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Basic Techniques in Pediatric Surgery

An Operative Manual

 Springer

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Dedication

We would like to dedicate this book to our wives and children. Annette Carachi and their sons Peter, Michael Andrew and Philip. Ranju Agarwala and their son and daughter Rishabh and Shreya. Rachel Bradnock and their sons Henry and Toby. Mariagrazia Cascio and their daughters Mariateresa and Costanza. Evelyn Tan and their daughter Melanie and son Alexander.

We would also like to thank Mr. Bachem, Ms. Blasig and Ms. Schröder from Springer who had an extremely difficult job and made the book so colourful.

The final dedication is to Mrs Kay Byrne who was a faithful academic secretary to the senior author of this book. She was responsible for all the correspondence and collating of the manuscripts which she has helped edit even after she retired.

Foreword

The “Basic Techniques in Pediatric Surgery” is not just another book in the field. The manual has been prepared to meet the basic need of the undergraduate and the postgraduate students and the general paediatric surgeons with the operative and the postoperative basic details related to various surgical procedures in children.

The authors of the manual are very senior and experienced paediatric surgeons from the Royal Children Hospital, University of Glasgow, Glasgow (RC) and All India Institute of Medical Sciences, New Delhi (SA). The scientific information is up-to-date, complete and authentic. Significantly, the chapters have been contributed by the younger trainees in pediatric surgery from the institutions of repute and these have been very well supervised by the senior authors. All the authors are very much familiar with the surgical techniques described in the manual and involved in the day to day actual planning in the preparation of the patients for surgery or the operative and the postoperative care.

The manual of about 640 pages has covered various paediatric surgical problems with the emphasis on preoperative, operative and the postoperative aspects. The manual has been divided into various subsections covering the basic surgical techniques, anatomic and fundamental principles of paediatric surgery.

Being produced by “Springer” a well known name in the field of medical publications around the world, the manual has maintained highest standard of publication. The language is simple and easily understood. It is well supported by diagrams and figures.

I wish to compliment the contributors for the thought and the splendid job so well done in producing a manual which was very much needed in the field. I am sure the manual would fill the void. It would serve as a good companion to all the under and the postgraduate paediatric surgical students working in various teaching and non teaching institutions in the developing and the developed world. I strongly recommend the same to all the users in the specialty and the institutional libraries around the world.

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Preface

This operative manual is a joint venture between the Department of Surgical Paediatrics at The Royal Hospital for Sick Children in Glasgow and the Department of Paediatric Surgery, All India Institute of Medical Sciences (AIIMS) in New Delhi. A total of 67 paediatric surgical trainees and consultant mentors have authored chapters for the book, with additional contributions from leading paediatric surgeons from around the world, who are well known for their expertise in a particular operation.

The operative manual aims to fill a niche in the surgical literature by providing concise, easy-to-follow descriptions of 183 paediatric surgical operations and the basic operative techniques that are required to perform them safely. The manual is intended to be something akin to a surgical 'cook-book', in that it describes very clearly, in a step-by-step sequence, the component parts of each operation. For ease of use, each chapter has been written in the same style, with a succinct, well-illustrated description of the operative technique, followed by further sections containing helpful tips and warning the reader about common pitfalls.

The operative manual covers the majority of operations and techniques that a paediatric surgical trainee could expect to be involved with at any level from interested spectator to first assistant and finally, principal operator. We are not suggesting that trainees should perform all the operations included in this book, but we feel that no matter what their level of experience and hence involvement in an operation, a trainee should always go into theatre armed with a basic understanding of the operative steps and sequence involved. We hope that the operative descriptions in the manual will not only help trainees prepare for cases in theatre but also serve as a useful revision tool for the FRCS (Paed Surg) exam and other Board exams worldwide.

The book starts with a 'Basic Surgical Techniques' section. This section takes the trainee through the preparatory stages of an operation, covering topics such as the 'WHO Safe Surgery Checklist', patient positioning, skin preparation and a 'field guide' to commonly employed surgical instruments and their uses. Further chapters describe commonly used skin incisions and some of the skills and techniques that trainees should develop in theatre. The remainder of the book describes individual operations by organ system or anatomical region. The final chapter of the book has been included to reflect the changes in the way in which paediatric surgical training is being delivered in the UK. This chapter provides the reader with an overview of the new paediatric surgery syllabus, with special reference to the operative competencies that should be developed by each stage of training. We hope that this will also be of interest to trainers in other countries.

It has not been our intention to provide information regarding underlying disease processes or their management and outcome, as these topics have been well covered elsewhere. We have excluded complex subspecialty surgery such as liver and bowel transplantation, neurosurgery, complex reconstructive orthopaedic surgery, and cardiac surgery as these procedures are best covered in large, specialist operative textbooks. Paediatric surgeons in the UK no longer perform some of the operations listed in the contents page. These cases are included for readers in countries such as India and parts of Europe, where paediatric surgery remains more generalised.

We are cognisant of the fact that in surgery as in life, there are many paths to the same end. We do not profess that the operative techniques described in this book are the only way of achieving the intended outcomes of a procedure. The operative descriptions presented in this book are included because they are safe and effective. Furthermore the descriptions have been enhanced with tips and modifications, which have been learnt and developed by senior surgeons through years of personal experience.

It has been a pleasure watching the operative manual evolve. We hope that you enjoy using it and that it helps you to develop a sound understanding of the operative techniques and procedures which underpin this most rewarding of specialties.

