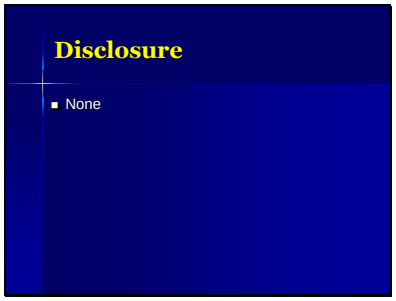
Slide 1

Slide 2



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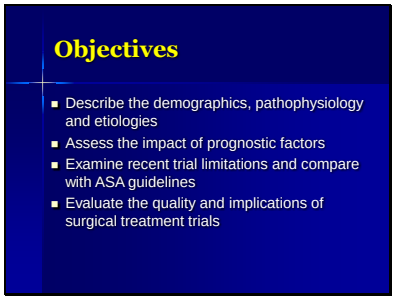

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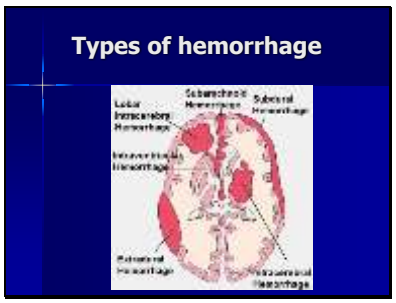

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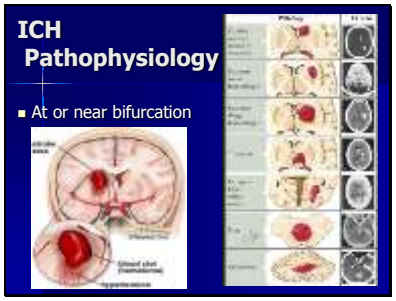

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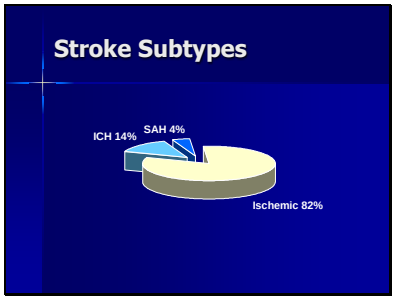


Slide 7

Age-standardized incidence of hemorrhagic stroke per 100 000 person-years for 2010

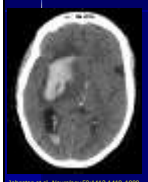
ICH is responsible for 9% to 27% of all strokes worldwide

Slide 8

Risk Factors

Slide 9

Spontaneous Intracerebral Hemorrhage (sICH)



Johnston et al. Neurology 50:1413-1418, 1998
Taylor et al. Stroke 26:1459-1466, 1996

- 10-15% of all strokes
- High morbidity and mortality
  - 35-52% 30-day mortality
  - 75% of ICH patients functionally **dependent** at one year
- 34% of years of potential life lost to stroke
- Lifetime cost per case ~ $124,000
- Total lifetime cost for annual US cases >$4B

Slide 10

Causes of ICH

- Chronic Hypertension
- Amyloid angiopathy
- Cerebral aneurysms
- Cerebral arteriovenous malformations
- Cerebral arteriovenous fistulae
- Cavernous malformations
- Moya-moya
- Vasculitis
- RCVS
- Anticoagulants/ antiplatelet agents, tissue-type plasminogen activator
- Recreational drugs
- Unrecognized trauma
- Postoperative
- Post-infarction
- Blood dyscrasias
- Idiopathic
- Brain tumors
- Other genetic conditions
- Cerebral venous thrombosis

