SPINA BIFIDA

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Spina Bifida

Spina Bifida

- Aetiology/Classification
- Incidence/ Prevalence/Prevention
- Initial assessment
- Clinical Description
- Management
  - Orthopaedic/Neuro/urology
  - Education/social
- Outcome

Spina Bifida

- Malformation of spinal cord and brain
- 28 days of development of embryo
- Failure of fusion of neural folds during neuralation
- Cause unknown?
- ?Genetic ?Metabolic ? Environmental
- 75% isolated
- 25% associated with other defects

Spina Bifida

- Partial paralysis of lower limbs
  - No weakness
  - Partial paralysis
  - Wheelchair dependence
- Joint deformity
- Spinal abnormalities
  - Scoliosis
  - Kyphosis/lordosis

Spina Bifida

Neurogenic bladder
Urinary incontinence
renal and bladder abnormalities
Neurogenic bowel
Faecal incontinence
Skin
anaesthetic – pressure sores

Spina Bifida

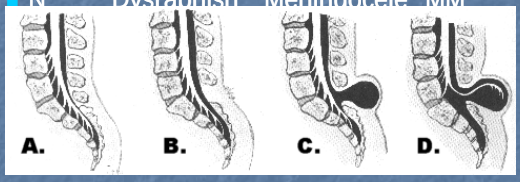
- Hydrocephalus
  - Arnold Chiari Type 2
  - CSF shunt
  - Learning problems
- Upper spinal cord mild abnormalities
  - Mild upper limb problems

Spina Bifida

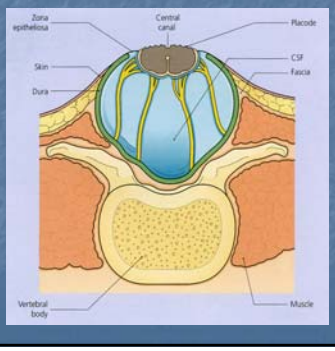
- spina bifida occulta — 10% adult spines
- meningocele — 6% cases; 11% survivors
- myelomeningocoele — 94% cases; 89%survivors
- Encephalocele
- Lipomeningocele

Spina Bifida - types

- N… Dysraphism… Meningocele… MM



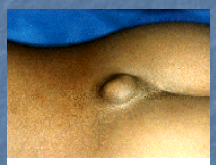
Myelomeningocele



Spina Bifida

Spina Bifida Thoracic

Meningocele



Preparing for Surgery on a Meningocele

Spina Bifida Severe

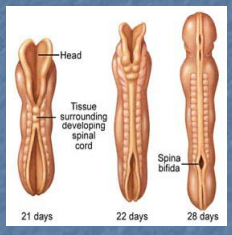
Incidence

Australia	0.95/1000
Western Europe	1.5-3.0/1000
Sex Incidence	
Male	58%
Female	42%

Spina Bifida- incidence

- Varies from country to country
- Range 1- 5 /1000 live births
- High in Celts (Ireland, Wales)
- Low in Northern Europe.
- Encephaloceles higher in SE Asia

Foetal neural tube



- Conception - D18
  - 3 germ layers which make the different tissues and the neural plate forms along length of fetus
- D19 - D28
  - Neural tubes folds and should close along length of foetus

Spina Bifida

Spina Bifida- Classification

- Neural tube defect
  - Anencephaly 50% (lethal)
  - Spina Bifida Cystica
    - Myelomeningcele 45% (2/3 – 90% live)
    - Meningocele 5% (all live)
    - Encephalocele
- Lipomyelomenigocele
  - Clinically similar but no Hydrocephalus
- Spina Bifida Occulta
  - ?10 % back pain, constipation

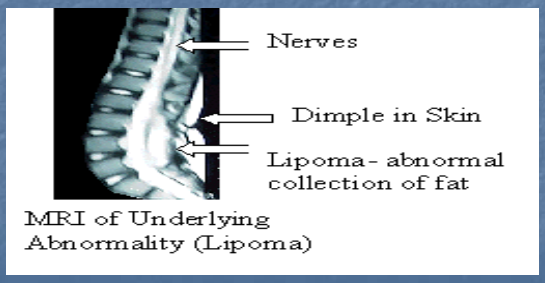
Myelomeningocele

Cervical	0.5%	mild
Thoracic only	0.5%	Severe
Low thoracic	27%	Severe
High Lumbar L1-2	23%	WChair
Low Lumb,Upper sacral	45%	Braces
Lower sacral	4%	Independ

