

Original Article

Retrospective study of neonatal ligation during 2002 in the United Kingdom of persistently patent arterial ducts

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Abstract Our aim was to ascertain the number of neonatal ligations of the patent arterial duct performed in the United Kingdom in 2002, and to determine the survival of the neonates after 30 days. A postal questionnaire was sent to the lead paediatrician in every hospital in the United Kingdom possessing a special care or neonatal intensive care unit, requesting information on the number of babies referred for ligation of a persistently patent arterial duct. A separate questionnaire was sent to the paediatric cardiothoracic centres for information on babies who underwent the procedure. Cross-referencing the responses identified neonates who were not reported in the separate questionnaires. Additional information was requested from the central cardiac audit database. The overall response rate was 74%, with 172 forms returned of 234 distributed. From the combined responses, we ascertained that ligation has been performed in 244, with survival at 30 days of 94%. There were problems in identifying some babies because of the incomplete nature of the information received from both referring hospitals and specialist cardiothoracic centres. We would recommend a joint prospective study is conducted by paediatricians and paediatric cardiologists to determine the short and long term outcomes in this population known to be at high risk.

Keywords: Preterm; cardiothoracic centres; paediatricians

PERSISTENT PATENCY OF THE ARTERIAL DUCT WITH significant left-to-right shunting is known to be associated, in neonates born prior to term, with chronic pulmonary disease, necrotising enterocolitis, and intraventricular haemorrhage.^{1,2} In the United Kingdom, surgical ligation of persistently patent ducts is usually performed only in babies who have failed conservative management, or where medical treatment has either failed or is contraindicated. The timing of surgical intervention in preterm babies with persisting ductal patency remains controversial. There is little published data

on the long term morbidity and mortality in these infants. Recent work³ shows that, in infants born prior to term, surgical ligation may be associated with chronic lung disease. We have previously looked at the outcome of surgical ligation from 3 centres in the United Kingdom, finding reasonable 30 day survival. There was significant late mortality related to complications of premature birth rather than surgery, with only 80% surviving to hospital discharge with substantial comorbidity.⁴ The primary aim of our current study was to ascertain the number of ligations undertaken in the United Kingdom during 2002, establishing where the surgery was performed, and determining the survival at 30 days after surgery. By contacting both paediatricians and paediatric cardiologists in cardiothoracic centres, we hoped to achieve complete ascertainment of those neonates undergoing ductal ligation.

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Methods and materials

We designed a retrospective study of ligations performed between 1st January and 31st December 2002. A questionnaire (Appendix A) was sent in early 2003 to the lead paediatrician in each hospital in the United Kingdom possessing either a special care baby unit or a neonatal intensive care unit. Those working in units in which ligations were not performed were asked to provide details of babies born prior to term who had been referred for ligation in a tertiary referral centre. Demographic details included initials of the patients, date of birth, the hospital in which ligation was performed, gestational age and weight at birth, age and weight at ligation, and survival after 30 days. Units that performed ligations were asked to provide the details for all babies undergoing ligation, including those referred from outside hospitals (Appendix B1 and B1.1). As our study was designed to establish the workload, we did not attempt to review the medical management or cause of death in individual cases. Information was also requested from the central cardiac audit database regarding numbers of ligations of persistently patent arterial ducts performed in 2002.

Results

We distributed 234 questionnaires, obtaining responses from 172 (74%) units. Of these, 112 units (65%) had not referred any babies for ligation of the arterial duct. In 11 instances, the units were unable to provide any information from their records. The remaining 49 units (29%) provided information on 122 babies who underwent ligation. Replies were received from 13 centres that performed ligations. Of these, 11 were cardiothoracic centres and 2 were non-cardiothoracic centres. They identified 216 babies who had undergone ligation of patent arterial ducts following premature birth. Cross-referencing both sets of responses identified 244 babies who had undergone surgery. Half of the cases were identified by the paediatricians, and 86% by the paediatric cardiologists. The Central Cardiac Audit Database had received reports of 225 infants undergoing ligation at weights less than 1 kilogram.

The survival at 30 days as reported by the paediatricians was 91%, with 111 of the 122 babies surviving, while the figure reported from the cardiothoracic centres was 94%, with 202 of 216 neonates surviving to 30 days. The overall rate for the cohort was 94%, with 229 of 244 surviving to 30 days. Ligations had been performed in 15 centres, of which 13 were recognised centres

performing paediatric cardiothoracic surgery, and 2 were not. Responses were obtained from 11 of the 13 cardiothoracic centres currently functioning in the United Kingdom. The number of ligations performed at the cardiothoracic centres ranged from 5 to 44. The procedure was always performed by a consultant cardiothoracic surgeon in 9 of the units (85%), and by a consultant or surgical trainee in the other 2 units. The place of operation varied. In 9 centres, the operation was always performed in an operating room. In one centre, ligation was routinely undertaken in the neonatal intensive care unit, and in the other centre ligation was performed either in an operating room or the intensive care unit. Of the units, 3 advocated that the procedure was performed on a day case basis, with 94 (38%) of the procedures carried out in this fashion. The 2 non-cardiac centres had been responsible for 9 ligations, which were performed by an adult consultant cardiac surgeon working in the neonatal intensive care unit in one centre, and a general paediatric surgeon working in the operating room in the other. We found that the babies had been transported over long distances for ligation, with the longest distance travelled being 163 miles, passing on the way 3 units that were closer to the referring hospital.