Slide 11

Work-up

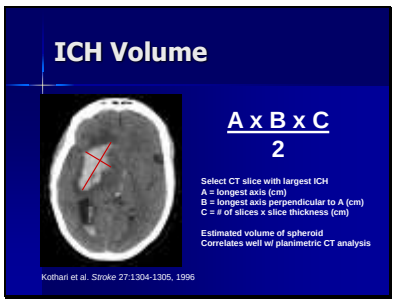
- CT
  - Volume
  - Intraventricular hemorrhage
  - Hydrocephalus
- CTA or formal angiogram
  - Spot sign
  - Aneurysms
  - AVMs
  - AV fistula
  - Moya-moya
  - Vasculitis
  - RCVS
- MRI
  - Amyloid angiopathy
  - Brain tumor
  - Cavernous malformation
  - Cerebral venous thrombosis
  - Hemorrhagic infarct

Slide 12

ICH Management

- ABC
- Blood Pressure
- IVH/Hydrocephalus
- Reverse anticoagulation if present
- Intracranial Hypertension
- Surgical evacuation
- Fever control
- Glucose control
- Seizures
- Prognosis

Slide 13



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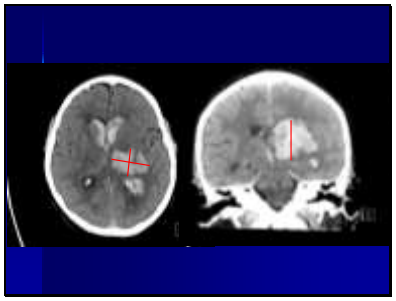

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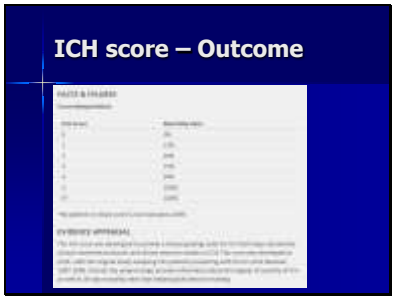

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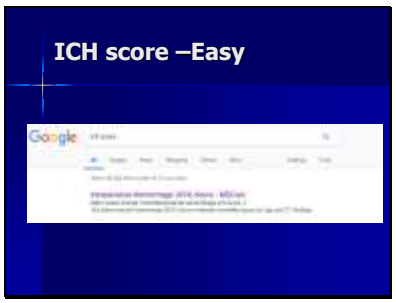

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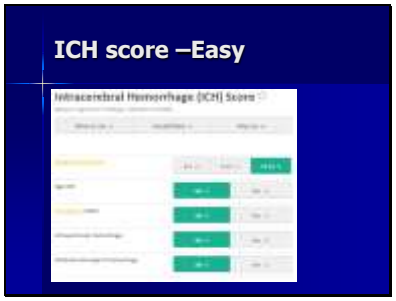


Slide 18

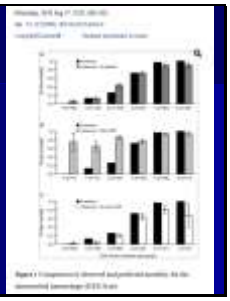
Slide 19

Caveats to Prognosis

- Self-Fulfilling prophecy
- Using Statistics—Population based
- Continued improvement in management

Slide 20

ICH Outcome Predictor: DNR order



Slide 21

DNR

Outcome Prediction and Withdrawal of Technological Support: Recommendation

1. Aggressive care early after ICH onset and postponement of new DNAR orders until at least the second full day of hospitalization is probably recommended (*Class IIa; Level of Evidence B*). Patients with preexisting DNAR orders are not included in this recommendation. Current prognostic models for individual patients early after ICH are biased by failure to account for the influence of withdrawal of support and early DNAR orders. DNAR status should not limit appropriate medical and surgical interventions unless otherwise explicitly indicated (*Class III; Level of Evidence C*). (Revised from the previous guideline)

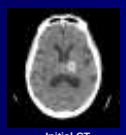
Slide 22

Potential ICH Treatment Targets

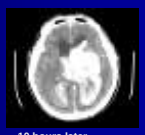
- Expanding hematoma
  - Mass Effect
    - Local shear forces
    - ↑ Intracranial pressure
- Perihematoma perfusion
  - ↑BP may increase ICH
  - ↓BP may impair local blood flow
- Local toxic effects
  - Blood Products
  - Edema
  - Excitotoxicity
  - Inflammation

