

# Prospective survey of neonatal surgical admissions

01/11/2008 – 28/02/2009

## **Purpose of study**

- To estimate current UK neonatal surgical activity
- To examine neonatal surgical case-mix and demography

## **Study design**

A prospective survey was undertaken of neonatal admissions to paediatric surgical centres in the UK over the 4 month period 1<sup>st</sup> November 2008 – 28 February 2009. The intention was to include all neonates (ie babies < 44 weeks post conceptual age) including those admitted to paediatric rather than neonatal beds with conditions such as pyloric stenosis and inguinal hernia.

Inclusion criteria: all babies < 44 weeks post-conceptual age (PCA) admitted to a paediatric surgical service.

Exclusion criteria: cardiac and ENT conditions

## **Data collection**

Patents were registered using a commercial (QuestionPro<sup>®</sup>) on-line data entry from (Appendix A). The questionnaire had been reviewed and agreed by the members of the NHS/Department of Health Neonatal Taskforce Surgery working group. The URL link to this form was sent to one identified surgeon in each of 26 surgical centres in the UK with the request that all patients satisfying the inclusion and exclusion criteria be registered on the survey. It was left to each centre to determine the most effective way to do this. No patient identifiers were recorded.

Data collection started in Oct 08 but all entries prior to 1/11/08 were removed from analysis as numbers before this date were small. Data collection ceased on 28/2/09.

## **Results**

A total of 1164 patients were entered onto the survey. Data were complete in 1149. After exclusion of babies with PCA > 44 wks, admissions outside the study period and duplicate entries there were 1116 patients for analysis. Most of these had complete data but there were reduced numbers for “bed type” (1004) and “source of admission” (939).

Of the 26 centres invited, 23 returned data (Table 1). 2 Scottish centres and one English centre did not return data. Four hospitals in London who care for only a small number of surgical neonates each year were not included in the survey.

### Qusetion1: Admitting surgical centre

Table 1 shows the number of reported admissions per centre. The names of centres have been removed to prevent unfair comparisons as it is acknowledged that data entry is incomplete and comparisons invalid.

Centre number	Number of cases	% of total
1	40	3.58%
2	55	4.93%
3	19	1.70%
4	66	5.91%
5	84	7.53%
6	24	2.15%
7	52	4.66%
8	46	4.12%
9	17	1.52%
10	17	1.52%
11	30	2.69%
12	76	6.81%
13	28	2.51%
14	34	3.05%
15	115	10.30%
16	84	7.53%
17	36	3.23%
18	26	2.33%
19	66	5.91%
20	47	4.21%
21	68	6.09%
22	56	5.02%
23	30	2.69%
<b>Total</b>	<b>1116</b>	<b>100%</b>

**Table 1**

	Admissions/centre	Annual equivalent
mean	40	120
median	35	105
Range	17 - 115	50 - 330

### Analysis of admission numbers

There is no way of knowing whether all surgical neonates have been recruited in this time period. The number of admissions per centre varied from 17 to 115 with a mean of 40. However under-reporting renders these figures inaccurate.

One large centre in England returned no data. It can be estimated from the size of this centre compared to others that there would have been about 120 admissions to this centre in the study period. If entries from Scotland, Northern Ireland and Wales are excluded and the above estimated 120 missing patients included, a rough estimate of the number of surgical neonates admitted in England in the 4 months is 1012. This equates to an annual neonatal surgical workload in England of 3036 (253 per month).

### Question 3: Admitting venue

The venue to which neonatal surgical admissions occurred once they reached the surgical centre is shown in Table 2.

Bed type admitted to	Number	%
Neonatal surgical unit	321	29.59%
Neonatal unit (medical/combined)	407	37.51%
PICU	48	4.42%
Paediatric ward (medical or surgical)	270	24.88%
Theatre	29	2.67%
Postnatal ward	5	0.46%
Other (eg HDU, A&E, neuro)	5	0.46%
<b>Total</b>	<b>1085</b>	<b>100.00%</b>

**Table 2**

#### Analysis of admitting venue

The majority of patients were admitted to either a neonatal surgical unit or to a combined neonatal medical/surgical unit. This is to be expected given the current configuration of neonatal surgical services in the UK. The high number of admissions to paediatric wards reflects the inclusion of babies with conditions such as pyloric stenosis.

The use of paediatric intensive care beds for surgical neonates is confirmed but the proportion of admissions is low (4%).

Twenty nine patients were admitted directly to an operating theatre (Table 3). This practice, described by one centre as “drive-through theatre”, is confined to 3 centres, all Children’s hospitals that lack an on-site neonatal medical unit. Although the subsequent care of these admission is not known enquiries from these centres reveal that some preterm infants are admitted to theatre following ambulance transfer from a nearby neonatal unit and returned by ambulance post-operatively. Eleven of the 29 patients were < 30 weeks PCA at surgery.