Lipomyelomeningocele

- Lipoma
- Grows in the spinal canal or outside
- Press on the spinal cord
- Nerves traverse and become nonfunctional
- Partial weakness of lower limbs
- Neurogenic bladder and bowel
- Spine abnormality
- No hydrocephalus – normal cognition

Lipomeningocele



MRI of Underlying Abnormality (Lipoma)

Spina Bifida- Aetiology

- Unknown – multifactorial
  - Abnormal gene interacts with other genetic loci and or environmental factors to modulate the incidence or severity of the defect.
- Genetic
  - Increased in chromosomal abnormalities i.e. trisomy 13 and 18.
  - Increased in siblings and other relatives
  - Abnormal genes
    - Som
    - VANGL1 (mouse, 3/166) (NEJM 356,(14)2007,

Genetics

- Multi-factorial

1 affected child	1:50 Recurrence Risk
2 affected children	1:10 RR
3 affected children	1:4 RR

Note

- Risk of any child born with a major defect 1:30 (3%)
- If an adult with Spina Bifida has a child risk is 1:25

Spina Bifida- aetiology

- Drugs
  - Valproate (1%)
  - Methotrexate
  - Clomiphene
  - Folic acid antagonists
    - Trimethaprim, Anticonvulsants

Environment
- Maternal diabetes, Hyperthermia,

Paternal- Agent orange

Incidence

- Australia 0.95 /1000
- Western Europe 1.5-3 /1000
- Male 58%
- Incidence has decreased significantly in Victoria, largely due to termination, secondarily due to folate.

Spina Bifida - Prevalence

- NTD conceptions in Victoria
- 40% decline 1995 to 2000
- Due to folic acid supplementation

	1995	2005
NTD	19.2	-12.2/10000
Spina Bifida	8.3	-7.9/10000

- Increase in encephalocele (increased Asian)
- Reduced births due to TOP

Spina Bifida
Common Birth Defect

Ten most common birth defects, 2005

Defect	N/10,000	1 in X number of births & TOPs X
Hypospadias	65.7*	153
Obstructive defects of the renal pelvis	36.4	275
Ventricular septal defect	28.5	351
Trisomy 21	27.5	364
Congenital dislocated hip	26.1	383
All NTDs	12.2	817
Trisomy 18	9.1	1,098
Hydrocephalus	8.8	1,135
Cleft palate	8.4	1,196
Cystic kidney disease	7.3	1,367

*This figure has used male babies only as the denominator.

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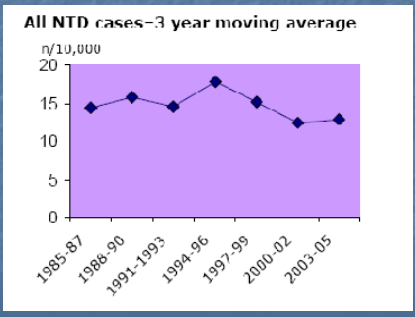
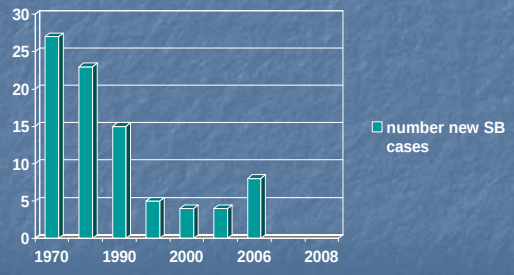
Spina Bifida



Number of new cases/year
Royal Children's Hospital



Spina Bifida Incidence

- So why have the numbers dropped
- Antenatal diagnosis with ultrasound
- Termination of pregnancy
- Folate – small impact
- Small drop in prevalence

Spina Bifida- Prevention

- 1960's Laurence in Wales ?Vitamin Deficiency.
- 1970's Smithells
  - Periconceptual multivitamins
  - Reduced conception rate if previous NTD
  - Methodological flaws
- MRC Study 1992
  - Multi centre trial
  - Stopped at 1400 (n = 2000)
  - 76% reduction recurrence risk for NTD
  - Folate rather than other Vitamins the cause

Folate

- Folate supplementation reduces recurrence by up to 72% *Lancet 1991*
- Recommend -
  1 month pre- and 3 months post-conception
  - Routine 0.5mg daily
  - High risk pregnancy 5mg oral daily
    - Parent with SB
    - Parent with a previously affected child
    - Mother on Anti-Epileptic Drugs
    - Mother with Diabetes Mellitus