Slide 23

Anticoagulation-related hemorrhage



Initial CT



10 hours later

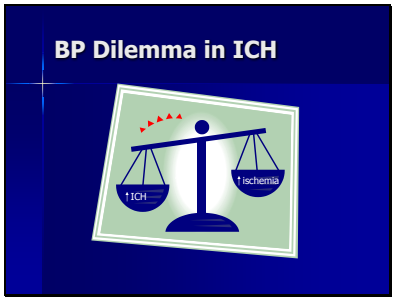
Slide 24

The guidelines for reversing warfarin and NOAC coagulopathies in patients with symptomatic ICH. ICH, intracerebral haemorrhage.

Cynai H. Dastur, and Wengui Yu Stroke Vasc Neurol 2017;vsn-2016-000067

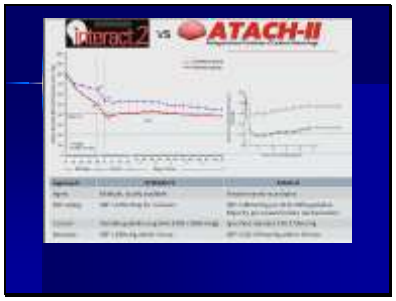
Slide 25

Slide 26



Slide 27

Slide 28



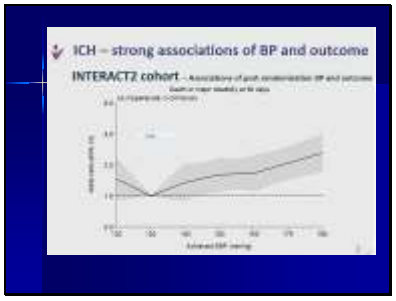
Slide 29

INTERACT II

- 2839 patient who has ICH the previous 6 hours with a target of < 140 within one hour or prior guideline recommended <180
- The trial results showed that intensive blood pressure lowering did not reduce the risk of death or severe disability

New Engl J Med 2013

Slide 30



Slide 31

ATACH 2

- N=1000 within 4.5 hours of onset
  - At least 1 reading of SBP>180
- Randomized to intensive treatment (SBP 110-139) within 30 minutes vs standard 140-170 for 24 hours
- Stopped early for futility
- Primary outcome Death or disability (MRS> e) at 90 days
  - 38.7% intensive and 37.6 in standard (RR 1.04 CI 0.85 to 1.27)
  - No significant difference in hematoma expansion
- Intensive therapy: more had renal adverse events (9.0% vs 4% p= 0.002)
- Non significant difference in adverse events within 72 hours of randomization (elevation in creatinine)

Qureshi et al N Engl J Med 2016

Slide 32

Slide 33

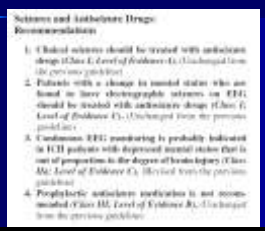
ASA 2015 guidelines

BP: Recommendations

1. For ICH patients presenting with SBP between 150 and 220 mmHg and without contraindication to acute BP treatment, acute lowering of SBP to 140 mmHg is safe (*Class I; Level of Evidence A*) and can be effective for improving functional outcome (*Class IIa; Level of Evidence B*). (Revised from the previous guideline)
2. For ICH patients presenting with SBP >220 mmHg, it may be reasonable to consider aggressive reduction of BP with a continuous intravenous infusion and frequent BP monitoring (*Class IIb; Level of Evidence C*). (New recommendation)

