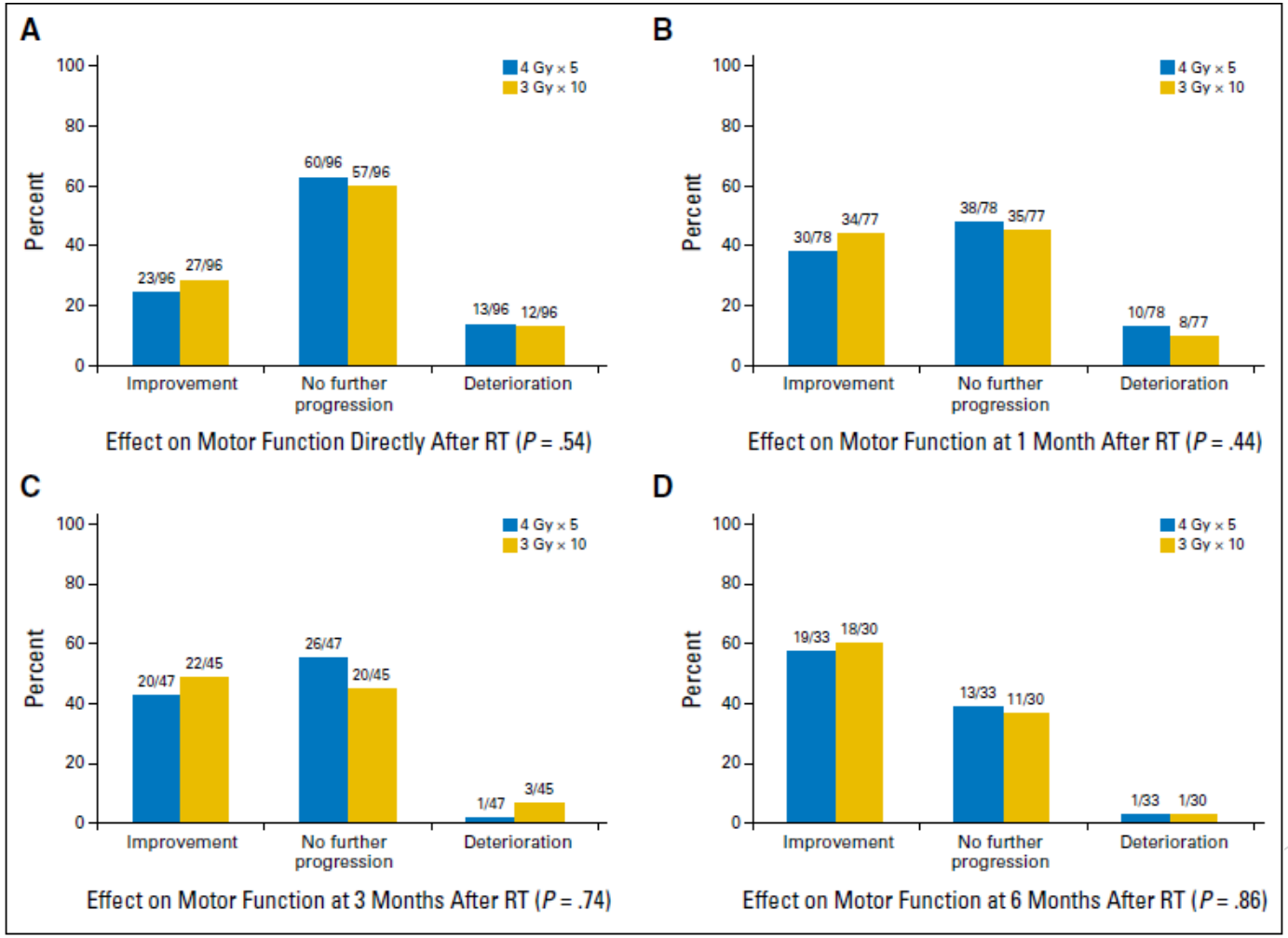


Fig 3. Comparison of 4 Gy × 5 (blue columns) and 3 Gy × 10 (gold columns) with respect to effect on motor function (improvement, no further progression, deterioration) (A) directly after radiotherapy (RT), (B) at 1 month after RT, (C) at 3 months after RT, and (D) at 6 months after RT.