SB -Folate Prevention

How does it work – unknown

Generalizable.?
Berry NEJM 2004
130000 Chinese women 0.4 mg folate,117000 controls – 41% reduction NTD
Risks – nil reported ? Twins

How much?
0.4mg – 36%
5mg - 85%

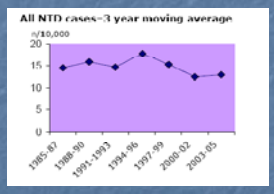
Peri-conceptual folic acid Awareness post 1996,1999

	Before	1997	2000
15-24 yrs	5%	6%	4%
25-34 yrs	19%	24%	29%
34yrs+	12%	16%	26%

NTD Recurrence Risk

- One child 2%
- Two Children 10%
- Parent NTD 4%
- Blood related 1%
- Remarry 0.6%

Spina Bifida



- 12.2 NTD per 10000 conceptions
- 85 NTD for 70000 conceptions Vic pa
- 5 new case treated
- 1% blood relative risk

SB – Folate to flour

- Folate added to flour
- Average daily consumption
  - Supplement to 0.4 mg
- USA and 38 other countries
- 36 % reduction in NTD
- Australia about to start

Spina Bifida Management

MultidisiplinaryTeam

- Allied Health
- Medical
- Stomal therapist
- Urologist
- Physiotherapist
- Neurosurgeon
- Occupational therapist
- Orthopaedics
- Orthotist
- Neonatologist
- Paediatrician

Multidisciplinary team

- Neuropsychologist
- Social Worker
- Clinical Psychologist
- Education
- General practitioner
- Spina Bifida Association -social

Spina Bifida Antenatal diagnosis

- Ultrasound
  - Lesion vertebral column
  - Hydrocephalus – lemon sign
- Amniocentesis
  - AFP, open lesion only
- Maternal Serum Screening
  - AFP non specific (twins, down etc)

Spina Bifida
Antenatal Ultrasound

- Can visualise at 15-16 weeks
- Vertebra have 3 ossification centres

Spina Bifida
Antenatal Ultrasound

- Ultrasound – "sac"

Spina Bifida
Antenatal ultrasound

- Lemon and banana sign

Spina Bifida
Foetal Surgery

- Does foetal surgery improve outcome
- Randomized trial USA
- Ongoing at moment
- No data yet

Termination

- Prenatal Ultrasound
  - 18-20 weeks
  - Detailed foetal anatomy
  - Feto-maternal obstetric outpatients for discussions and counselling
  - Termination at 20-22 weeks should the parents choose

Spina Bifida
Mode of Delivery

- Improved outcome with elective LUCS
- Use if leg movement seen on US
- Rationale
- – reduces damage to neural plaque
- 2 neurosegmental levels better
- Bladder and bowel status unchanged
  - (LUTHY et al NEJM 1989)

Spina Bifida
Initial Assessment

- Refer specialist centre
- Neurosurgical assessment
- Paediatric assessment
- Discussion with family
- Facts not biases
- If severe - non treatment option
- Family's wishes respected
- Palliative care – 10% survive

Spina Bifida
Initial Assessment

- Clinical exam – chromosomal/other
- Extent of lesion – can it be closed
- Motor level
- Hydrocephalus — cranial US
- Musculoskeletal — Hip US
  - Joint deformity
  - Spine deformity
- Renal — Renal US

Spina Bifida
Initial Assessment

- "to treat or not to treat"
- Prior 1955 most died
  - Hydrocephalus, Meningitis, Renal
- 1955 CSF shunt (VA), Ileal conduits
- 1955-70 many with severe abnormalities
- Treatment Criteria
  - Lorber 1971
  - Smith and Smith 1973

Spina Bifida

- Treatment considerations
- Severe paralysis
- Severe hydrocephalus
- Kyphosis
- Other congenital abnormalities

Spina Bifida
Initial Treatment

- Back closure within 24 hours (infection)
- Prophylactic antibiotics
  - Delay closure for 72 hour
- Monitor for hydrocephalus
  - Back closure head circumference increases
- Shunt insertion about 1 week later
- Hospital 1-3 weeks

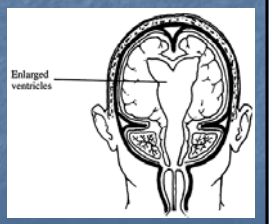
SB - Neurosurgical

- Back Closure
  - Within 24 hours
  - Preserve nerves
  - Motor deterioration post surgery
- Investigations US, CT MRI
- Back closure - hydrocephalus

Spina Bifida Hydrocephalus

SB - Hydrocephalus

- 80-90% develop significant hydrocephalus
- Increased with higher level
- 26% present at birth and by 1 month of age in 77%
- Rarely develops after 6 months
- Frequently progress after back closure/
- Most shunts in 1st month.