Slide 34

ASA guidelines

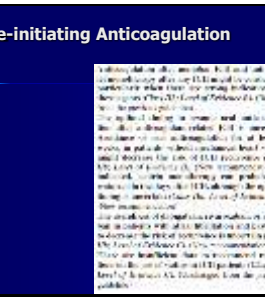


Seizures and Antiseizure Drugs: Recommendations

1. Clinical seizures should be treated with antiseizure drugs (Class I; Level of Evidence A). (Unchanged from the previous guidelines)
2. Patients with a change in mental status who are found on latest electrographic seizures on EEG should be treated with antiseizure drugs (Class I; Level of Evidence C). (Unchanged from the previous guidelines)
3. Continuous EEG monitoring is probably indicated in ICH patients with depressed mental status that is out of proportion to the degree of brain injury (Class IIb; Level of Evidence C). (Revised from the previous guidelines)
4. Prophylactic antiseizure medication is not recommended (Class III; Level of Evidence B). (Unchanged from the previous guidelines)

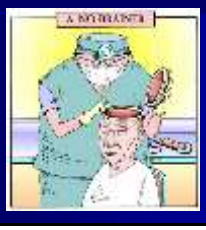
Slide 35

Re-initiating Anticoagulation



Slide 36

Surgical Intervention?



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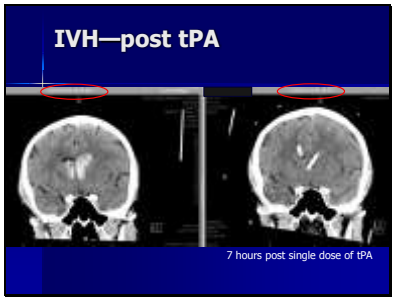

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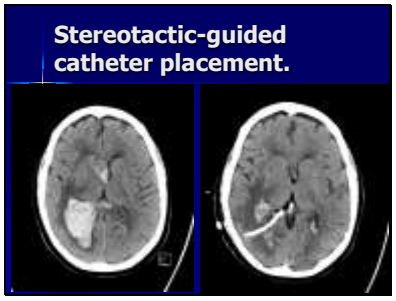

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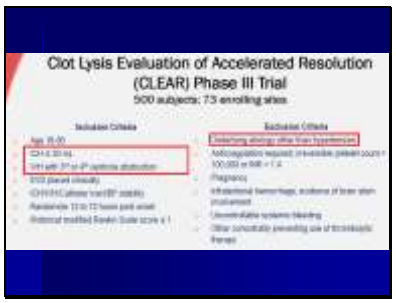

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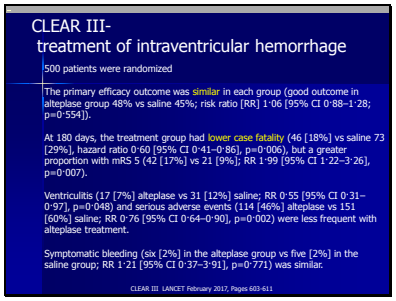

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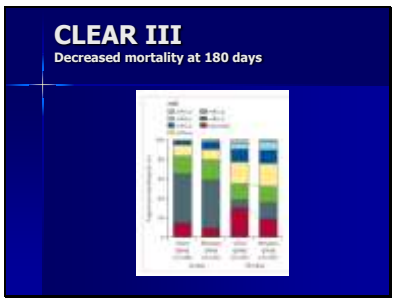
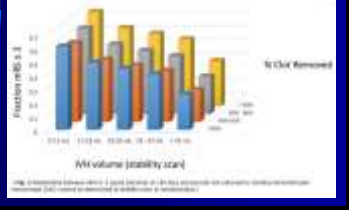


Slide 43

CLEAR III

Subgroup analysis: Benefit with increased IVH removed. Patients with larger IVH volume (>20ml) received significant benefit



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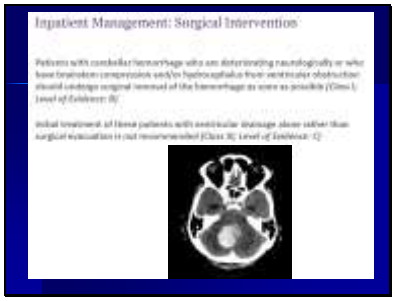

