

CURRENT TOPIC

Liquid paraffin: a reappraisal of its role in the treatment of constipation

F Sharif, E Crushell, K O'Driscoll, B Bourke

Liquid paraffin or mineral oil is a transparent, colourless, odourless, or almost odourless, oily liquid composed of saturated hydrocarbons obtained from petroleum.¹ Petroleum was used as a medicine at least 400 years before Christ.² The earliest internal use of refined petroleum appears to date back to 1872, when Robert A. Chesebrough was granted a patent for the manufacture of "a new and useful product from petroleum".² The use of liquid paraffin gained popularity, after Sir W. Arbuthnot Lane, Chief Surgeon of Guy's Hospital in 1913, recommended its use as a treatment for intestinal stasis and chronic constipation.³

The popularity of liquid paraffin as a treatment for constipation and encopresis stems primarily from its tolerability and ease of titration. Although conversion of mineral oil to hydroxy fatty acids induces an osmotic effect,⁴ liquid paraffin appears to work primarily as a stool lubricant.⁵ Therefore, liquid paraffin is not associated with abdominal cramps, diarrhoea, flatulence, electrolyte disturbances, or the emergence of tolerance with long term usage, side effects commonly associated with osmotic or stimulant laxatives.⁶ These features make liquid paraffin particularly attractive for use in chronic constipation and encopresis of childhood, where large doses and prolonged administration commonly are necessary during the disimpaction and maintenance phases of treatment, respectively.⁶

However, although liquid paraffin is widely accepted and recommended as a fundamental component of regimens for the management of constipation in North America and Australia,^{6,7} it is little used in the United Kingdom.^{8,9} This trans-Atlantic dichotomy in liquid paraffin usage has been underscored by the American Academy of Pediatrics (AAP) endorsement of practice guidelines developed by the North American Society for Pediatric Gastroenterology and Nutrition (NASPGN) for the management of constipation in infants and children.⁶ NASPGN clearly identify liquid paraffin (mineral oil) as a medication of first choice in the management of paediatric constipation. Therefore, it is timely to reappraise the role of liquid paraffin in the management of childhood constipation and to explore the reasons underlying local distrust of this medication.

Approach to childhood constipation

Functional constipation is one of the most common conditions treated by paediatric gastroenterologists and general paediatricians.¹⁰ Recommendations for management have varied from dietary manipulation, administration of lubricants, osmotic agents, stimulants, or enemas,¹¹ to toilet regimens, psychotherapy, and biofeedback programmes.¹² It has been reported that over half of children with constipation remain chronically constipated if they do not receive frequent doses of laxative.¹³ The pathophysiological basis of functional constipation is uncertain.¹⁴

Currently, most widely used treatment regimens for childhood constipation and encopresis^{6,7} are modelled on the strategy described by Davidson and colleagues¹⁵ in 1963. This seminal paper outlines three phases in the management of children with constipation: complete evacuation or disimpaction; sustained evacuation to restore normal colorectal tone; and long term follow up with weaning from intervention. As the success of each phase depends on the cooperation and understanding of the parent and, when possible, the child, an initial phase of patient and parent education⁷ has been incorporated into recent guidelines.^{4,6,16}

Complete bowel clean out is the cornerstone of successful therapy prior to implementation of long term pharmacological therapy.¹⁷ Once rectal evacuation has been confirmed, the challenge is to keep the rectum empty. This is accomplished by habitual toilet use, and the use of stool softeners to facilitate daily complete evacuation. This phase can last at least six months. The aim of this and the follow up phase is to restore normal bowel habit. Although a period of successful maintenance treatment may be followed by attempts to wean medication, close medical/nursing supervision is essential in order to promptly adjust or reinstitute doses, when necessary.

Role of liquid paraffin in childhood constipation

EVIDENCE FOR EFFICACY

In stating that grade I evidence (defined as evidence from at least one properly designed randomised, controlled study) exists for the efficacy and safety of liquid paraffin, the authors of the NASPGN medical position statement on childhood constipation may have

Children's Research Centre, Our Lady's Hospital for Sick Children, and Department of Paediatrics, The Conway Institute for Biomedical and Biomolecular Research, University College Dublin, Ireland
F Sharif
E Crushell
K O'Driscoll
B Bourke

Correspondence to:
Dr Bourke
billy.bourke@ucd.ie

Accepted 27 February 2001

overestimated the quality of the existing literature on this medication. However, direct evidence for the efficacy of liquid paraffin compared with other forms of intervention does exist, as liquid paraffin has formed the basis of treatment in a number of outcome studies of paediatric constipation/encopresis.^{11 18-21}

For the purposes of disimpaction, liquid paraffin appeared to be slightly less efficacious than an oral lavage solution in a small randomised study by Tolia and colleagues.¹⁹ However, liquid paraffin was better tolerated and compliance was improved compared with the polyethylene glycol solution.