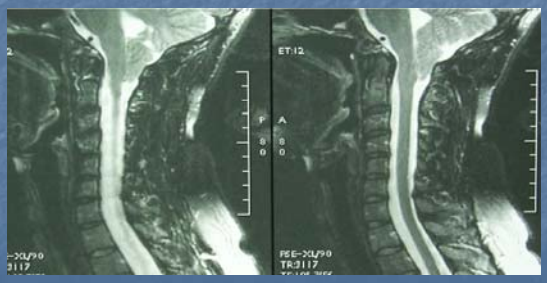


SB - Hydrocephalus

- Arnold chiari type 2
- VP shunt
- Complications
  - Infection, obstruction, disconnection
  - Low pressure

CSF Shunt

Arnold Chiari Type 2



Tethered Cord Causes

- Myelomeningocele
  - Post operative
  - Tight filum
- Lipoma/lipomeningocele
- Split Cord (diastematomyelia)
- Dermal sinus
- Tight or fatty filum terminale

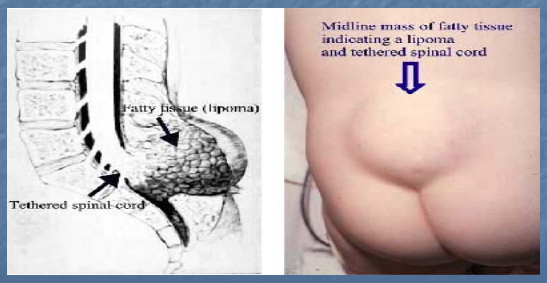
Tethered Cord Symptoms

- Pain
- Weakness- evolving
- Sensory Loss
- Incontinence
- Scoliosis
- Cutaneous markers

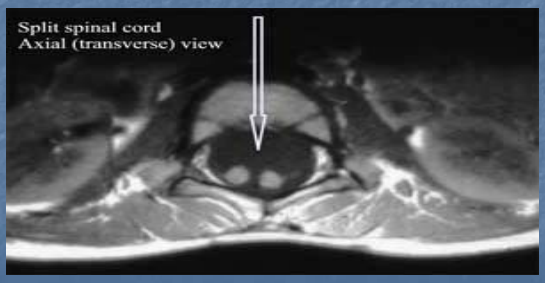
- Investigate Muscle chart, MRI

Spina Bifida Tethering

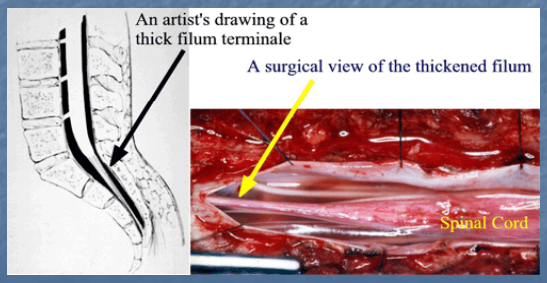
Lipoma -tethering



Diastematomyelia



Filum terminale



Neurosurgical Clinical

- Epilepsy
  - 10 – 15%
  - Increased with shunt obstruction, Infection, ventriculitis
- Arachnoid Cysts
- Sphyrinx

Spina Bifida

- Orthopaedic

SB Orthopedic Aims

- Pattern of motor development near normal
- Maximize mobility
- Stable posture if standing
  - Centre of gravity over feet
- Prevent pelvic obliquity
- Correct spinal deformity
- “stability of skin”

SB Orthopaedics Principals

- Developmental knowledge
- Natural history of condition
- Monitor progress
- Time interventions
- Investigations
  - Imaging
  - Muscle Charts
  - Gait analysis

SB - Orthopaedic Hip

- Hip Flexion contracture
  - Anterior hip release
  - Femoral or pelvic osteotomies
- Abduction External Rotation Deformity
- Limitation of Abduction
- Hip surveillance prevent dislocation