Robert Carachi

Sandeep Agarwala

Tim J. Bradnock



Dr. Sandeep Agarwala and Robert Carachi



Tim J. Bradnock and family



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Contents

Part A Basic Surgical Techniques	1
A1 The World Health Organisation Surgical Safety Checklist	3
A2 Positioning	5
A3 Preparation	8
A4 Surgical Instruments	11
A5 Diathermy	21
A6 Local Anaesthesia	26
A7 Skin Lines and Wound Healing	34
A8 Transverse Supraumbilical Incision	37
A9 Midline Laparotomy and Paramedian Incisions	40
A10 Subcostal and Rooftop Incisions	43
A11 Pfannenstiel Incision	47
A12 Gridiron, Lanz and Rutherford Morison Incisions	50
A13 Sutures and Their Uses	53
A14 Knots and Their Uses	56
A15 Hand Tying	58
A16 Instrument Tying	60
A17 Repair of Vessels, Nerves and Tendons	64
A18 Haemostasis	67
A19 Debridement	70
A20 Management of Acute Thermal Injuries in Children	72
A21 Venepuncture, Intraosseous Access and Venous Cut-down	76
A22 Open Insertion of Tunnelled Central Venous Lines and Portacaths	82
A23 Percutaneous Insertion of Central Venous Lines and Portacaths	85
A24 Principles of Tumour Biopsy	87
A25 Skin and Muscle Biopsies	90
A26 Excision of Common Skin Lesions	92
A27 Compartment Syndrome and Lower-Limb Fasciotomy	95
A28 Plastering	98
A29 Traction and the Thomas Splint	101

A30	Tourniquets	105
A31	Drains and Drain Fixation Techniques	107
A32	Principles of Wound Management	110
Part B Head and Neck		119
B1	Layers of the Scalp and Suturing	121
B2	External and Internal Angular Dermoid Cyst	125
B3	Cleft Lip and Palate	128
B4	Lacerations to the Face, Lips, Tongue and Ears	132
B5	Ear Deformities	134
B6	Branchial Remnants	137
B7	Parotid Dissection	141
B8	Ranula and Tongue-Tie	144
B9	Excision of Thyroglossal Cyst and Fistula	147
B10	Lymph Node Biopsy	149
B11	Principles of Surgery for Lymphatic Malformations	151
B12	Tracheostomy	153
B13	Torticollis	155
B14	Burr Holes	157
B15	Ventriculoperitoneal Shunting for Hydrocephalus	159
B16	Cervical Oesophagostomy	163
B17	H-Type Tracheo-oesophageal Fistula	166
Part C Spine and Limbs		169
C1	Spina Bifida	171
C2	Forearm Manipulation and Molded Cast	174
C3	Distal Radius Wiring	178
C4	Forearm Diaphyseal Reduction and Fixation (Closed Wiring)	181
C5	Displaced Supracondylar Humeral Fracture	184
C6	Femoral Fracture and Spica Cast	188
C7	Tibial Diaphysis Fracture – External Fixation	190
C8	Infection – Washout of the Knee and Hip	192
C9	Syndactyly	195
C10	Polydactyly	198
C11	Biopsy of an Extremity Tumour	202
C12	Ingrown Toenail	204

Part D Thorax	209
D1 Chest Tube Insertion	211
D2 Thoracotomy	214
D3 Empyema	218
D4 Bronchoscopy and Removal of Foreign Body	222
D5 Oesophageal Atresia and Tracheo-oesophageal Fistula	224
D6 Right Pneumonectomy	228
D7 Right Upper Lobectomy	231
D8 Right Lower Lobectomy	234
D9 Wedge Resection	237
D10 Cannulation for Extracorporeal Life Support	239
Part E Abdomen	243
E1 Upper Gastrointestinal Endoscopy	245
E2 Endoscopic Management of Upper Gastrointestinal Bleeding	248
E3 Proctoscopy and Rigid Sigmoidoscopy	252
E4 Colonoscopy	254
E5 Open Pyloromyotomy	256
E6 Stamm Gastrostomy	260
E7 Percutaneous Endoscopic Gastrostomy (PEG)	263
E8 Umbilical Hernia Repair	266
E9 Epigastric and Supra-umbilical Hernia Repair	268
E10 Open Nissen Fundoplication	270
E11 Gastroschisis	273
E12 Exomphalos	275
E13 Loop Enterostomy	278
E14 Bowel Resection and Anastomosis	280
E15 Right Hemicolectomy	283
E16 Subtotal Colectomy and Ileostomy	286
E17 Small Bowel Atresia	290
E18 Malrotation and Volvulus	293
E19 Open Appendectomy	296
E20 Meckel's Diverticulum and other Vitello-intestinal Anomalies	300
E21 Intussusception	303
E22 Peritoneal Drainage	306
E23 Trauma Laparotomy	309

E24	Congenital Diaphragmatic Hernia	312
E25	Diaphragmatic Eventration	314
E26	Long-Gap Oesophageal Atresia – Gastric Pull-Up	317
E27	Duodenal Atresia	322
E28	Necrotising Enterocolitis	325
E29	Wilms Tumour	328
E30	Abdominal Neuroblastoma	331
E31	Meconium Ileus	334
E32	Rectal Biopsy	338
E33	Transanal Endorectal Pull-Through for Rectosigmoid Hirschsprung Disease	341
E34	Open Endorectal (Soave-Boley) Pull-Through	344
E35	Myomectomy for Ultrashort segment Hirschsprung Disease	349
E36	Open Swenson Procedure	353
E37	Open Duhamel Pull-Through	357
E38	Principles of Liver Surgery	361
E39	Biliary Atresia	364
E40	Choledochal Malformations	366
E41	Pancreatic Pseudocyst	369
E42	Inflammatory Bowel Disease	371
Part F Groin and Genitalia		375
F1	Exposure of the Inguinal Canal and Spermatic Cord Structures	377
F2	Inguinal Hernia and Ligation of Patent Processus Vaginalis	380
F3	Incarcerated Inguinal Hernia	383
F4	Femoral Hernia	386
F5	Acute Scrotal Exploration	389
F6	Varicocele	392
F7	Testicular Tumour	396
F8	Circumcision and Prepuceplasty	398
F9	Urethral Meatotomy and Dorsal Slit of the Foreskin	402
F10	Open Orchidopexy	404
F11	Ovarian Surgery	407
F12	Labial Adhesions and Imperforate Hymen	410
F13	Principles of Hypospadias Surgery	413
F14	Glandular and Coronal Hypospadias Repair	423
F15	Two-Stage Hypospadias Repair: Stage One	426
F16	Hypospadias Repair: Stage Two	429