In a direct comparison of lubricant and stimulant laxatives as maintenance treatment for constipation,²⁰ liquid paraffin fared better, with 11 of 19 children treated with liquid paraffin successfully discontinuing regular medications after six months compared to only four of 18 using senna. Liquid paraffin was also among the laxatives used in a randomised, controlled study showing the superior efficacy of laxatives combined with behavioural modification compared with behavioural modification alone²¹ in children with encopresis. However a direct comparison of liquid paraffin with other laxatives was not undertaken in that study.

These data, coupled with extensive accumulated experience, provide support for the current NASPGN/AAP guidelines recommending liquid paraffin both for the initial disimpaction and maintenance phases of treatment in children older than 1 year of age. There do not appear to be any objective data on the use and safety of liquid paraffin in young infants. However, it is recommended that infants under the age of 1 year should not receive liquid paraffin because gastro-oesophageal reflux and incoordination of swallowing are more common in infants, thereby posing a greater risk of aspiration and the development of lipoid pneumonia.^{22 23}

EVIDENCE FOR TOXICITY

Absorption and histological changes in the gut

A *Lancet* "Noticeboard" article of 1990,²⁴ noting restrictions placed on the availability of, and indications for the use of liquid paraffin by the Committee on Safety of Medicines⁸ (CSM) appears to underlie much of the reluctance on this side of the Atlantic to use the medication. The CSM, noting clinical reports associating liquid paraffin ingestion with granulomata of the intestinal tract, recommended against prolonged use of the medication and stated it should not be used in children under 3 years of age.

However, the precise reports to which the CSM refers are not referenced. Our own database searches have failed to uncover any specific link between liquid paraffin ingestion and intestinal granulomas. Apparent liquid paraffin deposits (without granuloma formation) were described at autopsy in the jejunum of a 53 year old man who also had lipoid pneumonia and liquid paraffin accumulations in his abdominal viscera.²⁵ However, the patient's complex, poorly documented medical history

and findings at autopsy, including pulmonary tuberculosis, preclude meaningful interpretation of the relevance of these findings to liquid paraffin use in general. Oil induced granulomas of the rectum have been described.²⁶ However, these appear to arise from direct perianal or per-rectal application of liquid paraffin.

Earlier studies reported the absorption and deposition within various tissues of mineral hydrocarbons in animals,^{27 28} and the presence of lipid granulomas in human tissue.²⁷ However, recent evidence refutes the classification of these lipid associated lesions as granulomas and their frequent occurrence in large unselected autopsy series^{29 30} casts considerable doubt as to the relation of these histopathological findings to liquid paraffin ingestion.

Despite widespread and often prolonged use of this medication in children worldwide, there are no reports of liquid paraffin deposition in the intestinal tracts or intra-abdominal viscera of children. For instance, Rabah and colleagues³¹ described autopsy findings in a child with Hirschprung's disease who developed peritonitis as a result of liquid paraffin entering the peritoneal cavity following enema treatment. However, there was no evidence of liquid paraffin within the intestinal tissues in this report.

Fat soluble vitamin absorption

The widely held belief that fat soluble vitamin absorption may be affected by ingestion of liquid paraffin is based on early studies.³²⁻³⁴ In 1939 Curtis and Ballmer showed a slight decrease in serum carotene values after a number of weeks of liquid paraffin use.³³ However, concentrations of carotene in the deficient range were not observed in this study. In 1941, Javert and Macri documented hypoprothrombinaemia during liquid paraffin therapy of variable duration in a small sample of adult patients (n = 10).³²

In contrast, Ballantine and colleagues,³⁵ in a study of prothrombin time, serum retinol, and α tocopherol concentrations, did not find any significant difference in values among 19 children receiving liquid paraffin compared with a group of control patients. Some of these children had received liquid paraffin for as long as six years.³⁵ This study did not include pretreatment vitamin concentrations for comparison. However, Clark and colleagues,³ using sequential measurements of fat soluble vitamin markers, showed that up to four months of liquid paraffin treatment does not adversely affect concentrations of retinol or α tocopherol. In a more recent study, McClung and colleagues¹⁷ showed stable serum concentrations of vitamin E among 16 children taking liquid paraffin over a period of six months. Taken together these data clearly indicate that liquid paraffin therapy is inadequate to deplete tissue stores of fat soluble vitamins.