Spinal Instability Neoplastic Score (SINS) System

Component	Score
Location	
Junctional (O-C2; C7-T2; T11-L1; L5-S1)	3
Mobile spine (C3-6; L2-4)	2
Semirigid (T3-10)	1
Rigid (S2-S5)	0
Mechanical pain	
Yes	3
No	2
Pain free lesion	1
Bone lesion	
Lytic	2
Mixed (lytic/blastic)	1
Blastic	0
Radiographic spinal alignment	
Subluxation/translation present	4
Deformity (kyphosis/scoliosis)	2
Normal	0
Vertebral body collapse	
>50% collapse	3
<50% collapse	2
No collapse with >50% body involved	1
None of the above	0
Posterolateral involvement	
Bilateral	3
Unilateral	1
None of the above	0

Malignant Spinal Cord Compression

- Treatment Outcome/Prognosis:
  - Degree of neurologic impairment
  - Radiosensitivity of tumor
  - Most have limited survival although up to one third survive beyond 1 year
  - Rades et al prospective study demonstrated that the strongest predictor for ambulatory status after therapy was time from onset of any symptoms to motor deficits.
- Emergency surgery within 48h tended to improve neurological outcome, whereas delaying up to 7 days still achieved a better survival than delaying it for more than 7 days.
- Several studies demonstrate that survival is better in preoperative ambulant patients

Hemoptysis

- Involves expectoration of blood from the lower airways
- Annual incidence ~ 0.1% in ambulatory patients
- Potentially life-threatening medical emergency and carries high mortality
- Malignant etiology:

  friable endobronchial tumor

  tumor eroding into a small intrapleural vessel

  tumor eroding into major vessels of the thorax
- In case of severe hemoptysis, the bleeding usually stems from bronchial (90%) and pulmonary (5%) arteries
- Work-up includes CT chest+/-angiogram followed by complementary bronchoscopy; ascertain cause and exact location of bleed

Hemoptysis

- Non-life threatening- urgent initiation of radiation
- Life-threatening- immediate stabilization with surgical or interventional techniques followed by radiation.
- Endobronchial source-laser, argon plasma coagulation, electrocautery, or cryotherapy can be performed bronchoscopically.
- Pulmonary periphery source- arterial endovascular embolization is the first line of treatment. Provides hemostasis in 75–98%. Surgery indicated if bronchial artery embolization is not successful.
- Studies have reported 76-84% symptomatic improvement with radiation.