SB Orthopaedic Hip dislocation

- Thoracic L1, L2, L3 53%
- L4 33%
- L5 20%
- Bilateral
  - Operative benefit ?marginal
  - Pain
  - Prevent hip flexion contracture – or fit an orthosis (RGO)
- Unilateral
  - Leg length discrepancy, pelvic obliquity
  - Ducubiti
  - Operate on low lesion

SB Orthopaedics Knee

- Valgus deformity
- Flail undeformed knee
- Undeformed knee with reduced quadricep
- Fixed flexion
- Treatment
  - Cast
  - Braces
  - Muscle transfers
  - Ostetomies

Deformities in Ankle Feet

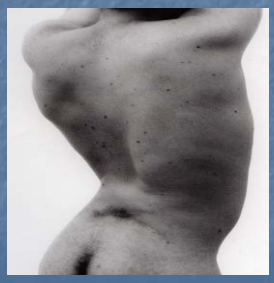
- The deformities include;
  Equinus deformity
  Clubfoot or talipes equino varus deformity.
  Calcaneal deformity.
  Cavus or cavo-varus deformity.
  Plano-valgus deformity.

Clubbed Feet

Spine deformity

- Scoliosis
- Kyphosis
- Lordosis

- Monitored by Xray
- Worsen with age
- Adolescence
- Pain , decubiti sitting
- Brace
- Surgery



Scoliosis Surgery

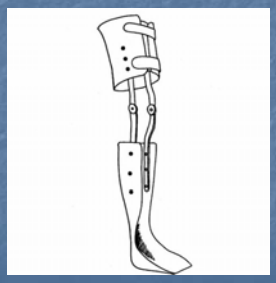
SB Orthopaedics Techniques

- Casting
- Orthosis
- Soft tissue releases
- Muscle transfers

- Bony procedures
  - Osteotomies
  - Arthodesis
  - Ilizarov frames

AFO

KAFO



- Knee and ankle stability
- Mobilize with crutches
- Lock to enable sitting

RGO
Reciprocating gait orthosis

Muscles and movement 3

- Physiotherapist
  - In community provide regular therapy
  - Equipment assessment and funding
  - Independent skills - transfers/muscle strength
  - RCH service 6-12mly muscle mapping
- Orthopedic surgeries
  - Major reason for admission

Spina Bifida
Urology

- Bladder
- Bowel
- Skin

SB
Neurogenic Bladder

- 90% plus affected
- Inervation S2-4
- Associations
  - VU reflux
  - Renal Anomalies (horseshoe kidney)
  - Bladder wall trabeculation
  - UTI/pyelonephritis

SB Urology
Treatment

- Principles
  - Protect the kidney's from damage
  - Social continence
- Management
  - Evaluate renal tract (imaging, urodynamics)
  - Regular imaging (deterioration silent)
  - Prevent infection (Bactrim, keflex, macrodantin, cranberry)
  - Treat infection
  - Investigate deterioration
  - Surgery

SB
Neurogenic Bladder

- Types
  - Areflexic (acontractile)
    - Enlarged
    - Urine dribbles
    - Sphincter incompetent
    - common
  - Contractile (Spastic)
    - Small Volume
    - Thick wall
    -

Neuropathic Bladder 2

Bladder type	Contractile	Intermediate *most common	Acontractile
Detrusor contraction	Strongly	Continuous weak	Doesn't contract
Sphincter tone	High	Weak/ ineffective	Weak
Outflow	Obstructed	Obstructed	Mild resistance (incomplete relaxation)
Effects	High residual volume, small bladder capacity	Small capacity and continuous dribbling	Continuous dribbling
Upper tracts	At risk	At risk	Rarely at risk
Options	C.I.C Sphincterotomy Augmentation	C.I.C Sphincterotomy Augmentation	Anticholinergic Botox AND C.I.C

Neuropathic bladder 4

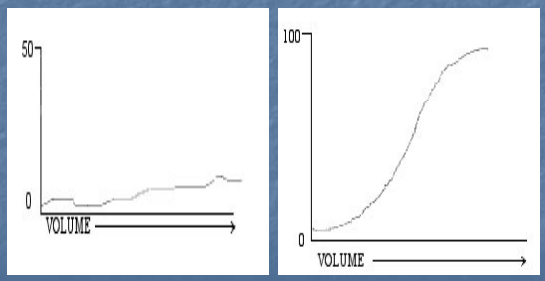
1. Preserve renal function
(ensure emptying and prevent infection)
2. Achieve continence