Carcinogenesis

Occupational mineral oil exposure has been associated with the development of human cancer. In particular, oil exposure in early textile industries was shown to increase the risk for

the development of skin cancers.³⁶ However, evidence to support carcinogenicity of mineral oil products in modern occupational settings, even when there was prolonged dermal and inhalational exposure, has been less convincing.³⁶⁻³⁷

In addition, results from animal challenge studies with liquid paraffin type products are reassuring. For example, "light" mineral oils (the form comprising liquid paraffin medication) do not appear to be carcinogenic in dogs or rodents.³⁸⁻³⁹

For those ingesting liquid paraffin as a medication, there are no studies explicitly examining the potential carcinogenicity of this treatment. However, to our knowledge, widespread usage of liquid paraffin for patients with constipation has not engendered any connection between use of this product and the development of cancer.

Lipoid pneumonia

There have been a number of case reports of lipoid pneumonia developing in association with liquid paraffin ingestion.⁴⁰⁻⁴⁴ In some reports the mechanism predisposing to liquid paraffin aspiration is not clear. For instance, lipoid pneumonia developed in a child in whom the only source of liquid paraffin identified was lip gloss.⁴¹ However, in most cases there has been a coexistent neurodevelopmental abnormality clearly predisposing the patient to aspiration.⁴²⁻⁴³ Undoubtedly, access of liquid paraffin to the lower respiratory tract can result in severe tissue damage, and children at risk for aspiration or those who have difficulty with swallowing should not be prescribed this medication.

Personal practice

When the diagnosis of constipation/encopresis is established, the child and parents are provided with a conceptual framework of constipation and the mechanisms of overflow incontinence using simple diagrammatic representation. The family then meets the gastroenterology liaison nurse who reinforces the treatment strategy and the need for compliance.

We recommend disimpaction using a three to five day cycle of bisacodyl (Dulco-Lax) by mouth: 5 mg/day for children under 5 years; 10 mg/day for children over 5 years. The use of bisacodyl, a stimulant laxative, appears to expedite disimpaction and avoids the seepage associated with the ingestion of large doses of liquid paraffin that would be required if liquid paraffin was used as the sole treatment during this phase. Bisacodyl is administered in the morning. Parents and patients are warned of the possibility of abdominal cramps and urgent stools during this phase. If disimpaction has not occurred following the initial cycle of bisacodyl, parents are advised to repeat the cycle. Liquid paraffin is commenced simultaneously, at a dose of approximately 1 ml/kg at night. Telephone contact between parents and the gastroenterology liaison nurse is established during the first week of treatment. Liquid paraffin is increased in 10 ml increments every

three to five days until the child is having soft stools that are easy to pass.

Although most young children do not complain of taste aversion to liquid paraffin, mixing with yoghurt or ice-cream can improve palatability. However, failure to finish liquid paraffin mixed with yoghurt or other foods is a common reason for an apparent inadequate response. Therefore, if liquid paraffin is being mixed with yoghurt or fatty ice-cream, an extra 10 ml should be added to ensure adequate intake of the required dose. In addition, it is recommended that liquid paraffin be kept in the refrigerator, as it is less viscid when cold.

Leakage of oil (commonly orange in colour) may indicate ingestion of excess liquid paraffin. However, more commonly oil seepage indicates the presence of retained impacted faeces. Therefore, parents are advised always to contact the gastroenterology nurse before considering reduction in liquid paraffin dose for presumed over-treatment. The family is instructed to expect treatment to continue for six months or more. In practice many can wean the dose before this time but that decision is usually made in conjunction with the gastroenterology team. Non-compliance or inappropriate discontinuation of medication is the most common reason for early treatment failure.

Parents are advised not to force feed the liquid paraffin and it is never prescribed for children with underlying neurological conditions or in those with disorders of swallowing. In addition, because of the theoretical possibility of aspiration, most children less than 12 months old are treated with lactulose in place of liquid paraffin.

Conclusion

Liquid paraffin has an established track record as an effective treatment modality for childhood constipation. This medication combines ease of titration with tolerability and sustained effect despite prolonged use, making it attractive for use in childhood constipation/encopresis.