The only relevant data points available from the Central Cardiac Audit Database were date of birth, weight at operation, date of operation, and date of death. There was no data regarding gestation at time of delivery, or corrected gestational age. We collected, therefore, data for babies weighing less than 1 kilogram at operation. This produced a total of 225 cases, with mortality at 30 days of 7.6%.

Discussion

Our study shows that, each year, a substantial number of infants in the United Kingdom undergo ligation of their patent arterial ducts. This group is at high risk, and management remains controversial. Work to date shows that preterm infants who undergo ligation are at a higher risk of morbidity and mortality.^{3–5} The trial of prophylactic indomethacin in preterm neonates showed that the rate of mortality in the group with persistent patency of the arterial duct that did not undergo surgery was 22%, as against 14% in those that undergoing surgical closure, this being a statistically significant difference, with those with greater prematurity having the highest risks.⁶ A retrospective review of 237 infants with patent arterial ducts referred to a single centre³ also showed that the most premature infants undergoing ligation did not experience the rapid clinical improvements in cardiorespiratory

state, and went on to develop chronic lung disease. They also reported that a higher gestational age, a lower dependence on oxygen at the time of surgery, a higher weight, and performance of ligation in the operating room rather than the neonatal intensive care unit, were all associated with an increased survival to discharge. Recent work shows that there were no relationship between ductal ligation and neurodevelopment outcome.⁷ This study also confirmed that ligation was a significant risk factor for chronic lung disease, defined as a requirement for supplemental oxygen at 36 weeks gestational age to maintain saturations greater than 90%. The group studied, however, included babies who had received prophylactic indomethacin, and the decision to ligate was based on the initial response to prophylactic indomethacin, and not on the clinical condition of the baby, this being contrary to current clinical practice in the United Kingdom.

In this study, we sought to identify all the preterm babies who had undergone ligation of a patent arterial duct in the United Kingdom over the period of 1 year. Our experience shows that it is difficult to collect accurate data from referring hospitals and the tertiary cardiac centres. Although the Central Cardiac Audit Database collects data from all the cardiothoracic centres treating patients with congenitally malformed hearts, their findings may not be particularly applicable to preterm babies, as the data collected does not include important variables, such as the gestational age, nor consider other long term morbidities, which is essential for providing a complete picture of the risks and benefits of the procedure. This is particularly important when determining the optimal timing of ligation. Delaying surgery may result in prolonged ventilation and barotrauma, these factors predisposing to chronic lung disease rather than the ligation procedure itself. Accurate information is required to determine the workload for neonatal transport services, and to provide sufficient access to surgical capacity in the cardiothoracic centres. It is also important for

counselling of parents regarding the short and long term outcomes of ligation of the patent arterial duct.

An ongoing, and as yet unpublished, prospective study across 17 units in the East of England has shown survival of 98% at 30 days, with improved survival over 90% to discharge from hospital, in a cohort of 80 patients studied over a period of 4 years. We recommend that a national joint prospective follow-up study should be undertaken by paediatricians and cardiologists to review the short and long term outcomes for babies born prior to term who undergo ligation of the patent arterial duct. Such a study would provide accurate information on workload, prior medical management, and longer term clinical outcome for these babies in terms of morbidity and cause of mortality.

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Appendix A**Patent Arterial Duct (PDA) Ligation – National Survey****Form 1**

To be completed by units where patent arterial duct ligation is not performed and babies are transferred away to other units for patent arterial duct ligation

Name of Hospital

1. Is neonatal patent arterial duct ligation performed in your hospital? (circle) Yes/No

If yes turn to Form 2, If no please complete questions below

2. How many babies born at a gestation of less than 37 weeks were transferred elsewhere for patent arterial duct ligations between 1st January 2002 and 31st December 2002

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3. For each baby please provide the following details in the table below:

Patient initials	Date of birth	Hospital performing ligation	30 day outcome Alive/Dead

Name of person completing the form:

(Please print)

Thank you for your time

Appendix B 1**Patent Arterial Duct Ligation –National Survey****Form II**

To be completed where patent arterial duct ligation is performed

Name of Hospital

1. Is neonatal patent arterial duct ligation performed in your hospital? (circle) Yes/No

If yes turn to Form 2, if no please complete questions below

2. How many babies born at a gestation of less than 37 weeks were transferred elsewhere for patent arterial duct ligations between 1st January 2002 and 31st December 2002

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3. Where are patent arterial duct ligations performed?

Neonatal Intensive Care only Theatre only Both

4. Who performs the patent arterial duct ligations (tick all which apply)

Paediatric Cardiac Surgeon Adult Cardiac Surgeon

General Paediatric Surgeon Other (please specify) _____

5. What is the grade of the surgeon?

Consultant always Specialist Registrar always Both

For each baby please provide the details in the table below