- Medical
  - Clean intermittent catheterisation
  - Anticholinergics (reduce detrusor hyperreflexia)
  - Manage infections
- Surgical
  - Botulinum toxin
  - Sphincterotomy
  - Bladder augmentation
  - Artificial urinary sphincter
  - Vesicostomy, urinary diversion/ undiversion
  - Mitroffanoff procedure

SB Neurogenic Bladder Investigations

Renal Ultrasounds	Yearly
MCU	prn
Nuclear Scans	Baseline prn
Urodynamics	Prn
Cystoscopy	prn

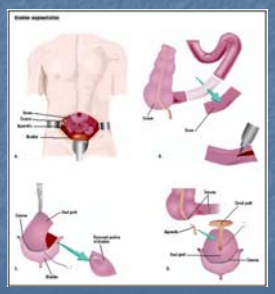
SB Urodynamics



SB Urology Surgery

- Reflux surgery
- Vesicostomies
  - high pressure, infection
- Bladder Augmentation
  - Enlarge the bladder (mucus, rupture, cancer)
  - Flap from Ureter, stomach, bowel, cultured cells
- Mitrofanoff - appendix for anterior access
- Artificial Sphincters
  - Select candidates
- Ileal Conduits
  - Bleed, Stenosis, stones, Cancer, Last 10 years

SB Augmentation cystoplasty



SB Artificial Sphincter

SB Urology
Recent Developments

- Botox
  - High pressure bladder
  - Detrusor instability
- Nerve Transplants
  - Chinese research
  - Improved function
  - Trials underway in USA

SB Urology
Continence

- Initially nappies
- Prophalactic antibiotics
- Clean intermittent catheterization 3-5/day
- Pads
- Bokka Pants
- Condom drainage
- Medication eg oxybutinin
- Surgery

Spina Bifida
Neurogenic Bowel

- 90% + have faecal incontinence
- Sensory nerve to colon, rectum, anus
  - S2-4
- Autonomic nerves
- Major social problem

Neuropathic bowel 1

- 25% of adults with Spina Bifida are bowel continent
- Most who are incontinent have poor sensation AND either

i. Increased bowel outlet resistance	Constipation and overflow diarrhoea
ii. Decreased bowel outlet resistance	Frequent stools throughout the day

SB Neurogenic bowel Types

- Patulous anus and constipation
- Diarrhoa
  - Diet sensitive
  - 10- 20%
  - Loperamide
- Patulous anus and constant leakage
  - Seen in mobile (abdominal compression)

SB Neurogenic Bowel Principles

- Aim for social continence
- No single program that works
- Bowel management starts from birth
- Try to have a program by school
- Teenagers and adults work it out

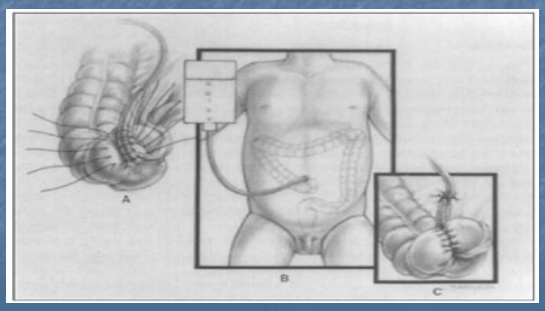
SB Neurogenic Bowel Treatment

- Nappies initially
- Diet
- Laxatives often worsen but used.
  - Movicol
- Timed Toileting
- Pressure
- Digital stimulation
- Combinations

SB Neurogenic Bowel Treatments

- Suppositories
- Microlax enema's
  - Give 4-5 hour clean - good for school
- Bowel washouts
  - 2 or 3 per week
- Malone antegrade enema
- Anal Plugs
  - Work well in some 30%
  - , expensive, last 6 hrs
- Buttock strapping eg for swimming

SB neurogenic Bowel Malone procedure



SB Neurogenic Bowel Malone / Anal plugs

Malone Antegrade Washout

Bowel Washout Peristeen System

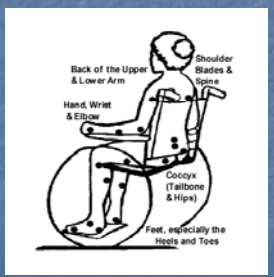
SB - Bowel Management Experimental

- Gracilis slings
- Electrical stimulation
- Cuff similar to Artifical Sphincter.