Part G Urology	431
G1 Cystourethroscopy	433
G2 Urethral and Suprapubic Catheterisation	435
G3 Open Surgical Approaches to the Kidney	439
G4 Open Nephrectomy	442
G5 Pyeloplasty	445
G6 Ureteric Duplication	448
G7 Surgery for Renal Calculi	450
G8 Nephrostomy	453
G9 Vesicostomy	459
G10 Ureterostomy	461
G11 Conduit Diversion	465
G12 Ileocystoplasty	468
G13 Continent Catheterisable Conduit	471
G14 V-Quadrilateral-Z (VQZ)-plasty for Stoma	473
G15 Endoscopic Treatment of Vesicoureteric Reflux	475
G16 Ureteric Reimplantation	478
G17 Posterior Urethral Valves	482
Part H Perineum	485
H1 Perineal Injuries	487
H2 Anal Fissures and Skin Tags	490
H3 Perianal Abscess and Fistula-in-Ano	493
H4 Anterior Ectopic Anus	496
H5 Excision of Rectal Polyp	499
H6 Sacrococcygeal Teratoma	501
H7 Posterior Sagittal Anorectoplasty in Females with Perineal or Vestibular Fistulae	504
H8 Posterior Sagittal Anorectoplasty (PSARP) for Males with Recto-urethral Bulbar Fistula and Prostatic Fistula	508
H9 Posterior Sagittal Anorectoplasty (PSARP) with Laparotomy/Laparoscopy in Males with Rectal–Bladder Neck Fistulas	512
H10 Posterior Sagittal Anorectoplasty (PSARP) with Total Urogenital Mobilization for Cloacae with a Common Channel Smaller than 3 cm	515
H11 Colostomy Creation in Anorectal Malformation	519
H12 Colostomy Closure in Anorectal Malformation	522

Part I	Minimally Invasive Surgery	525
I1	Ergonomics, Heuristics and Cognitive Skills in Laparoscopic Surgery ...	527
I2	Complications of Laparoscopic Surgery	530
I3	Energy Sources in Laparoscopic Surgery	539
I4	Minimally Invasive Repair of a Pectus Excavatum	542
I5	Thoracoscopic Lung Biopsy	547
I6	Thoracoscopic Lobectomy	550
I7	Thoracoscopic Decortication for Empyema	556
I8	Thoracoscopic Diaphragmatic Hernia Repair	558
I9	Laparoscopic Cardiomyotomy	562
I10	Laparoscopic Fundoplication	565
I11	Laparoscopic pyloromyotomy	569
I12	Laparoscopic Appendectomy	572
I13	Laparoscopic Button Placement for Antegrade Enema	575
I14	Primary laparoscopic-assisted endorectal pull-through	577
I15	Laparoscopic Duhamel Pull-Through Procedure	580
I16	Laparoscopic Splenectomy	583
I17	Laparoscopic Cholecystectomy	586
I18	Diagnostic Laparoscopy for Non palpable Undescended Testis	589
I19	Laparoscopic Fowler–Stephens Orchidopexy	592
I20	Lymphatic-Sparing Laparoscopic Varicocelectomy	595
I21	Laparoscopic Inguinal Herniotomy	598
I22	Retroperitoneoscopic Nephrectomy	601
I23	Retroperitoneoscopic Partial Nephrectomy	604
I24	Laparoscopic Dismembered Pyeloplasty	607
I25	Button Vesicostomy	611
I26	Laparoscopic-Assisted Insertion of a Peritoneal Dialysis Catheter	614
I27	Laparoscopic Repair of Duodenal Atresia	618
I28	Laparoscopic excision of Choledochal cyst and Hepatico-duodenostomy ...	622
I29	Management of Upper Urinary Tract Calculi	627
Appendix	Training in Paediatric Surgery	633
Subject Index	639

PART A

**Basic Surgical
Techniques**

The World Health Organisation Surgical Safety Checklist **A1**

I. Yardley

Background

In recent years there has been a growing awareness of surgical care as an important public health issue. A great deal of mortality and morbidity are caused by conditions that are amenable to surgical intervention. For these conditions to be treated successfully requires safe, efficient surgical facilities and practice.

One estimate puts the number of surgical procedures performed each year worldwide at 234 million. If conservative estimates for complication rates of 3% and mortality rates of 0.4% are applied to this figure, then there are 7 million complications and 1 million deaths each year related to surgical care worldwide. A proportion of these will be due to unsafe care; they are potentially preventable.

Development of the Checklist

The World Health Organisation (WHO) Patient Safety body recognized the importance of unsafe surgery and the potential to improve surgical care worldwide and drew up their *Safe Surgery Guidelines* in 2007. A key component of the *Guidelines* is the recommendation to use a surgical checklist with every surgical procedure (see figure below).

The checklist was not intended to introduce new steps to surgical routines. Instead it applied techniques from other high-risk activities, notably the airline industry, to create an evidence-based collection of simple, mostly cost-neutral, actions that should be performed for every procedure. If

carried out consistently these steps have the potential to reduce complications and make surgical care safer. The checklist has been designed to be applicable in a range of environments, from the most high tech to the most cost constrained.

The checklist is divided into three sections: the ‘sign in’, performed before the patient is anaesthetised; the ‘time out’ immediately before surgery starts; and the ‘sign out’ immediately before the patient leaves the theatre. At each stage the entire team come together to discuss and agree on the relevant points before progressing.


An international, multicentre trial of the checklist demonstrated an improvement in both morbidity and mortality. Use of the checklist has since spread around the world and is now actively in use in 1,600 hospitals in more than 50 countries, and a further 2,000 hospitals have registered an interest in the checklist. There is growing evidence of its benefits, both in improving outcome for patients and for improving communication and teamwork in the theatre environment.