## Admissions direct to theatre

Centre	n	Surgical condition/procedure			
		NEC/isolated perforation	Stoma closure	Central line	Other
1	14	4	3	5	Abscess, malrotation
2	10	6		2	Oesophageal atresia, gastroschisis
3	5	2		2	gastroschisis
<b>Total</b>	<b>29</b>	<b>13</b>	<b>3</b>	<b>9</b>	<b>5</b>

**Table 3**

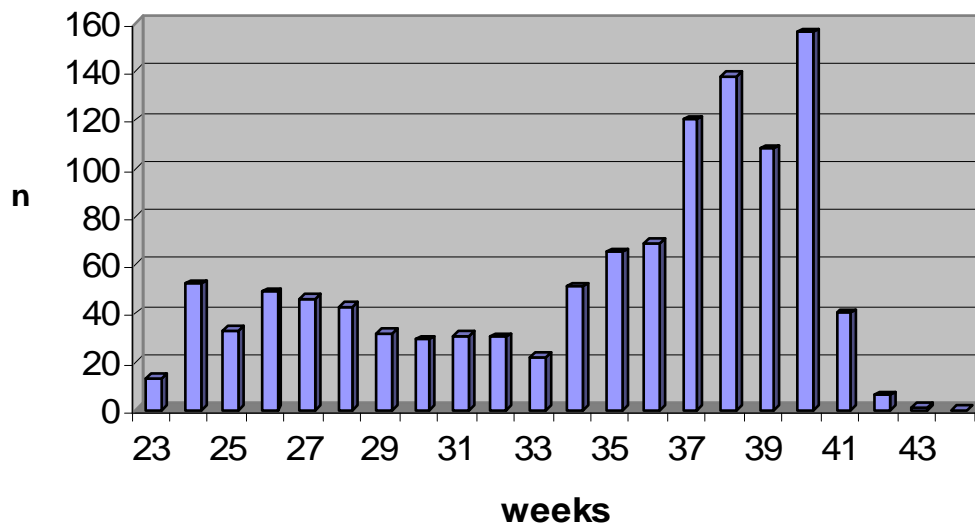
## Questions 4 & 5 – Demographic data

Data on gestation, postnatal age and PCA at admission to a surgical unit of the 1116 patients are shown in Table 4

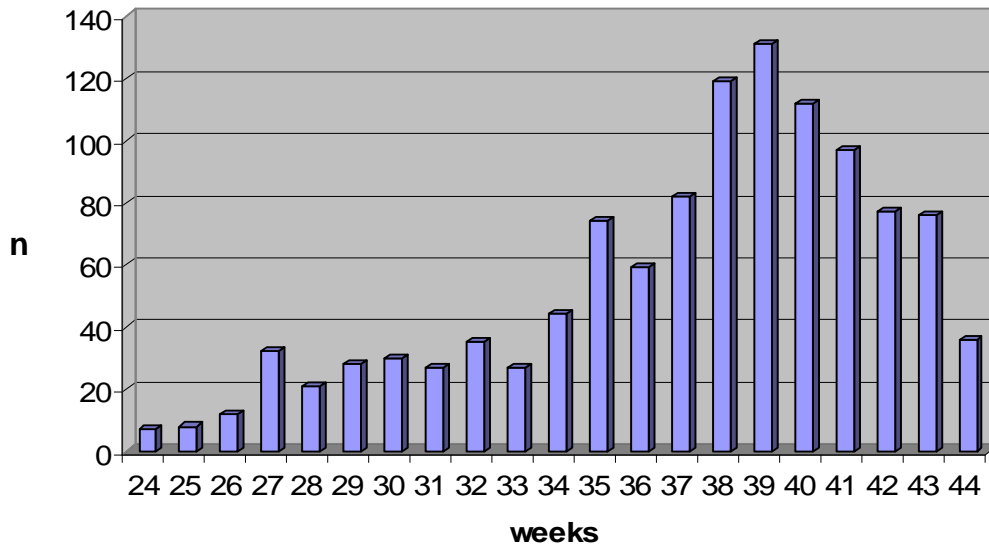
	Gestational age at birth (weeks)	Postnatal age (days)	PCA (weeks)
mean	34.5	19	37.2
median	37.0	9	38.2
range	23 – 43	0 -141	24 – 44

**Table 4**

More detail about gestational age at birth and PCA at admission (Figure 2) is seen in Figures 1 & 2.



**Figure 1. Gestational age at birth**



**Figure 2. Post-conceptual age at admission**

Analysis of demographic data

The figures show the wide range of birth gestation and PCA of surgical neonates. Although the median postnatal age at admission is 38 weeks (Table 4), 9% of patients were < 30 weeks PCA and 34% preterm (< 37 weeks) at transfer to a surgical centre.