SB Pressure sores

- Skin Level
  - dermatomes
  - Mapped using pin prick
  - Can be different to motor level
- Problem anaesthetic skin
  - Pressure areas sitting braces
  - Burns
  - friction

SB Decubitus



Decubitus

Spina Bifida Pressure Sores

- Prevalence 20 -25%
- 80 – 90% will have at some stage
- Cause
  - Anaesthetic skin
  - Excessive pressure 42%
  - Orthosis 23%
  - Urine, faecal soiling 23%
  - Friction 10%

SB Pressure sores

- Prevention
  - Pressure care training, regular lifts
  - Correct fitting orthosis
  - Pressure cushions
- Site
  - Low Lumbar, Sacral
    - Feet, buttocks
  - Thoracic, high lumbar
    - Spine, buttocks, feet

Spina Bifida Latex Allergy

- Recognized since late 1980's
- ? Due to intra abdominal surgery
- Most Sensitivity
  - Rash, lip swelling
  - Rubber gloves, catheters, balloons
- Some Anaphylaxis
  - Risk during surgery
- Prevalence 33% on RAST
- Treatment
  - Test
  - Latex free theatre

Spina Bifida Other Medical Issues

- Obesity
  - Especially in adolescence
  - Stop walking - wheelchair
- Endocrine
  - Precocious puberty, osteoporosis
- Ophthalmology
- Psychological
  - Adults suicidal ideation 10%

Cognitive function

- Intellectual disability strongly associated with hydrocephalus

Spina Bifida Cognitive

- General intelligence "normal range"
- Skewed to the lower end
- Specific Learning difficulties
- Verbal IQ > Performance IQ
- Relative Deficit Increases with age
  - Primary school 5 points down - overestimates
  - Secondary 10-15 points down
- Factors
  - Hydrocephalus, shunt blockage, infection

Spina Bifida Cognitive profile

- Executive Functions
  - Difficulty completing task
  - Difficulty organizing task
  - Overwhelmed by complex new information
  - Impulsive
  - Difficulty applying new knowledge
- Higher order Language
- Information Processing (memory)
- Attention Memory, New learning
  - Poor sequential and working memory
- Sequencing

Spina Bifida Cognitive profile

- Visuo motor Integration
  - Delayed laterality
  - Poor motor planning
  - Poor hand control
  - Slow mastery of writing
  - Untidy and disorganized presentation or written work

Spina Bifida Educational

- Most attend normal school
  - Special on cognitive grounds (Yooralla)
- parent should visit schools
- Usually require an integration aide
  - Continence
  - Cognitive
  - Safety
- School modifications (access, toilets)
- Program Support group
- School therapy

SB School Problems

- Lack of understanding about cognitive problems
- Toileting expectations unrealistic
- Academically problems around Grade 4
- Teacher zealous – disillusioned
- Child withdrawn, depression
- Socialization issues

Spina Bifida Secondary School

- Cognitive Difficulties more apparent
- Mobility/incontinence affect relationships
- Peer group issue – isolation
- Poor body image
- Sexuality issues
  - Impotence in males
- Misery , low self esteem
- Depression

Spina Bifida Therapy

- Developmental program
  - Mainly physiotherapy
  - OT many have upper limb/ cognitive issue
  - Speech
- RCH initially or
- Specialist Children Services (home)
- Centre Based from 3y
- School based therapy

Spina Bifida Therapy

- Motor development depends on level
- L3 and quads for walking
- Motor developmental program
  - Standing frames
  - Walking frames
  - Braces
  - Crutches
  - Wheelchair training

Continence

- Continence nurses
  - Advise: management of the bladder and bowels
  - Training (CIC, washouts): parents, carers, aides and patients
  - Applications for CAAS funding
  - Sourcing equipment (catheters, pads, nappies, specialised underwear)
- Also Stomal Therapists and Wound Care!