Implementing the Checklist

The checklist is not intended to be fully comprehensive, and individual institutions are encouraged to make adaptations and additions in order to increase the relevance to their respective practice and environment. For example, an addition particularly relevant to paediatric surgical practice is to ensure adequate warming devices are in place.

For further information about the checklist, see www.safesurg.org and www.who.int/patientsafety.

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World Health Organization
A PARTNERSHIP FOR THE PEOPLE

Patient Safety
A PARTNERSHIP FOR THE PEOPLE

Surgical Safety Checklist

Before induction of anaesthesia

Before skin incision

Before patient leaves operating room

(with at least nurse and anaesthetist)

(with nurse, anaesthetist and surgeon)

(with nurse, anaesthetist and surgeon)

Has the patient confirmed his/her identity, site, procedure, and consent?

 Yes
 No
 Not applicable

Confirm all team members have introduced themselves by name and role.

 Confirm the patient's name, procedure, and where the incision will be made.
 Has antibiotic prophylaxis been given within the last 60 minutes?
 Yes
 Not applicable

Nurse Verbally Confirms:

 The name of the procedure
 Completion of instrument, sponge and needle counts
 Specimen labelling (read specimen labels aloud, including patient name)
 Whether there are any equipment problems to be addressed

Is the anaesthesia machine and medication check complete?

 Yes
 No

Anticipated Critical Events

To Surgeon:

 What are the critical or non-routine steps?
 How long will the case take?
 What is the anticipated blood loss?

To Anaesthetist:

 Are there any patient-specific concerns?

To Nursing Team:

 Has sterility (including indicator results) been confirmed?
 Are there equipment issues or any concerns?

Is essential imaging displayed?

 Yes
 Not applicable

To Surgeon, Anaesthetist and Nurse:

 What are the key concerns for recovery and management of this patient?

Is the pulse oximeter on the patient and functioning?

 Yes
 No

Does the patient have a:

Known allergy?

 No
 Yes

Difficult airway or aspiration risk?

 No
 Yes, and equipment/assistance available

Risk of > 50ml blood loss (7ml/kg in children)?

 Yes, and two IVs/central access and fluids planned
 No
 Not applicable

Are there any patient-specific concerns?

Are there any patient-specific concerns?

Are there any patient-specific concerns?

Further Reading

Haynes et al (2009) A surgical safety checklist to reduce morbidity and mortality in a global population. N Eng J Med 360:491–499

Weiser TG (2008) An estimation of the global volume of surgery: a modelling strategy based on available data. Lancet 372:139–144

The key to an ordered and successful day in theatre is good communication among all the staff involved. A briefing involving the surgeons, theatre staff and anaesthetists should always take place before starting the theatre list. It is good practice to discuss each case that will be performed during the operating list. Important information that should be discussed for each patient includes significant past medical history (e.g. malignant hypertension), the optimal positioning on the table, the requirement for specialist equipment (e.g. fluoroscopy), the need for a diathermy pad, the site of the incision and whether antibiotics are required perioperatively. Any anticipated difficulties should also be discussed. In conjunction with a briefing at the start of the list, The World Health Organisation *Safe Surgery Checklist* has been shown to reduce surgical morbidity and mortality and its use for each case should be strongly encouraged (see Chap. A1).

The position of the patient is as fundamental as is the initial incision. Good positioning and draping will allow optimal exposure of the operative field. For each position, any potential pressure points where the skin overlies a bony prominence should be protected with additional padding. In this chapter we discuss some of the common positions used in paediatric surgery.

Extended Neck for Head and Neck Surgery

The patient lies on their back with a roll placed under the shoulders and the neck extended in the midline. This position is adopted for operations on the neck, e.g. thyroid and thyroglossal cyst.

Dorsal Position

The patient lies on their back on the operating table (Fig. 1). This is the position most commonly adopted in paediatric surgery. Arms should be kept at the side of the patient, with the use of curved supports.

Trendelenburg Position

The patient is placed on the operating table in the dorsal position, but the table is tilted with a head-downwards slope (Fig. 2). The feet are now at a higher level than the head. This increases venous return from the body, but increases the risk of aspiration of gastric contents and may hinder diaphragmatic excursion. The head-down position can be used in central venous surgery to fill the internal and external jugular veins, and in pelvic surgery to displace the abdominal organs out of the pelvis. In a laparoscopic appendectomy the patient is usually positioned head down, with a left lateral tilt to help mobilise the small bowel from the pelvis and right iliac fossa, providing optimal exposure of the caecum and appendix base.

In the reverse-Trendelenburg position (Fig. 3), the patient is tilted in the opposite direction, so that the head and chest lay superior to the lower limbs. This position may be used to facilitate exposure of the upper abdomen during laparoscopy.

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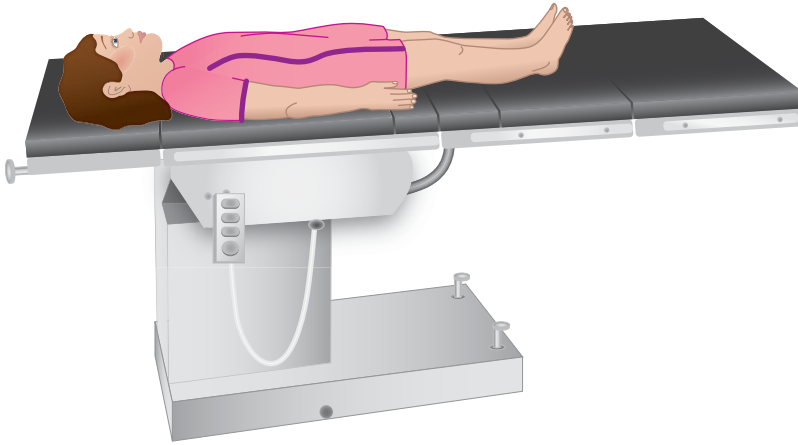