**Question 6: Provisional diagnosis**

Table 5 lists the most common provisional diagnoses at admission to a surgical centre. A more complete list is found in Appendix B.

Diagnosis	Number	%
NEC/Isolated perforation	186	16%
Inguinal hernia	118	10%
Intestinal obstruction ? Cause	95	8%
Gastroschisis	90	8%
Pyloric stenosis	89	8%
Malrotation	53	5%
Anorectal malformation	49	4%
Hirschsprungs disease	46	4%
Oesophageal atresia	42	3.5%
Exomphalos	34	3%
Diaphragmatic hernia	29	2.5%

**Table 5**

Analysis of diagnoses

The most common diagnosis is NEC/Isolated perforation, conditions usually occurring in preterm babies. This highlights the importance of neonatal surgery in the management of conditions complicating prematurity and low

birth weight. These patients require the involvement of a neonatal medical team as well as neonatal surgical care.

The full list of diagnoses (Appendix B) demonstrates the wide range of surgical conditions encountered in the neonate. It also highlights the rarity of many of the conditions encountered in neonatal surgical practice.

### Question 7: Source of admission

Table 6 shows the source from which admissions occurred.

Source	Number	%
Neonatal unit	354	38.4%
Same unit (medicine to surgery referral)	151	16.4%
Paediatric ward	106	11.5%
Home	167	18.1%
Labour ward	100	10.8%
Postnatal ward	43	4.7%
Repatriation (from another neonatal surgical centre)	2	0.2%
<b>Total</b>	<b>923</b>	<b>100.0%</b>

**Table 6**

As part of this question the name of the referring hospital was requested. This was provided in 640 entries, 583 of which were from English centres. Detailed analysis of the referring and receiving hospitals, the host neonatal networks and, in networks with no surgical centre, local geography indicated that 94 referrals (16.12%) were admitted to another network or to a more distant surgical centre than expected. Although this has always been highlighted as a particular problem with London and surrounding areas, only 33 of these 94 admissions were from the normal London catchment area to another London, indicating that this is a national issue.

#### Analysis of admission source

The majority of admissions occurred from a neonatal unit, either external or internal (medical to surgical referral within the same combined unit). 10% of admissions were directly from labour ward. This represents the increasing proportion of infants born following prenatal diagnosis of an abnormality requiring postnatal surgery. Of these the commonest conditions were gastroschisis (49), exomphalos (13), oesophageal atresia (6), diaphragmatic hernia (5) and spina bifida (5).

The high proportion of admissions from home and paediatric wards is explained by the inclusion of conditions such as pyloric stenosis and inguinal hernia in the survey.

Data on referring hospitals indicates that 16% of admissions were to another network or more distant hospital than needed. This is further evidence for the difficulty encountered locating neonatal surgical beds in English networks.

## **Discussion**

This is the first survey undertaken to try to assess neonatal surgical activity in the UK. Although data collection is likely to be incomplete the results suggest that there are in excess of 3000 babies born in England each year requiring surgical care in the neonatal period. Given the incompleteness of data ascertainment it is not possible to make definitive comment about the level of activity in each centre but it is well known that some centres (including 4 in London not included in this survey) have few admissions. This has led to the suggestion that the number of centres providing neonatal surgery in the UK should be reduced. The data reported in this survey would tend to support this suggestion.

The venue to which patients were admitted highlights a number of important issues. It could be argued that there are too many wards expected to provide neonatal surgical care. A separate survey of neonatal units undertaken in parallel to this survey also highlights this issue. Specialist medical, surgical and nursing care as well as environment, facilities for mothers and other support services are required for neonatal care. Surgical neonates should be able to access the same expertise and resources as medical neonates<sup>(1)</sup>.

The concept of “drive-through theatres” for the management of very preterm infants with NEC and bowel perforation raises significant concerns. These are the most vulnerable of neonates and this practice involves inter-hospital ambulance transfer, transfer to theatre and return transfer to the referring neonatal medical unit. This must expose these infants to increased risk compared to those who may only be transferred to a theatre in the same building. The increasing use of cot-side surgery enables these risks to be reduced further. This issue is one that particularly applies to Children’s hospitals which do not have on-site maternity and neonatal services. Despite recognition of this issue for many years a solution has yet to be found.

Analysis of the demographic and diagnosis data has identified that a significant proportion of neonates requiring surgical referral are very small preterm babies. 9% were less than 30 weeks post-conceptual age at referral and babies with NEC or isolated perforation make up the single most common reason for surgical referral, being twice as frequent as the most common congenital abnormality, gastroschisis. This further highlights the need for neonatal surgical services to be closely linked to neonatal medical units, if not combined with them.