SB Social problems

- Friendship difficulties
- Realization that they are different 7-8y
- Exclusion by peers
- Unable to keep up in playground
- Reduced self esteem
- Body image problems

Spina Bifida Post School

- Unrealistic expectations re careers
- Tertiary few
  - University a few.
  - TAFE
- Employment
- Independent Living

Spina Bifida

- CLINIC STAFF
- Monitoring
  - Medical 6 monthly
  - Orthopaedic varies
    - Physio annually
  - Neurosurgery - annually
  - Urology 6 -12 monthly
    - Ultrasounds 1-2 years

Transition

- When complete high school
- Sometimes ongoing orthopaedics or urology
- MECRS
- Monash
- Bendigo, Ballarat, Geelong

Spina Bifida Outcome

- Medical
- Psychological
- Employment
- Housing

Spina Bifida Adults Medical

- Urological
  - Recurrent UTI 38%
  - Hypertension 11%
  - Stomal Problems 58%
  - Review recommended 36%
- Orthopaedic

Spina Bifida Adults Medical

- Orthopaedic
  - Backache 25%
  - Knee Instability 15%
  - Hip pain 14%
  - Shoulder Pain 10%
  - Arthritis 6%

Spina Bifida Adults Medical

- Neurosurgical
  - Symptoms of cord tethering 14%
  - Shunt review 4%
  - Seizures 2%

Spina Bifida Adults Psychological

- Depression 5%
- Anxiety 3%
- Psychosis 2%
- Suicide attempts 7%
- Substance Abuse 7%

Spina Bifida Adults Education

- 114 Seen in 1992
- Tertiary 8%
- Completed High School 16%
- Special school 28%
- England 42% completed high school compared to 75% Controls (Tew 1984)

Spina Bifida Adults Employment - Home

- Competitive Employment 33%
- Not Working 54%

- Living with parent 62%

Spina Bifida Adults Pregnancy

- 17 women 23 pregnancies
- Less complications if Vaginal delivery

- Recurrent UTI
- Pyelonephritis
- Back pain
- Pressure sores

The End

i. Which tissues are involved?

- Spina bifida occulta (bone only)
  10% adult spines
- Meningocoele (bone and meninges)
  6% SB, 11% survivors
- Myelomeningocoele (bone, meninges, nerves)
  94% SB, 89% survivors

QuickTime™ and a decompressor are needed to see this picture.

ii. Where is the lesion?

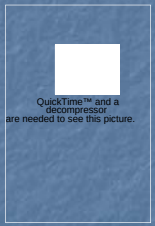
- 1% Cervical only (Level 1)
- 1% Thoracic only (Level 1)
- 6% Lower thoracic (Level 2) and Upper lumbar (Level 3)
- 92% occur at L3 and below [42% Lumbosacral jct (Level 4)] Lower sacral (Level 5)

QuickTime™ and a decompressor are needed to see this picture.

Neuropathic Bowel 2

- Diet, fluids
- Regular sit, cough, push on toilet
- Laxatives, enemas, washouts
- Anal plugs
- Biofeedback
- Malone Procedure

(exclude other causes diarrhoea)

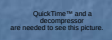


Myelomeningocele
Functional Ambulation

Non Ambulator	Thoracic
Household Indoors only, braces Wheelchair	Thoracic – L3
Community Indoor/outdoor Braces Crutches Wheelchair long distances	L3 –Sacral

Sensation

- Sensory loss below level of lesion
  - Patchy
  - Dense
- High risk of pressure areas/burns
  - Slow healing (poor blood supply)
  - Historically, common cause of death
- Occupational therapists
  - Seating advise (includes car)
  - Pressure care
  - Tools for function/ home modification (hoists, rails, handles, grips)
  - Upper limb function
  - Driver's Licence



Roho cushion

SB – Prevention
Peri-conceptual folic acid

- Folic acid 0.5mg
- 2 month pre conception
- Family history 5mg.

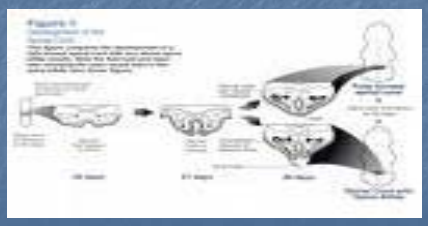
- Campaigns 1996,1999

SB Orthopaedic
Ilizarov frame

Spina Bifida
Initial Assessment

- Treatment considerations

- Severe paralysis
- Severe hydrocephalus
- Kyphosis
- Other congenital abnormalities



Spina Bifida- Numbers

- Treated at the RCH
  - 1970 27
  - 1980 23
  - 1990 15
  - 1995 5
  - 2000 4
  - 2005 4

Spina Bifida Embryology