Fig. 1

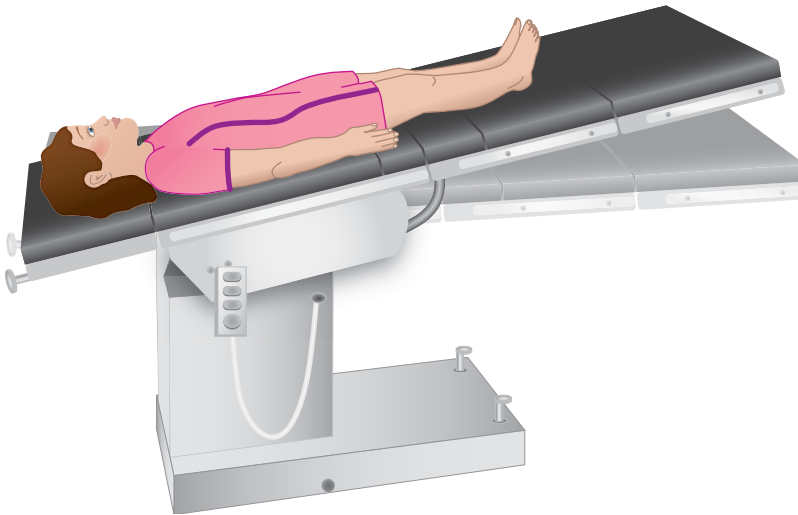


Fig. 2

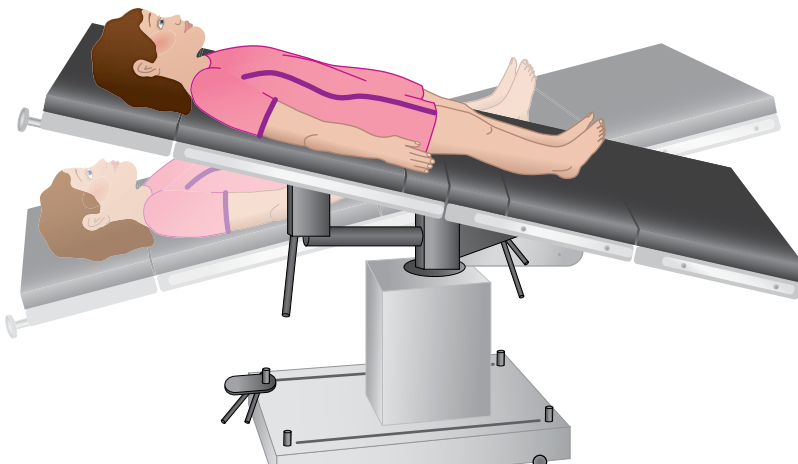


Fig. 3

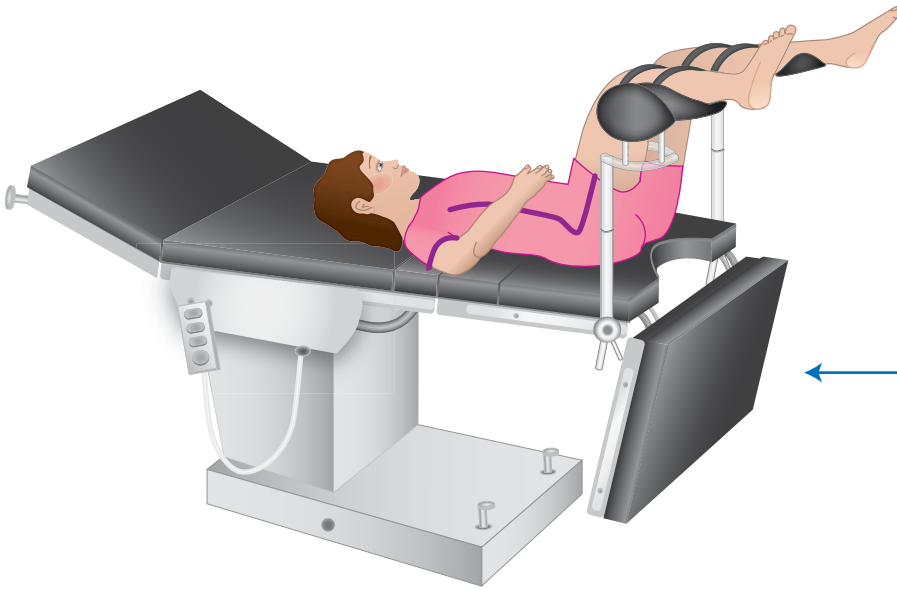


Fig. 4

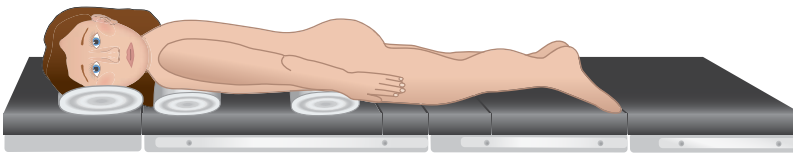


Fig. 5

Lithotomy Position

The patient lies supine on the operating table. The thighs and knees are flexed and supported on stirrups (Fig. 4). Additional padding should be placed under the posterior compartment muscles of the legs to reduce the risk of pressure ulceration. The legs are secured onto the stirrups with crepe bandaging. This position is routinely used for cystoscopy, as it provides good exposure of the perineum.

Prone Position

The patient is placed flat, face downwards on the operating table, with their arms at their side (Fig. 5). The face is supported with a head ring and the endotracheal tube position is safely secured. This position may be used for closure of myelomeningocele and excision of sacrococcygeal teratoma.

Lateral Position

The patient is placed on their side with the arm on the side of the incision, lying forward and over the face, supported on an armrest (Fig. 6). Care should be taken to avoid dislodging the endotracheal tube. The patient is secured to the edges of the table by using strong adhesive tape across the hips and shoulders to prevent the patient from rolling during the operation. This position may be used for posterolateral thoracotomies and open renal surgery.