Slide 45

STICH

Surgical Trial of ICH

- International RCT, surgery within 24hr (n=503) vs. medical management (n=530)
- <72 hrs onset, surgery, 24 hrs, GCS>5, hematoma>2cm
- Later surgery was allowed if deteriorated
- ITT analysis, 6 month outcomes

Lancet 2005;365:387-397

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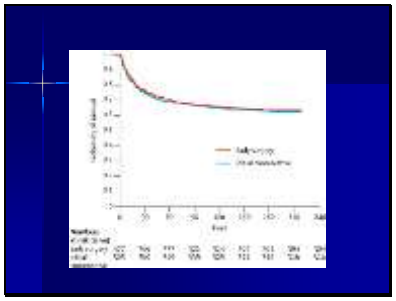

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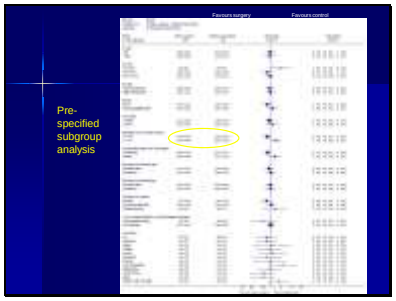

Slide 48

STICH II

Surgical Trial of ICH

The Lancet 2013; 382:397-408

- 601 patients with lobar ICH without intraventricular extension
- Within 48 hours from onset
- Bleed within 1 cm from surface
- Needed GCS motor score of 5 or 6
- 307 surgery group
- 294 conservative care group

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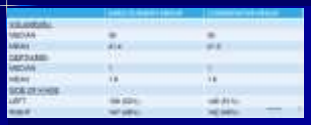
EXCLUSION CRITERIA

- Basal ganglia, thalamic, cerebellar or brainstem hemorrhage or extension of a lobar hemorrhage into any of these regions
- If surgery cannot be performed within 12 hours.
- Patients who did not consent to participate

Slide 50

Median



The Lancet 2013; 382:397-408

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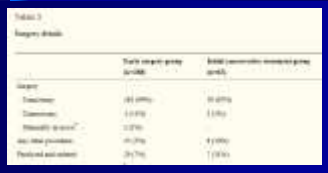
STICH II

Surgical Trial of ICH



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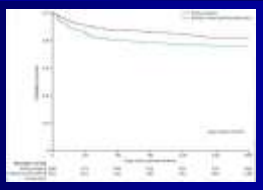
STICH II

early surgery was not superior to medical treatment (OR 0·86, 95% CI 0·62–1·20; *P* = 0·37)



The Lancet 2013; 382:397-408

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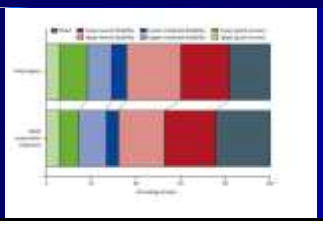
STICH II

Surgical Trial of ICH



Slide 54

SUBGROUP ANALYSIS

Slide 55

STICH II

- Cross over : 62 (21%) of 291 patients assigned to initial conservative treatment went on to have delayed surgery.
- The STICH II results confirm that early surgery does not increase the rate of death or disability at 6 months and might have a small but clinically relevant survival advantage for patients with spontaneous superficial intracerebral hemorrhage without intraventricular hemorrhage.

The Lancet 2013; 382:397-408

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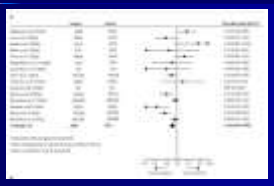
Randomized trials for surgery



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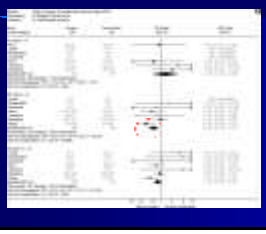
Randomized trials for surgery



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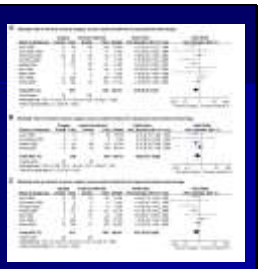
Randomized Clinical Trials in Minimally Invasive Surgical Evacuation of ICH