There is further evidence from this survey that there is inadequate provision of neonatal surgical beds with 16% of out-born admissions not being able to access their network or closest surgical centre.

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March 2009

## References

- (1) Neonatal Intensive Care Review: Strategy for Improvement, Department of Health, 2003.

## Appendix A

### PROSPECTIVE NEONATAL SURGERY AUDIT

1st November 2008 - 28 February 2009

Please enter data relating to any episode of neonatal surgical care at your centre. (Excluding cardiac surgery and ENT surgery).

No patient identifiers are requested and patient confidentiality is not compromised.

#### Q1: ADMITTING SURGICAL CENTRE

Please indicate the centre your are reporting from

\_\_\_\_\_

#### Q2: Date and Time of admission

\_\_\_/\_\_\_/\_\_\_ \_\_:\_\_\_

#### Q3: Bed type admitted to

1. Neonatal surgical unit
2. Neonatal unit (medical/combined)
3. PICU
4. Paediatric ward
5. Other

#### Q4: Gestational age of baby at birth (completed weeks)

\_\_\_\_\_

#### Q5: Age of baby on admission (days)- (First day of life = day 1)

\_\_\_\_\_

#### Q6: Provisional diagnosis (if > 1, pick main diagnosis, if not listed select other and complete box)

1. ABSCESS
2. ANORECTAL MALFORMATION
3. BILIARY ATRESIA
4. BLADDER EXSTROPHY
5. CONGENITAL LUNG ABNORMALITY
6. CENTRAL VENOUS ACCESS
7. CHOANAL ATRESIA
8. CHOLEDOCHAL CYST
9. CLOACAL EXSTROPHY
10. CYSTIC HYGROMA
11. DIAPHRAGMATIC HERNIA
12. DISORDER OF SEXUAL DIFFERENTIATION
13. DUODENAL ATRESIA
14. DUPLICATION CYST
15. EXOMPHALOS
16. GASTROSCHISIS
17. GASTROINTESTINAL BLEEDING
18. HIRSCHSPRUNGS DISEASE
19. INGUINAL HERNIA
20. INTESTINAL ATRESIA
21. INTESTINAL OBSTRUCTION ? CAUSE

22. MALROTATION
23. MECONIUM ILEUS
24. MECONIUM PERITONITIS
25. MECONIUM PLUG
26. NEC/ISOLATED PERFORATION
27. OESOPHAGEAL ATRESIA
28. OVARIAN CYST
29. POSTERIOR URETHRAL VALVES
30. PYLORIC STENOSIS
31. SPINA BIFIDA
32. TERATOMA
33. TESTICULAR TORSION
34. VOLVULUS
35. Other \_\_\_\_\_

Q7: Source of admission

1. Neonatal unit (please indicate name of unit in last option below)
  2. Same unit (medicine to surgery referral)
  3. Paediatric ward
  4. Home
  5. Labour ward
  6. Postnatal ward
  7. Repatriation (from another neonatal surgical centre)
  8. If hospital transfer, name of referring hospital
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## Appendix B

### Diagnoses

Provisional diagnosis	Number	%
NEC/isolated perforation	186	16.67%
Inguinal hernia	118	10.57%
Intestinal obstruction ? Cause	95	8.51%
Gastroschisis	90	8.06%
Pyloric stenosis	89	7.97%
Malrotation	53	4.75%
Anorectal malformation	49	4.39%
Hirschsprungs disease	46	4.12%
Oesophageal atresia	42	3.76%
Exomphalos	34	3.05%
Diaphragmatic hernia	29	2.60%
Urology	24	2.15%
Abscess	25	2.24%
Central venous access	21	1.88%
Posterior urethral valves	19	1.70%
Testicular torsion	18	1.61%
Duodenal atresia	16	1.43%
Tongue tie	17	1.52%
Intestinal atresia	12	1.08%
Gastrointestinal bleeding	12	1.08%
Spina bifida	12	1.08%
Stoma closure	12	1.08%
Congenital lung abnormality	9	0.81%
Meconium ileus	8	0.72%
Hydrocephalus	7	0.63%
Trauma	6	0.54%
Meconium plug	5	0.45%
Nec stricture	5	0.45%
Ovarian cyst	3	0.27%
Teratoma	4	0.36%
Biopsy (metabolic disorder)	3	0.27%
Meconium peritonitis	3	0.27%
Orthopaedic	3	0.27%
Patent urachus	3	0.27%
Vitello-intestinal duct	3	0.27%
Volvulus	3	0.27%
Vascular/lymphatic	2	0.18%
Cloacal exstrophy	1	0.09%
Cystic hygroma	1	0.09%
Disorder of sexual differentiation	1	0.09%
Duplication cyst	1	0.09%
Miscellaneous	26	2.31%
<b>Total</b>	<b>1116</b>	<b>100.00%</b>