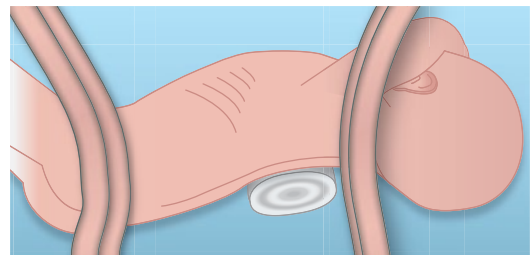


Fig. 6

- Position the patient appropriately before you scrub (see Chap. A2). Pressure areas should be protected. Ensure that the diathermy plate is safely attached.
- Select an appropriate antiseptic solution. Povidone–iodine may be systemically absorbed in infancy and can disrupt the thyroid axis.
- Start by painting the site of the incision and work outwards from there (Fig. 1a). Paint ‘dirty’ areas such as the umbilicus or groin last.
- With the second swab, work outwards again, but finish just within the area covered the first time. Do not touch unprepared skin with the second swab (Fig. 1b).
- If you are using sticky drapes, you may need to dry the outer margin to facilitate good fixation. Be careful not to touch any unprepared areas with the drying swab.
- Square draping is the most commonly used technique (Fig. 2). Special techniques are used for some areas, such as the head, limbs and perineum (Figs. 3–5).
- For the lithotomy position, move both legs symmetrically and simultaneously. Triangular drapes slide easily if the hypotenuse is held to the ceiling.
- Fixation of the drapes to the patient may be achieved by using self-adhesive drapes with sticky edges, securing tapes, towel clips or clear adhesive films that cover the operation site. Alternatively, the drapes may be sutured to the patient’s skin for the duration of the procedure.

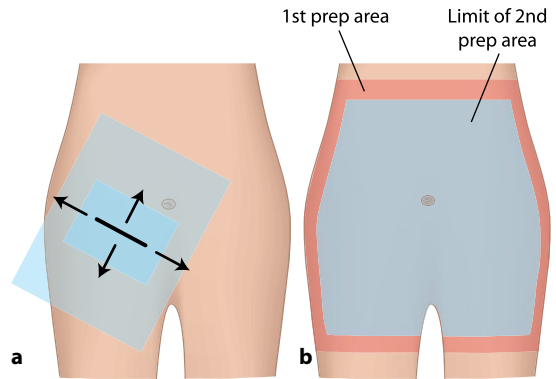


Fig. 1

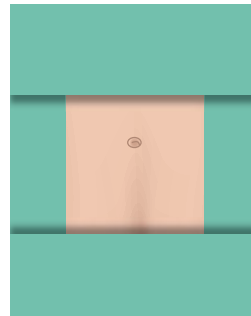


Fig. 2

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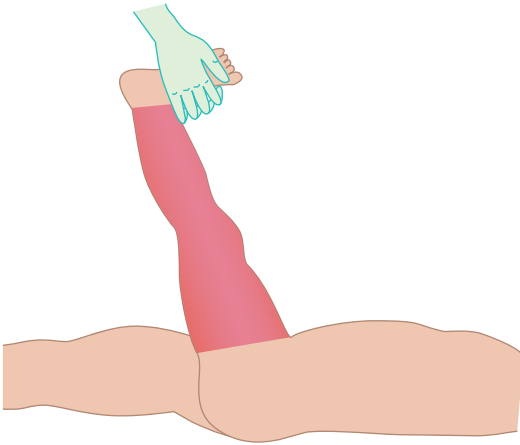


Fig. 3

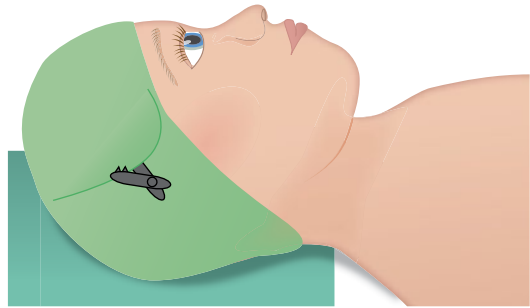


Fig. 4

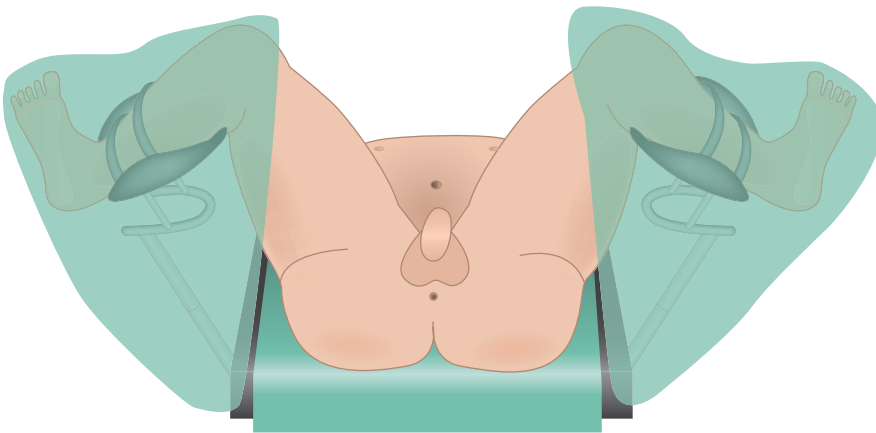


Fig. 5

Tips

- ▶ Allow time for alcohol-based solutions to evaporate before making your incision.
- ▶ Think where you may need to access in unexpected circumstances – for a laparotomy prepare from nipples to knees.
- ▶ Be careful when removing drapes at the end of the procedure not to dislodge the endotracheal tube or intravenous lines.
- ▶ Clean the patient before they wake up; seeing blood can distress children.

Common Pitfalls

- ▶ When draping, avoid moving the drapes from dirty to clean. Always place the drapes well within the prepared area and move them from clean to dirty if required.
- ▶ Avoid pools of fluid near the diathermy. Be especially careful with alcoholic preparation solutions, as pools can ignite.
- ▶ Be careful not to catch the patient's skin in towel clips.