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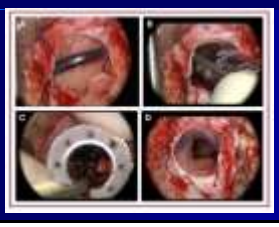
Stereotactic-guided surgery through radial retractor



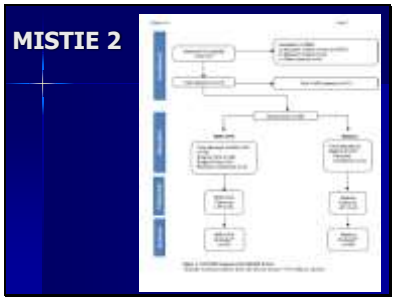
Slide 60

Minimally invasive surgery plus recombinant tissue plasminogen activator in intracerebral hemorrhage evacuation

MISTIE

Slide 61

Slide 62



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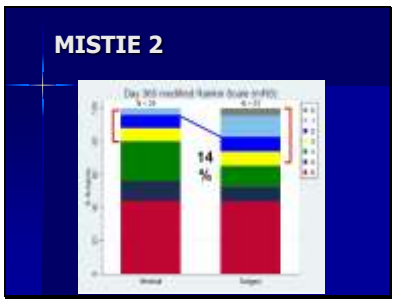
Slide 64



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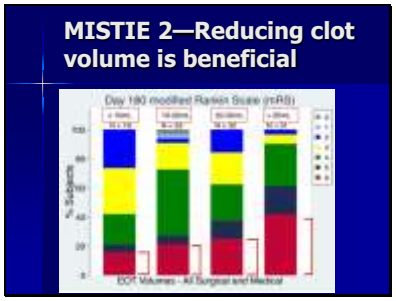

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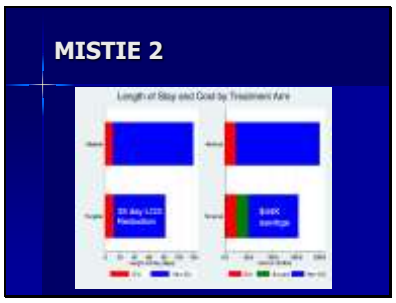

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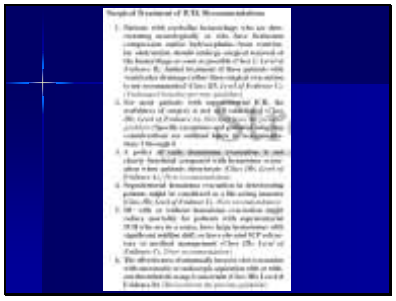

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Surgical indications

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ONGOING trials ClinicalTrials.gov

- MISTIE III
- ENRICH: Early MiNimally-invasive Removal of IntraCerebral Hemorrhage (ICH) (ENRICH)
- ARTEMIS: Minimally invasive hematoma evacuation with the Artemis Neuro Evacuation Device to best medical management for the treatment of intracerebral hemorrhage (ICH).

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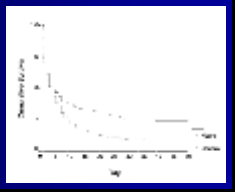
Admission to a neurologic/neurosurgical intensive care unit is associated with improved survival after intracerebral hemorrhage

1038 patients, 42 ICUs

Lower mortality:
- Neuro ICU
- Intensivist
- Larger number ICH patients
- Lower Age
- Higher GCS



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Summary

- BP lowering is indicated. The exact goal remains debated.
  - SBP 140-150 using nicardipine
- Anticoagulation should be reversed.
- Suboccipital craniotomy is indicated for posterior fossa compression.
- Minimally invasive clot evacuation is safe, and may have clinical benefit. MISTIE II has promising results.
- We will await results of MISTIE III.
- Treatment in a neuroICU is best.

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