Although the possibility of systemic absorption of liquid paraffin cannot be discounted, the contribution of liquid paraffin to lipid follicles in autopsy studies is unclear. Further studies on the potential for systemic absorption of liquid paraffin are warranted. The administration of liquid paraffin in patients at risk for aspiration is not recommended, and at present it is probably prudent not to administer this medication to children under 12 months old.

Concerns regarding the development of fat soluble vitamin deficiency in those administered liquid paraffin are unfounded, and there exists no evidence to support the carcinogenicity of this treatment.

We thank M Rowland and B Drumm for their helpful comments during the preparation of this manuscript.

- 1 Kathleen P, ed. Paraffins and similar bases. "Martindale". *Complete drug reference*, 32nd edn. London: Pharmaceutical Press, 1999:1382.
- 2 Council on Pharmacy and Chemistry. Liquid petrolatum or "Russian mineral oil". *JAMA* 1914;62:1740-2.
- 3 Lane WA. Chronic intestinal stasis. *The Practitioner* 1914: 301-33.

- 4 Loening-Baucke V. Management of chronic constipation in infants and toddlers *Am Fam Physician* 1994;**49**:397-411.
- 5 Clark JH, Russell GJ, Fitzgerald JF, Nagamori KE. Serum beta-carotene, retinol, and alpha-tocopherol levels during mineral oil therapy for constipation. *Am J Dis Child* 1987;**141**:1210-12.
- 6 Baker SS, Liptak GS, Colletti RB, *et al*. Constipation in infants and children: evaluation and treatment. A medical position statement of the North American Society for Pediatric Gastroenterology and Nutrition. *J Pediatr Gastroenterol Nutr* 1999;**29**:612-26.
- 7 Abi-Hanna A, Lake AM. Constipation and encopresis in childhood. *Pediatr Rev* 1998;**19**:23-30.
- 8 Committee on Safety of Medicines. *Liquid paraffin-restricted indications and availability*. London: CSM, 1990:28.
- 9 Drug information advisory line UK. The use of liquid paraffin for treatment of constipation in children. 1999(1).
- 10 de Araujo S, Calçado AC. Constipation in school-aged children at public schools in Rio de Janeiro, Brazil. *J Pediatr Gastroenterol Nutr* 1999;**29**:190-3.
- 11 Staiano A, Andreotti MR, Greco L, *et al*. Long-term follow-up of children with chronic idiopathic constipation. *Dig Dis Sci* 1994;**39**:561-4.
- 12 Loening-Baucke V, Yamada T. Is the afferent pathway from the rectum impaired in children with chronic constipation and encopresis? *Gastroenterology* 1995;**109**:397-403.
- 13 Taubman B, Buzby M. Overflow encopresis and stool toileting refusal during toilet training: a prospective study on the effect of therapeutic efficacy. *J Pediatr* 1997;**131**:768-71.
- 14 Taitz LS, Wales JK, Urwin OM, Molnar D. Factors associated with outcome in management of defecation disorders. *Arch Dis Child* 1986;**61**:472-7.
- 15 Davidson M, Kugler MM, Bauer CH. Diagnosis and management in children with severe and protracted constipation and obstipation. *J Paediatr* 1963;**62**:261-75.
- 16 Loening-Baucke V. Chronic constipation in children. *Gastroenterology* 1993;**105**:1557-64.
- 17 McClung HJ, Boyne LJ, Linsheid T, *et al*. Is combination therapy for encopresis nutritionally safe? *Pediatrics* 1993;**91**:591-4.
- 18 Levine MD, Bakow H. Children with encopresis: a study of treatment outcome. *Pediatrics* 1976;**58**:845-52.
- 19 Tolia V, Lin CH, Elitsur Y. A prospective randomized study with mineral oil and oral lavage solution for treatment of faecal impaction in children. *Aliment Pharmacol Ther* 1993;**7**:523-9.
- 20 Sondheimer JM, Gervaise EP. Lubricant versus laxative in the treatment of chronic functional constipation of children: a comparative study. *J Pediatr Gastroenterol Nutr* 1982;**1**:223-6.