WILLIAM STEWART HALSTED

(1852–1922)

American surgeon and inventor of the surgical gloves

The first Professor of Surgery at John Hopkins, Halstead pioneered many innovations in the field of surgery: the surgical residency programmes, the careful and meticulous technique of operating, the green surgical scrubs and the use of gloves in surgery. Halstead's scrub nurse was the able Caroline Hampton, for whom he had a soft spot. When he noticed that her hands were raw and chaffed from the sterilizing liquid mercuric chloride, he acted. He had the Goodyear Tyre and Rubber Company produce rubber protective gloves for her. Thereafter both Halstead and his surgical assistant started wearing gloves as well, and this became the norm. Halstead went on to marry Ms. Hampton, and the surgical gloves have become an effective tool in the surgical theatre.

B. Amjad

To enable clear communication with the scrub nurse, paediatric surgeons of every level of experience should familiarise themselves with the names and the uses of the surgical instruments at their disposal. This chapter aims to provide the reader with a field guide to the commonly used paediatric surgical instruments and their uses.

Surgical Instruments

- Rampley sponge-holding forceps
 - For the application of antiseptic solution to the skin prior to draping



Fig. 1 Rampley sponge-holding forceps

- Gallipots and kidney dish
 - Surgical preparation dispensers
 - Kidney dish used for handing instruments and for collecting samples as well
- Duff towel clips
 - Hold together the surgical drapes after they have been laid out

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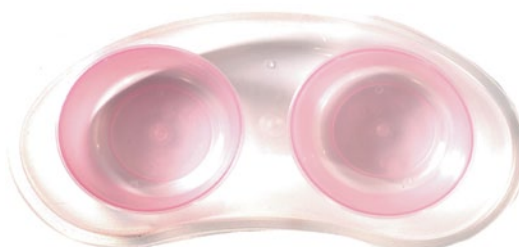


Fig. 2 Gallipots and kidney dish



Fig. 3 Duff towel clips



Fig. 4 Scalpel handle and disposable blades



Fig. 5 Adson tissue forceps (non-tooth)



Fig. 6 Adson tissue forceps (tooth) **Fig. 7** Broad non-tooth forceps

- Scalpel handle and disposable blades
 - Sizes 10, 11 and 15
 - For making incisions, dissecting and excising of tissues



Fig. 8 Charnley–McIndoe forceps



Fig. 9 DeBakey vascular forceps

- Adson tissue forceps (non-tooth)
 - For handling delicate tissues and blood vessels
- Adson tissue forceps (tooth)
 - For holding skin, fascia and other tougher tissues
- Broad non-tooth forceps
 - For tissue dissection, holding suture ends, vascular catheters and ventriculoperitoneal shunts
- Charnley–McIndoe forceps
 - For tissue dissection, holding tough tissues and skin
- DeBakey vascular forceps
 - For handling delicate tissues, hernial sacs and vessels
- Monopolar and bipolar diathermy
 - For dissection and haemostasis (see Chap. A5)
- Quiver and probe
 - Quiver for holding diathermy instruments
 - Probe for probing tissues and tunnelling catheters
- Army pattern modified hook retractor and Kilner–Lane (cat paw) retractors
 - For retraction of skin and subcutaneous tissues
 - Hook retractors also used for looping vessels
- Langenbeck and Durham retractors
 - For retraction of subcutaneous tissues and deeper retraction during laparotomy
- Malleable copper retractors and Deaver retractors
 - For deeper retraction during laparotomy and thoracotomy



Fig. 10 Monopolar (*left*) and bipolar (*right*) diathermy



Fig. 11 Quiver (*left*) and probe (*right*)



Fig. 12 Army pattern modified hook retractor (*left*) and Kilner-Lane (cat paw) retractors (*right*)



Fig. 13 Langenbeck (*left*) and Durham (*right*) retractors



Fig. 14 Malleable copper retractors (*left*) and Deaver retractors (*right*)



Fig. 15 Skin hooks (*left*) and Brodie hernia director (*right*)



Fig. 16 Balfour retractor

- Skin hooks and Brodie hernia director
 - Skin hooks for retracting and holding back skin
 - For retraction and dissection, Brodie hernia director
- Balfour retractor
 - Self-retaining retractor for laparotomies
- Denis Browne retractor
 - For retraction during major laparotomies and urology cases



Fig. 17 Denis Browne retractor



Fig. 18 West self-retaining retractor



Fig. 19 Finochietto self-retaining retractor

- West self-retaining retractor
 - For retracting thin subcutaneous tissues during relatively minor dissection including groin surgery and lymph node biopsy
- Finochietto self-retaining retractor
 - For retraction during thoracotomy, e.g. in open repair of oesophageal atresia and ligation of tracheo-oesophageal fistula
- Volkmann and Glasgow slotted spoons
 - To debride necrotic tissue and debris from an abscess cavity, the Volkmann spoon
 - During an inguinal herniotomy to keep the vas and vessels safe during transfixion of the sac, Glasgow
- Allis forceps
 - For retracting and holding fascia
- Babcock forceps
 - For holding bowel and mesentery
- Doyen bowel clamps
 - Atraumatic clamps for holding, occluding and controlling the bowel during dissection, anastomosis and repair
- Protected bulldog clamps
 - Used to occlude the bowel during anastomosis, dissection and stoma formation
- Mixer forceps
 - For fine dissection around the back of vessels and other delicate tissues
- Straight and curved Kelly (or mosquito) artery forceps
 - Small forceps used for dissection, retraction, and clamping of vessels or tissues
 - Mosquito variant more delicate, with finer tips



Fig. 20 Volkmann (*left*) and Glasgow slotted (*right*) spoons



Fig. 21 Allis forceps



Fig. 22 Babcock forceps

Fig. 23 Doyen bowel clamps

- Crile-wood needle holders (8 and 6")
 - For mounting needles during suturing
- Strabismus straight and curved scissors
 - For sharp dissection and cutting tissues
- Iris scissors
 - For fine, sharp dissection and cutting
- Tenotomy scissors
 - For delicate, sharp dissection