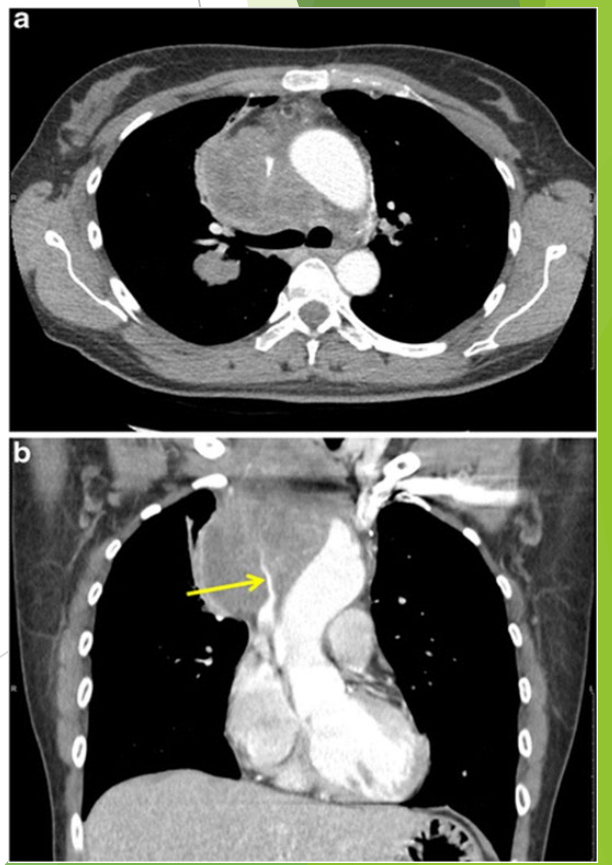
SVC Syndrome

- Constellation of symptoms which can occur when there is obstruction or compression of the SVC
- Signs and symptoms:
  - Facial or periorbital edema/erythema
  - Arm and neck edema
  - Engorgement of chest wall veins
  - Laryngeal or glossal edema/hoarseness/dysphagia
  - Dyspnea/orthopnea/cough
  - Headaches/dizziness/syncope
- Symptoms worse with positional changes: bending forward, stooping or lying down

SVC Syndrome

- In most cases, SVC syndrome does not represent a radiation emergency. Most patients who have SVC syndrome present without respiratory or hemodynamic instability.
- 97% of all cases of SVC obstruction are related to malignant disease.

- Most likely malignant causes:
  -small cell lung cancer
  -non–small cell lung cancer
  -lymphoma.
- Non-malignant causes:
  - Thrombosis (most common cause in cancer patients)
  - Substernal thyroid goiter, TB, RT, sarcoidosis



SVC Syndrome
Treatment:

- Management is highly dependent on clinical presentation. In some cases there is a rapidly developing syndrome, airway compromise, or hemodynamic instability. In these cases, RT is an appropriate emergent treatment option.
- Malignant etiology high probability- therapy should not be withheld in the absence of a definitive pathologic diagnosis, particularly when emergent
- RT goal may be palliative, or emergent palliative followed by curative

SVC Syndrome

Treatment:

- Symptom management: Elevation of head of bed, O2, bed rest
- Consider stenting (life threatening symptoms especially in radio/chemo insensitive tumors or lack of cancer diagnosis)
- Chemotherapy
  - Lymphoma or germ cell tumor or small cell lung cancer
- Consider thrombolysis, angioplasty if thrombosis
- Diuretics- transient, may cause dehydration and reduced blood flow
- Steroids

SVC Syndrome
Radiation therapy:

- Majority respond within 3 days
- 86% Complete resolution of SVC syndrome (Slawson et al)
- Overall response rates of 92% (Egelmeers A et al)
- High initial dose RT preferred if emergent/urgent. RT(3–4Gy daily x 3 fractions) yielded good symptomatic relief in less than 2 weeks in 70% of patients; conventional-dose RT (2 Gy daily for five weekly fractions) yielded the same response in 56% of patients. Combinations of RT and chemotherapy did not improve response rate, degree of symptomatic relief, or long-term survival. 13% had recurrence of SVC syndrome. (Armstrong et al)

SVC Syndrome Radiation:

Airway obstruction
Role of RT:

- A patient who is medically unstable because of airway compromise will receive much faster and more effective palliation from bronchoscopic stenting of the airway or laser ablation of endobronchial tumors.
- In a report from the U. of Maryland, patients who had atelectasis of a lobe or an entire lung treated with radiation only rarely achieved re-aeration of the affected area. Only 23% of patients had palliation of their atelectasis with radiation therapy. If, however, the patient was experiencing dyspnea without atelectasis, the chance of successful symptomatic palliation was 60%.
- Refer for RT early- dyspnea without atelectasis will respond better!

Radiation Oncology Emergencies Summary:

- Radiation therapy is an important and effective treatment modality
- Optimal management hinges on efficient multidisciplinary evaluation and communication.
- Treatment plans must be tailored to the individual patient.
- TIMING IS EVERYTHING.
- Optimal management may also include steroids, surgery, chemotherapy, or bronchoscopic intervention.
- When radiation therapy is used, total dose and fractionation should be tailored to the disease setting, treatment goals and life expectancy.

THANK YOU!!