- 21 Nolan T, Debelle G, Oberklaid F, Coffey C. Randomised trial of laxatives in treatment of childhood encopresis. *Lancet* 1991;**338**:523-7.
- 22 Fan LL, Graham LM. Radiological cases of the month. Lipoid pneumonia from mineral oil aspiration. *Arch Pediatr Adolesc Med* 1994;**148**:205-6.
- 23 Wolfson BJ, Allen JL, Panitch HB, Karmazin N. Lipid aspiration pneumonia due to gastroesophageal reflux. A complication of nasogastric lipid feedings. *Pediatr Radiol* 1989;**19**:545-7.
- 24 Noticeboard. Liquid paraffin restricted. *Lancet* 1990;**336**:240.
- 25 Nochomovitz LE, Uys CJ, Epstein S. Massive deposition of mineral oil after prolonged ingestion. *S Afr Med J* 1975;**2187**-90.
- 26 Mazier WP, Sun KM, Robertson WG. Oil-induced granuloma (eleoma) of the rectum: report of four cases. *Dis Colon Rectum* 1978;**21**:292-4.
- 27 Stryker WA. Absorption of liquid petrolatum ("mineral oil") from the intestine, a histologic and chemical study. *Arch Pathol* 1941;**49**:670-92.
- 28 Twort JM, Twort CC. Changes in the liver of mice following administration of hydrocarbon oils. *Lancet* 1932;**i**:448-9.
- 29 Cruickshank B, Thomas JM. Mineral oil (follicular) lipodosis: II. Histologic studies of spleen, liver, lymph nodes, and bone marrow. *Hum Pathol* 1983;**15**:731-7.
- 30 Wanless IR, Geddie WR. Mineral oil lipogranulomata in liver and spleen. A study of 465 autopsies. *Arch Pathol Lab Med* 1985;**109**:283-6.
- 31 Rabah R, Evans RW, Yunis EJ. Mineral oil embolization and lipid pneumonia in an infant treated for Hirschsprung's disease. *Pediatr Pathol* 1987;**7**:447-55.
- 32 Javert CT, Macri C. Prothrombin concentration and mineral oil. *Am J Obstet Gynecol* 1941:409-14.
- 33 Curtis AC, Ballmer RS. The prevention of carotene absorption by liquid petrolatum. *JAMA* 1939:1785-8.
- 34 Curtis AC, Kline EM. Influence of liquid petrolatum on the blood content of carotene in human beings. *Arch Intern Med* 1939;**63**:54-63.
- 35 Ballantine TVM, Zeigler D, Greecher CP, *et al*. The effect of mineral oil on fat-soluble vitamin levels [abstract]. *JPEN* 1986;**10**:18.
- 36 Tolbert PE. Oils and cancer. *Cancer Causes Control* 1997;**8**:386-405.
- 37 Siemiątycki J, Dewar R, Nadon L, *et al*. Associations between several sites of cancer and twelve petroleum-derived liquids. Results from a case-referent study in Montreal. *Scand J Work Environ Health* 1987;**13**:493-504.
- 38 Smith JH, Bird MG, Lewis SC, *et al*. Subchronic feeding study of four white mineral oils in dogs and rats. *Drug Chem Toxicol* 1995;**18**:83-103.
- 39 Shoda T, Toyoda K, Uneyama C, *et al*. Lack of carcinogenicity of medium-viscosity liquid paraffin given in the diet to F344 rats. *Food Chem Toxicol* 1997;**35**:1181-90.
- 40 Berg BW, Saenger JS. Images in clinical medicine. Exogenous lipoid pneumonia. *N Engl J Med* 1998;**338**:512.
- 41 Becton DL, Lowe JE, Falletta JM. Lipoid pneumonia in an adolescent girl secondary to use of lip gloss. *J Pediatr* 1984;**105**:421-3.
- 42 Weinstein M. Index of suspicion. *Pediatr Rev* 2000;**21**:173.
- 43 Ciravegna B, Sacco O, Moroni C, *et al*. Mineral oil lipoid pneumonia in a child with anoxic encephalopathy: treatment by whole lung lavage. *Pediatr Pulmonol* 1997;**23**:233-7.
- 44 Beermann B, Christensson T, Moller P, Stillstrom A. Lipoid pneumonia: an occupational hazard of fire eaters. *BMJ* 1984;**289**:1728-9.

Narrative Based Medicine, An Interdisciplinary Conference

Research, Narrative, and Practice

A two day conference—Monday 3rd and Tuesday 4th September 2001

Homerton College, Cambridge, UK

BMJ Publishing Group

For full details contact: BMA/BMJ Conference Unit, Tavistock Square, London, WC1H 9JP
Tel: +44 (0)20 7383 6819; fax: +44 (0)20 7383 6663; email: clyders@bma.org.uk.

www.quality.bmjpub.com