- Metzenbaum scissors
 - For dissection of delicate tissues during laparotomy and thoracotomy
 - Available in variable lengths
- Mayo scissors (straight and curved)
 - Heavy-duty scissors for suture cutting and tissue division



Fig. 25 Mixer forceps



Fig. 24 Protected bulldog clamps



Fig. 26 Straight and curved Kelly (or mosquito) artery forceps



Fig. 27 Crile-Wood needle holders (8" and 6")

- Catgut and nursing scissors
 - Heavy scissors for cutting sutures and dressings
- Urethral sounds
 - For probing or dilating the urethra and external urethral meatus
- Handheld twist drill
 - For creating burr holes prior to ventriculo-peritoneal shunt insertion
- Glasgow pattern rongeur and Luer-Jansen rongeur compound action
 - Bone nibblers to define and prepare the edges of a burr hole
- Pennybacker elevator and Cobb spinal elevator
 - Used as periosteal and dural elevators
- Watson Cheyne dissectors
 - For fine dissection and dural elevation



Fig. 28 Strabismus straight and curved scissors

- Subcutaneous tunnellers
 - Available in a variety of forms
 - Tunneller on the left in Fig. 39 for passing ventriculoperitoneal catheters through the subcutaneous tissues
 - Instrument on the right in Fig. 39 for tunnelling central venous catheters



Fig. 29 Iris scissors



Fig. 30 Tenotomy scissors



Fig. 31 Metzenbaum scissors



Fig. 32 Mayo scissors (straight and curved)



Fig. 33 Catgut scissors and nursing scissors



Fig. 35 Handheld twist drill

Fig. 34 Urethral sounds



Fig. 36 Glasgow pattern rongeur (*left*) and Luer-Jansen rongeur compound action (*right*)



Fig. 37 Pennybacker elevator (*left*) and Cobb spinal elevator (*right*)

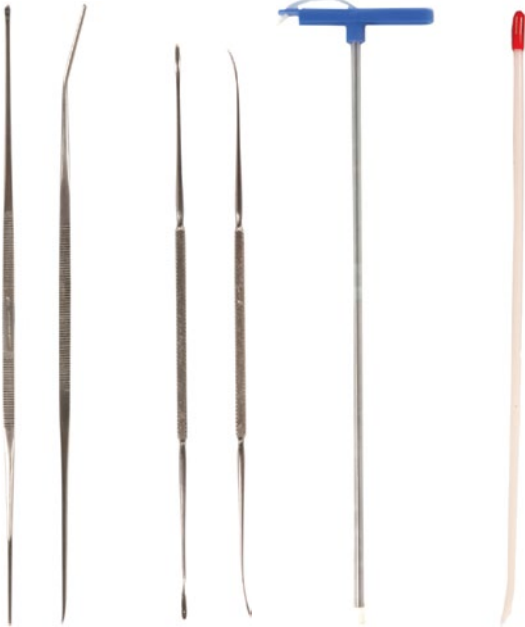


Fig. 38 Watson Cheyne dissectors

Fig. 39 Subcutaneous tunnelers

HOWARD KELLY

(1858 – 1943)

American surgeon and designer of the artery clip

An alumnus of the University of Pennsylvania, where he taught obstetrics. Kelly moved to Johns Hopkins University when it opened its doors. He is one of *The Four Doctors*, the famous painting by John Singer Sargent of the four chiefs at Johns Hopkins University at that time. The other three *Doctors* are William Halstead (Surgery), William Welch (Pathology) and the great William Osler (Medicine).

Over the course of a stellar career he made many advances in the field of obstetrics and gynecology. A number of surgical procedures and instruments bear his name, including the most common surgical instrument known: Kelly's forceps or clamp, also called the mosquito or artery clip.

General Principles

Diathermy (*dia* [through] + *therme* [heat]) is a tool used by surgeons to effect coagulation and cutting of tissues. The passage of high-frequency alternating current through the body causes a localised heating effect, with temperatures in some circumstances reaching 1,000°C. The safety of diathermy relies on the fact that neuromuscular tissue (such as cardiac tissue) is only stimulated by low-frequency alternating current. At frequencies above 50 kHz, the muscle contractions observed at lower frequencies disappear. Surgical diathermy employs current frequencies between 400 kHz and 10 MHz, allowing greater amounts of current to be used safely.

There are two types of diathermy used in surgical practice, monopolar and bipolar.

Monopolar Diathermy

Current is generated by transistors in the diathermy machine and passed to a point or blade diathermy (Fig. 1), which is held in the surgeon's hands. This acts as the small active electrode. Current passes through the tip of the blade diathermy, causing localised heating effects. Residual current is transmitted through the patient and conducted away through the diathermy plate, which should be placed on an area of flat, non-hair-bearing skin such as the patient's back or anterolateral thigh. The diathermy plate should have a large surface area suitable to the size of the patient (Fig. 2),

which ensures that the current density remains low, and no local heating effect occurs through the body as the current exits. The diathermy blade has two buttons, blue for coagulation and yellow for cutting (Fig. 1). In cutting mode the diathermy blade generates a continuous output, which results in current arcing between the active electrode and adjacent tissue, resulting in instant vaporisation of water and separation of tissues. In coagulation mode a pulsed output is generated, causing sealing of blood vessels and minimal tissue destruction. A 'blend' effect can be used in the cutting mode, to generate both cutting and coagulation waveforms, which increases the degree of haemostasis. For accurate coagulation, the diathermy blade can be applied to forceps holding the end of a vessel. It is important to familiarise yourself with the workings of the different types



Fig. 1

of diathermy machine (Figs. 3 and 4) and the appropriate settings for infants and children of different sizes (Fig. 5).

Bipolar Diathermy

Bipolar diathermy utilises a pair of fine forceps connected to the diathermy generator and does not require placement of a diathermy plate (Fig. 6). One limb of the forceps acts as the active electrode and the other limb as the diathermy plate. Current passes between the limbs facilitating ac-

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